PROJECT PERIODIC REPORT

Grant Agreement number: ICT-601102 STP TUCAN3G

Project acronym: TUCAN3G

Project title: Wireless technologies for isolated rural communities in developing countries based on cellular 3G femtocell deployments

Funding Scheme: STREP

Date of latest version of Annex I against which the assessment will be made:

Periodic report: 1st X 2nd ☐ 3rd ☐ 4th ☐

Period covered: from 1st Feb 2013 to 31st Jan 2014

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Declaration by the scientific representative of the project coordinator

I, as scientific representative of the coordinator of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate) [1]:

  X has fully achieved its objectives and technical goals for the period;

  ☐ has achieved most of its objectives and technical goals for the period with relatively minor deviations.

  ☐ has failed to achieve critical objectives and/or is not at all on schedule.

- The public website, if applicable

  X is up to date

  ☐ is not up to date

- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 3.4) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 3.2.3 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator: Prof. Josep Vidal

Date:

For most of the projects, the signature of this declaration could be done directly via the IT reporting tool through an adapted IT mechanism and in that case, no signed paper form needs to be sent

[1] If either of these boxes below is ticked, the report should reflect these and any remedial actions taken.

1. Publishable summary

Project context and objectives

TUCAN3G builds upon a basic premise that considers information and communications as key factors of human development. The diffusion of ICT in developing countries has been very uneven between densely populated urban areas and isolated rural areas. Geographic and economic conditions are often conditioning solutions for voice communication (typically based on 2G cellular technologies) and Internet connectivity in rural areas.

Rural communities in developing countries constitute a very large and diverse set, with many different ways of life. Regarding development, challenges also differ between communities and so do technology solutions for these challenges. The basic common characteristics of rural communities are poverty, geographical isolation and lack of infrastructure (water, roads, electricity, telecommunications, etc), implying disconnection with public services, and administrative and political isolation. UNDP (United Nations Development Programme) ensures that ICT access is a decisive factor for human development in those communities. Mobile telephony and Internet access bring the opportunity to break isolation by reducing knowledge and participation barriers, and by allowing these communities to access to new economic opportunities. On its turn, the mobile telephony growth has been exponential in recent years even in developing countries. ITU confirms that the next thousand million subscribers will belong mainly to poor rural populations.

The development of advanced wireless standards (like UMTS or LTE) has been driven by the expectation of high returns-on-investment, which are conventionally obtained by operating the networks in dense traffic urban and suburban areas. This fact, together with the constraints imposed by the electromagnetic propagation characteristics and the geographical distribution of users, need to be considered when defining access technologies (in terms of frequency bands, bandwidths, access modes, channelization modes) and transport technologies (in terms of backhauling and network architecture). As a consequence, the deployment of current 3G or 4G systems in rural and sparsely inhabited areas results in a non-profitable business to mobile operators: the well-known tradeoffs between coverage and capacity imply large investments which are not associated to large revenues. Therefore, offering wireless services in rural scenarios often requires public subsidies.

With the advent of heterogeneous network architectures that combine the presence of macro base-stations with small and low-power base-stations, relays, remote radio heads and cooperating meshed terminals, the conventional coverage-capacity tradeoff is overcome, lower investment expenses are needed and hence new opportunities appear. Reduced costs also imply reduced operating expenses: little human intervention and enhanced energy efficiency, so efforts are needed to enhance these networks with efficient self-organizing capabilities. While some of these technologies are being considered to a certain extent in LTE-A, their adaptation to specific rural scenarios, the generation of recommendations and their promotion in forums (like 3GPP, ITU and ETSI) is a task requiring major additional efforts.

A significant cost for these networks is also associated to the transport network. Together with the novel solutions for the access network, high-capacity low-cost solutions for the transport network are also needed. WiFi for Long Distances (WiLD) has been proposed and successfully used to connect remote regions in developing countries. WiFi systems are extremely low-cost as compared to other broadband technologies, and some improvements to the MAC layer, together with the modern physical improvements included in IEEE802.11n, permit to set up long distance links (up to 75 Km or longer in point to point links) giving throughput rates as high as 40 Mbps or even more. Using this technology, several multi-hop networks up to 500 kilometers have been deployed in remote areas of developing countries by members of this consortium (see annex). Nowadays these networks are being employed for health and education purposes but can also be used as backhaul for providing cellular services in remote localities.

Description of the work

Taking in consideration all the above social and technological context, TUCAN3G focus the scope of its research on a key question which we believe is at the centre of future rural communications systems:

> **How can we design a technologically feasible and yet economically sustainable solution for the progressive introduction of voice and broadband data services in rural communities of developing countries, using commercial cellular terminals, 3G femtocells (and its possible evolution to 4G) and heterogeneous backhauling (WiLD-WiMAX-VSAT)?**

TUCAN3G addresses this question in three parallel ways, by:

a) Jointly designing the access and transport network under criteria of low energy consumption and low maintenance/installation cost, while still fitting service level requirements.

b) Developing a demonstration platform supporting the project technical developments and being a showcase for international cooperation agencies, cellular telephony operators and rural communications investment funds.

c) Defining a viable business model that guarantees successful and generalized deployments in a mid-term.

TUCAN3G aims at evaluating the viability of backhauling 3G femtocells with WiLD-WiMAX-VSAT networks, from both technical and economic points of view. While femtocells are initially conceived for indoor use, interest has been recently growing for outdoor coverage due to the ease of deployment. In TUCAN3G, its use in remote rural communities is proposed as an appropriate way to provide their inhabitants with telephony and broadband connectivity. The technical challenges faced in terms of interference management, self-organization, self-healing and energy efficiency will be studied within the project. On the access tier, the constraints imposed by 3G standards will be taken into account, as well as those coming from a potential future evolution towards LTE and LTE-A. On the backhaul tier, TUCAN3G proposes to use WiLD-WiMAX technology to connect the remote femtocells to the operator's infrastructure in a city hundreds of kilometers away. In those situations where WiLD-WiMAX links are technically or economically unfeasible for reaching a well-connected city, WiLD-WiMAX backhaul is planned to be connected to the operator's infrastructure via VSAT.

As a result, 3G femtocells (and its evolution to 4G) with WiLD-WiMAX-VSAT backhauling are seen as a low-cost solution for full connectivity in isolated small communities where traditional cellular coverage is not a reasonable approach. We expect that, as happened in the past in other wireless deployments, once the initial deployment is operational the demand for cellular telephony and broadband data services will tend to increase. When the demand overpasses a certain threshold, the return on investment might permit to migrate both access and transport networks to more conventional solutions, provided that those are profitable. TUCAN3G will study the technical details of this solution and the business models that can make it possible.

Expected final results

The expected contribution of each WP is highlighted next.

WP3: Business case study

The TUCAN3G business case analysis will seek answers based on business terms focused on financial forecasts, business objectives, and measures of progress toward those objectives. Such a thorough approach of business case will offer project partners the ability to meet business objectives through a specific proposed decision or action. The business case study will focus on a remote rural scenario not well considered, where inputs need to be collected by local partners in close contact with the target communities. Different plans for the network exploitation will be considered, including penetration strategy, service offering, pricing strategy and sustainability measures, not previously considered.

WP4: Access network optimization

The access network will be designed to deal with the challenges faced by femtocell deployments with a wireless backhaul. The topology of the access network and density of active femtocells is expected to be varying as a function of the traffic demands, interference patterns and decisions taken to reduce energy consumption. It will ultimately depend on the band adopted for the access network (450 MHz, 900 MHz, 2 GHz), so a previous network dimensioning exercise is needed. In this regard, new procedures for self-organizing resource allocation in the access network will be proposed. Such procedures should consider interference management, energy efficiency and coverage enhancement. Also, autonomous carrier selection, transmit power and spreading codes adjustment procedures to reconfiguration of the access network when some femtocells are switch on/off.

Another major novelty addressed in this project is the interoperability of the transport and access networks. The scheduling of the users and the admission of new connections will depend on the quality of the wireless backhaul and its level of congestion. Proposed algorithms should tackle these issues: LIPA/SIPTO offloading mechanisms will be considered as a way of reducing congestion at the transport networks when the traffic demands evolve in time. Therefore, a close coordination between WP4 and WP5 will be enforced during the whole life-time of the project.

Moreover, the project will consider the possibility of evolving towards 4G technology when it becomes affordable. In this respect, TUCAN3G will investigate new procedures non-constrained by the current technology. Two examples of these are: distributed algorithms to manage the interference in a coordinated way and stochastic approximation tools to effectively allocate transmitted power depending on the requirements imposed by QoS on multiple flows. A final challenge is to be able to design the resource allocation of the

wireless backhaul and the access radio in a joint way, even though both networks might be implemented in different RATs.

WP5: Transport network optimization

The state of the art demonstrates that heterogeneous WiLD+WiMAX+satellite networks may offer the best chance to bring broadband connectivity to different scenarios. These are the best (the only) possible technologies for transport networks in rural outdoor femtocells deployments. There are many recent works that separately study the requirements for the backhauling at a superficial level, integration architectures for those heterogeneous networks and several partial techniques to provide end-to-end QoS support and admission control to the access network. However, more research is required for better characterization of the requirements for femto backhauling and the limitations to meet those requirements with the technologies considered (each of them alone, or combined). Additional research is also needed for optimizing performance and energy consumption. To this end, a strict definition of the requirements for the transport network is a must. Optimization implies allocating resources to backhauling as a function of the number of users supported and service level. Again, joint optimization of transport and access segments of the network will be sought during the life-time of the project, and a close coordination between WP4 and WP5 will be pursued.

WP6: Demonstration platform

The networks currently implemented by PUCP in Putumayo and Napo rivers use equipment based on long distance IEEE802.11b. The availability of new technologies (like WiMAX) with enhanced data transmission rates, power consumption and QoS guarantees, allows for upgrading the equipment while reusing the same civil infrastructure. All the platforms currently deployed were conceived to provide services (Internet access, VoIP telephony, videoconference, etc.) just to public health establishments on rural areas. Differently, in TUCAN3G we will use 3G technologies to enlarge the portfolio of services provided and to give access to both private customers and institutions. To that end, we plan to integrate the activities of WP4 and WP5 in the demonstrator at the following levels:

- Deploying the access and transport networks by following the recommendations provided in WP4 and WP5, respectively.
- Selecting the access network configuration settings of HSPA in accordance with the recommendations provided in WP4.
- Selecting the transport networks configuration settings (for 802.11 and VSAT) in accordance with the recommendations provided in WP5.
- Implementing selected technologies based on 802.11 from WP5 into the transport network.

WP7: Dissemination and knowledge utilisation

WP7 will contribute to ETSI standardization mainly in BRAN, and will keep track of activities in 802.22b and ITU-D without discarding the possibility to contribute to them if project activities match their schedule. WP7 is also responsible for generating a plan of exploitation of project results. It is in the plans of the project to organise a conference or special session on rural communications at an international level.

2. Core of the report for the period: project objectives, work progress and achievements, project management

2.1 Project objectives for the period

WP2: Requirements and specifications

The Workpackage Leader is EHAS. The main objectives per activity are:

- Activity 2A1: Technical and socio-economical scenarios

Duration: M1-M2 Participants: EHAS, UPC, URJC, PUCP, FITEL, TdP
Documents : D21

Objectives:

- Define and explain the new/future operational scenarios and the associated services relevant to the femto-cells deployment

- Activity 2A2: Requirements and specifications for transport and access networks

Duration: M3-M4 Participants: EHAS, URJC, UPC, TdP, TIWS
Documents : D22

Objectives:

- Define the general simulation paradigms
- Define the range of requirements (terminal, user, and system requirements) to be taken as a reference point in terms of both single link characteristics and architecture design
- Draw up the Operational Technical Document, and distribute it as master document for all the project partners and all WPs.

- Activity 2A3: Parameters and scope of market research and business models

Duration: M3-M4 Participants: EHAS, UCAU, FITEL, TdP, CREPIC, KINNO
Documents: D23

Objectives:

- Define the parameters and basic conditions to be used in the market research and the business model.

- Activity 2A4: Architecture for the demonstration platform

Duration: M3-M4 Participants: EHAS, PUCP, IPA, TdP
Documents: D21, D22

Objectives:

- Define a reference architecture including all the segments from the operator's network to the access network

WP3: Business case study

The Workpackage Leader is FITEL. The main objectives per activity are:

- Activity 3A1: Market study

Duration: M4-M8 Participants: FITEL, UCAU, TdP, CREPIC, KINNO
Documents : D31

Objectives:

- Provide critical analysis of the market situation and short-term trends indicating the points where the project could impact the most and to keep technical WPs aligned with market trends.
- Study the demand for services (both private and institutional) and possible deals, with criteria allowing to evaluate its evolution over a period of 5 years.

- Perform detailed per-sector cost analysis (service providers, transport and equipment) so as to find the factors behind the business sustainability.
- Study market segmentation, customers' profile and competition.

- Activity 3A2: Product definition

Duration: M8-M11 Participants: FITEL, TdP, EHAS
Documents : M32, D34

Objectives:

- Establish the segmentation of clients (private and institutional) to properly configure voice services and data to be provided to each group.
- Define the different tariffs and payment mechanisms, including public subsidy,.
- Plan the portfolio of sustainable services for the areas under study.
- Design marketing strategies taking into account the different public targets.

- Activity 3A3: Models for funding and return on investment

Duration: M2-M15 Participants: UCAU, FITEL, TdP, EHAS, KINNO
Documents : M33, D34

Objectives:

- Study the structure of costs and the reliability-cost tradeoff, pondering the impact of a modest reduction in availability to a reduction in infrastructure costs and maintenance.
- Propose funding models that explore public-private partnerships and social investment models, estimating the ratios of return appropriate to each of the proposed models.

WP4: Access network optimization

The Workpackage Leader is UPC. The main objectives per activity are:

- Activity 4A1: Network dimensioning

Duration: M3-M6 Participants: UPC, TdP
Documents : D41

Objectives:

- Design and dimension the access network elements according to the requirements defined in WP2, based on UMTS/HSPA and LTE specifications.

- Activity 4A2: Femtocell network optimization and monitoring

Duration: M3-M18 (originally M14) Participants: UPC, URJC, IPA
Documents : M42, D42

Objectives:

- Propose distributed non-supervised methods for network monitoring and optimization under energy consumption and service constraints.

- Activity 4A3: Access and transport network interoperability

Duration: M6-M18 Participants: UPC, URJC, IPA, TdP
Documents : M43, D43

Objectives:

- Define procedures allowing effective control of multiple flows when the access network is connected to a variable quality transport network.

WP5: Transport network optimization

The Workpackage Leader is URJC. The main objectives per activity are:

- Activity 5A1: Usage terms of WiFi, WiMAX and VSAT links

Duration: M4-M7 Participants: URJC, PUCP, UCAU, TIWS
Documents : D51

Objectives:

- Establish under what conditions and limitations WiLD, WiMAX and VSAT can be used in the backhaul with femtocells

- Activity 5A2: Heterogeneous transport network architecture for the backhaul

Duration: M4-M15 Participants: URJC, PUCP, UCAU, TIWS
Documents : M52, D52

Objectives:

- Propose a "technology-agnostic" mechanism that dynamically accounts for the resources available in the transport network and provides the access network with this information for admission control.

- Activity 5A3: Transport network optimization

Duration: M11-M22 Participants: URJC, PUCP, UCAU, TIWS
Documents : M53, D53

Objectives:

- Optimize traffic management in WiLD, WiMAX and VSAT in order to optimize the bandwidth used for the backhaul.
- Optimize energy consumption in nodes belonging to the transport network.

WP6: Demonstration platform

The Workpackage Leader is PUCP. The main objectives per activity are:

- Activity 6A1: Technical and operational design

Duration:M1- M6 Participants: PUCP, FITEL, IPA, TdP, EHAS
Documents : D61

Objectives:

- Ensure the technical feasibility (infrastructure, energy, security, physical access) and legal physical healing of the pilot deployment scenarios, which includes the transport network, terrestrial network and satellite network.

- Activity 6A2: Compatibility tests

Duration: M7-M13 Participants: PUCP, UPC, URJC, FITEL, IPA, TdP
Documents : D62

Objectives:

- Assure the compatibility of equipment and systems in TUCAN3G's network and the operator's network
- Implement a protocol of technical tests (reliability, robustness, maximum and minimum capacity of transport and access network, etc.) and tests designed to obtain qualitative and quantitative acceptance by users of communication services provided.

- Activity 6A3: Pilot network deployment

Duration: M11-M22 Participants: PUCP, FITEL, IPA, TdP, EHAS, TIWS
Documents : M61, M62, D63

Objectives:

- Upgrade the TUCAN3G pilot network in the Putumayo and Napo

WP7: Dissemination and knowledge utilisation

The Workpackage Leader is UCAU. The main objectives per activity are:

- Activity 7A1: Dissemination

Duration: M1-M30 Participants: All partners
Documents : M711, M712, M713, D71

Objectives:

- Create and maintain the project web site
- Disseminate results international journals and conferences, and through direct contacts with regional operators and authorities.
- Organize project's technical workshop

- Activity 7A2: Standardisation

Duration: M2-M30 Participants: UPC, CEA, CTU, SEQ, 4GC
Documents : D71, D72, D73

Objectives:

- Promote the project outcomes at industrial level through the presence in standardisation committees.

2.2 Work progress and achievements during the period

The following sections describe the project activities and achievements per workpackage and partner, along with the efforts, according to the quarterly management reports in this period.

WP2: Requirements and specifications

Use of resources

Participant	UPC	URJC	PUCP	UCAU	FIT	IPA	TdP	EHAS	TIWS	CREP	KIN	**Total**
Total	0,52	0,5	2,66	0,25	1,00	0,89	1,25	6,00	0,25	0,51	1,00	14,83
2A1	0,26	0,25	1,33		0,50		0,5	1,50				4,34
2A2	0,26	0,25						1,50	0,25			2,26
2A3				0,25	0,50	0,25	0,25	1,50		0,51	1,00	4,26
2A4			1,33			0,64	0,5	1,50				3,97

Progress and results

The purpose of WP2 was to provide reference scenarios where TUCAN3G solutions could be applied, as well as to define the basic requirements from a social and technical perspective to develop the project.All partners have contributed to this workpackage with information about rural reality of developing countries, markets, technology limits or similar experiences in other regions since the beginning of the project. EHAS (WP2 leader) has collected and assembled inputs from all partners for four months in order to generate the deliverables D21, D22 and D23 that will provide data for the rest of the WPs during the project. Latin American partners as UCAU and CREPIC took an important part describing in a quantitative and qualitative way the socio-economic scenarios, while technical partners as PUCP, UPC, URJC, IPA and TIWS worked on defining the main specifications for the access and the transport network. These partners have also provided a design for the demonstration platform with a proposal for target localities, a general description of test to be carried out and the needs of existing networks. On the other hand, partners like FITEL, TdP and KINNO have outlined the dimensions of the potential market for this technology, preliminary step to develop the Business Model in WP3.

Finally, EHAS has also developed the Operational Technical Document in coordination with all WP leaders as well as the technical coordination of the project.The Operational Technical Document has become the master document of the project which specifies activities, tasks and timings for all the partners and all WPs.

- Activity 2A1: Technical and socio-economical scenarios

The specific activities per partner were the following:

EHAS:

- In coordination with al WP leaders, EHAS has identified the information needs of each WP, and based on those needs, defined the information to be collected in D21 and its table of contents. After that, EHAS has coordinated with WP2 partners the distribution of tasks in activity.
- Besides, EHAS has worked specifically on the description of scenarios of remote rural areas of developing countries, focusing specially in Latin American case.
- Finally, EHAS has collected and reviewed the contributions of the rest of partners, and has edited D21 doing an important effort to get a coherent document with so different sources and levels of English.

UPC:

- Worked on the definition and description of technical and socio-economical requirements towards WP4 including the following aspects: energy efficiency requirements, coverage scenarios, description of the 3G and 4G air interface (with the corresponding releases) and the system architecture, traffic models, interference models, and PHY layer abstraction.

URJC:

- URJC contributed to the technical specification part of D21. It identified the technological limits on the transport network considering the regional requirements and actual installations on the region.

PUCP:

- PUCP collected detailed information about the networks deployed in the river Napo, Putumayo and Balsapuerto district in Peru. PUCP has completed the description of these target networks. All the contributions were included in deliverable D21.

TdP:

- TdP has contributed in this task supporting EHAS in the definition of operational scenario models, supplying concrete data of Peruvian socio-economic evolution and main rural areas characteristics.

FITEL:

- FITEL has contributed to the definition of scenarios and target localities, providing information about the social context and about the infrastructures available in the isolated rural areas of Peru.

- Activity 2A2: Requirements and specifications for transport and access networks

The specific activities per partner were the following:

EHAS:

- EHAS has worked with UPC, URJC and TIWS in order to define the parameters to be used in the requirements and specifications for transport and access networks. These parameters will provide basic information to research activities in WP4 and WP5.
- EHAS has worked with TdP to have a first insight of the expected traffic in the network, which is critical information to the design of access and transport networks.

URJC:

- URJC described the technical requirements, laboratory needs to verify each considered technology, and link characteristics oF transport network with respect to identification of different technologies such as WILD and WiMAX. Finally, it completed the required work plan for its further activities in D21.

UPC:

- Worked on the definition of system requirements and technical scenarios to be addressed in the project. Moreover, the main properties of the radio access technologies considered in TUCAN3G (3G, 3G-HSPA and LTE) were provided. UPC elaborated a common evaluation methodology to be considered in the project.

TIWS:

- TIWS has contributed with an analysis about the state-of-the-art of IP transport networks through satellite links, and its application to cellular backhauling. After a first part with a brief overview of the different topics of satellite communications (satellite orbits, network architecture and topologies, frequency bands, …), in a second part the analysis of application of IP transport over satellite for cellular backhauling was done, focused on its application to rural 3G femtocells under the scope of TUCAN3G. As conclusion, there are technical possibilities to achieve greater efficiency and savings of satellite bandwidth, allowing IP transport networks over satellite to be used for 3G femtocell backhauling.

- Activity 2A3: Parameters and scope of market research and business models

The specific activities per partner were the following:

EHAS:

- EHAS has defined the table of contents for D23, detailing what information was expected from each partner, and coordinated with WP2 partners the tasks of this activity.
- EHAS has performed a review of similar experiences worldwide for D23.
- EHAS has been responsible for integrating the information provided by each partner for D23 and has edited the final document

UCAU:

- Contribution to the description of the operational scenarios for rural areas of Colombia, describing the services provided by operators in rural Colombia and the issues related with these services based on existing studies

TdP:

- TdP has contributed in this task providing the operator´s perspective of Peruvian rural jungle in this days and its possible evolution, describing socio-economic characteristics of business and private users based on existing studies and its own know-how.

FITEL:

- FITEL has contributed to this task providing the public sector perspective, and describing the different programs existing in Peru to support rural communities.
- FITEL has also worked to identify the research questions per target group, focusing on public sector and operators.

CREPIC:

- Six rural localities in Colombia were identified which can be a potential market for the technology developed in TUCAN3G, these are Piamonte, Santa Rosa and San Sebastian in Cauca, and Puerto Leguizamo, Puerto Guzman and Puerto Caicedo located in Putumayo. In this sense, a description of social and economic characteristics of these localities was developed based on existing studies. CREPIC proposes the structure of the Business Model for TUCAN3G in three phases: Phase 1 Description of the nine elements, Phase 2: Evaluation of each element of the business model in order to identify opportunities, strengths, weaknesses and threats, Phase 3: Improving model according to the results of the evaluation.

KINNO:

- KiNNO has designed the methodological approach of the activity through the identifications of all relevant stakeholders and synthesis of their expectations to concrete suggestions.

IPA:

- IPA supplied the manufacturer's market description and candidate market research questions that a manufacturer would wish to answer before entering the rural coverage market segment.

- Activity 2A4: Architecture for the demonstration platform

The specific activities per partner were the following:

EHAS:

- EHAS has worked on defining the architecture for the proof of concept, and on a proposal for target localities. The final proposal collected in D21 has been agreed among the partners, including all the perspectives: scientific, technical, social and economic.
- EHAS has developed the Operational Technical Handbook (D22) with the planning provided by each WP leader, analyzing interactions between WPS and defining mechanisms for technical supervision and the methodology to be used in case of deviations. The definition of supervision methodology was performed together with the project technical coordinator.

PUCP:

- Initially, PUCP has provided a detailed work plan for WP6, then, PUCP has performed an analysis of the limitations of deployed networks in Balsapuerto and Napo. Also, PUCP has designed a preliminary network proposal of reinforcement and proposed performance tests for the demonstrative platform. Except for the WP6 work plan, all the contributions were included in deliverable D21.

IPA:

- IPA contributed details of its product roadmap and capabilities and ongoing discussion, plus various other queries and had preliminary discussions about including 3rd party LIPA type offload technology in the demonstration platform.

TdP:

- TdP has contributed in this task providing the compatibility test for operation, manage and configuration to connect IP Access RNC to TdP´s voice and data core network and the integration guide to install and integrate IP Access Equipment in TdP´s Node in Lima for the validation of the model designed by TUCAN3G in a real scenario.
- TdP has specified the compatibility tests and the locations where the RNC could be placed.

Liaison with other WPs

The main objective of WP2 has been to establish a common start point for the rest of WPs, defining and collecting the basic information to develop the project. The description of reference scenarios provided in WP2 will be used in WP3, WP4 and WP5. Besides, WP2 also defines the strategy for the market research and provides the guidelines for developing the business model, both in WP3. Finally, in WP2 the scenario and basic architecture for the pilot deployment (WP6) was agreed among all the partners.

Deviations from the workplan

All the activities were performed according with the established workplan.

WP3: Business case study

Use of resources

Participant	UPC	URJC	PUCP	UCAU	FIT	IPA	TdP	EHAS	TIWS	CREP	KIN	Total
PM				0,31	0,60	0,50	1,88	1,50		1,10	3,25	9,14
3A1				0,25	0,60		0,5	1,50		1,10	3,25	7,2
3A2							0,75					0,75
3A3				0,06			0,63					0,69
3A4						0,5						0,5

Progress and results

WP3 has first focussed on taking the information provided by WP2 and performing an in depth market research in order to better understand the potential clients of mobile services in the isolated areas of developing countries. The research activity took place in Peru and Colombia, and focused on two main target groups: demand and supply side groups. In order to better collect both data and needs from providers and end users of the potential services, a set of qualitative and quantitative tools has been used, such as questionnaires and semi-structured interviews. The data collected have been assessed, analysed and presented from different angles and views (private and business users, institutional users, decision makers, network operators and equipment manufacturers), what allowed us not only to draw a bigger and complete landscape of the regions but also to grasp critical matters for all sides. The results provide an input for the design and execution of the final business model. Currently the work of this WP3 is focussed on defining the portfolio of products and services (M32) that should be soon ready. In parallel the analysis of costs and financial models has started, and will be reflected in M33.

- Activity 3A1: Market study

The specific activities per partner were the following:

FITEL:

- FITEL has collected data for possible target localities (economic sectors, potential applications, socioeconomic structure of population).
- FITEL has performed surveys to 400 people living in rural isolated areas, which have provided crucial information for the market survey.
- FITEL has contributed to the analysis of surveys in Peru, providing their insight and experience in this type of works and contexts.

UCAU:

- Review of research questions per target group.
- Final translation and localization of research questions.

TdP:

- TdP contributed to the research questions and application of the research method to supply side stakeholders and business users. This task was updated from M8.

CREPIC:

- CREPIC contributed to the research questions for the market study and business model. In this sense, interviews with the organization named APROPESCA were conducted in the municipality of Silvia with different members of that organization. We carried out a new cycle of interviews and analysis of private and institutional users, this time in the native community of Coconuco in the municipality of Purace. We had three meetings with leaders of the indigenous community and worked together with an intercultural articulator in order to conduct the surveys. We carried out two interviews for institutional users -Policia Nacional and the Health Center of Coconuco-. For business users, we carried out interviews with small businesses as Chiliglo Fishfarming Station, Coconuco – Comfandi Inn and the

transport enterprises Transtimbio. These interviews were analyzed in order to build the report for document D31.

KINNO:

- KiNNO was initially responsible for the preparation of the business model framework and analysis of planned work. Moreover, KiNNO researched all relevant bibliography and business models developed in similar context in order to better identify key factors. Moreover KiNNO was responsible for the preparation of execution of market research and identification and analysis of research methods. Following the above, KiNNO developed all research guides for each research method and did the analysis and categorization of research questions to relevant constructs and development of draft research tools. Also, KiNNO continuously monitored the activity, coordinated all research efforts in order to manage the collection and analysis of the results and fine-tuned and harmonized all input provided by the partners. Last but not least, KiNNO elaborated all key input and produced all draft and final versions of the deliverable D31.

EHAS:

- EHAS has contributed to the review of research questions per target group for the market research.
- EHAS has carried out the execution of the market research by contacting with Peruvian Operators and doing the interviews with those responsible of rural areas.
- EHAS has carried out the analysis of results of the interviews with staff Responsible for Rural Areas in Peruvian Operators, drawing up the main lines identified from operators' perspective for the market survey (D31). EHAS has also contributed to WP3 supporting the coordination of activity 3A.1 in order to collect the results for D31.

- Activity 3A2: Product definition

The specific activities per partner were the following:

TdP:

- TdP´s contribution to this task is to develop a model funded by a public-private association taking advantage of the government funds and operators experience and know how saving transport bandwidth and energy cost.

- Activity 3A3: Models for funding and return on investment

The specific activities per partner were the following:

UCAU:

- Initial considerations for identification of technical critical success factors.

TdP:

- TdP´s contribution to this task is to evaluate and optimize the OPEX cost of structure, and also identify the technical activities and key partners

- Activity 3A4: Business model design and verification

The specific activities per partner were the following:

IPA:

- IPA worked with TdP on gathering the collection of the market study results for subsequent business model design, designed the questionnaire for supplier inputs, identified the suppliers and helped ensure that the questionnaires were completed.

Liaison with other WPs

The strategy to develop the market research was developed in WP2 and used as starting point in WP3. WP3 will also require information about the cost related with the access and backhaul networks, that is part of the work of WP4 and WP5. WP3 is also related with the WP6, since the business model developed in WP3 will be tested in the demonstration platform.

Deviations from the workplan

The activities to perform the market research have taken longer than expected given the difficulty to perform field surveys in the isolated region where the project plans to provide 3G services. The M31 has been finally completed, but the deviation in this Deliverable will have an impact on M32 and M33 plan.

WP4: Access network optimization

Use of resources

Participant	UPC	URJC	PUCP	UCAU	FIT	IPA	TdP	EHAS	TIWS	CREP	KIN	Total
PM	10,41	6,0				1,28	2,61					20,30
4A1	5,41						2,0					7,41
4A2	3,5	2,8				0,8						7,1
4A3	1,5	3,2				0,48	0,61					5,79
4A4												0

Progress and results

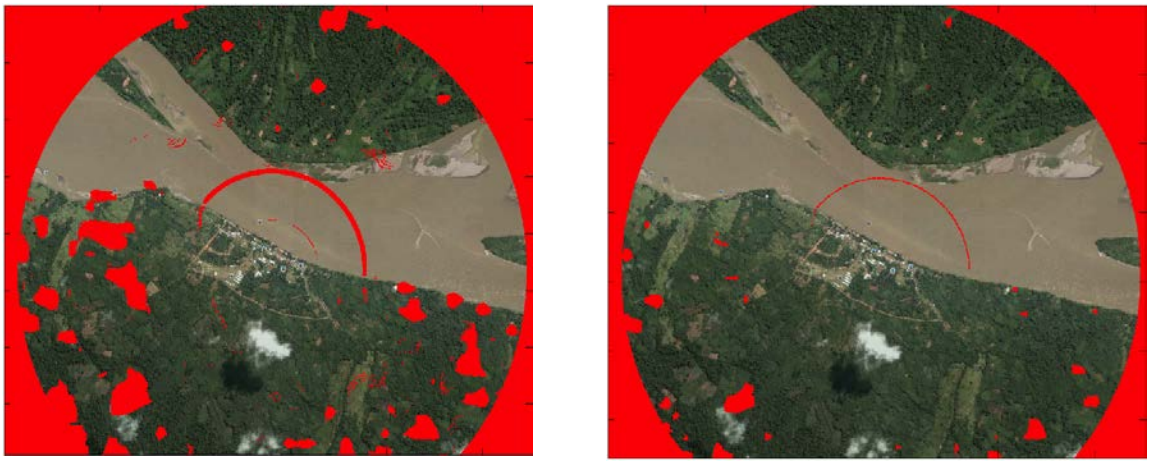
The objective of this WP is the definition of tools for the design of the access network considering the particularities of the rural areas in Amazon. In this respect, substantial progress has been done in the first period by adopting a precise methodology for the network dimensioning, given the fact that the power and capabilities of the femtos are limited. Also, the design adopts the criterion of minimum backhaul dimensioning for a given blocking probability for mixed voice and data traffic. Results for five different locations will be applied to the actual deployment of WP6. This dimensioning is addressing the lowest network dynamics (considered in 4A1). The second network dynamics (considered in 4A2) affect the definition of mid-term parameters: assignment of carriers to each femto, scrambling codes, cell range expansion for load balancing and ON/OFF decisions. The highest variability in network dynamics affects the user association and packet scheduling (considered in 4A3). Again, these are being designed by taking into consideration the backhaul constraints which will affect the admission of users and the allocation of resources in a multicell setup at a given location. In this later case, battery constraints and energy harvesting are included.

- Activity 4A1: Network dimensioning

The specific activities per partner were the following:

UPC:

- Definition of a new methodology for network planning: The methodology adopted is suited to the simple scenarios defined in WP2 for the rural areas in Amazon. It provides a precise 3G dimensioning. The radio links are computed using the freeware software "RadioMobile" and dimensioning is grounded on the following constraints: coverage, probability of congestion, limitations imposed by the IPA's equipment, and antenna radiation patterns.
- Traffic models for rural areas: In collaboration with TdP, daily voice and traffic model patterns in Peruvian rural areas have been obtained. The obtained models have been compared with the ones given in the FP7-Earth project for European countries.
- Energy consumption: Review of the energy consumption models described in the FP7-Earth project that are needed for dimensioning the necessary energy-infrastructure (solar cells and batteries).
- Network planning recommendations for villages participating in the pilot network deployment (WP6): Elaboration of precise recommendations of the required equipment (height of the towers, type of antennas, type and number of IPA's HNB, type and number of solar cells and batteries) to provide 3G service in Santa Clotilde, Negro Urco, TutaPisco, San Gabriel, and San Juan over a period of 5 years. Figure 1 depicts the coverage provided by two different models of IPA's HNBs over Santa Clotilde.



(a) Scenario #1 and HNB S-class 16 **(b) Scenario #5 and HNB E-class 24***

Figure 1. Coverage areas for two scenarios and HNB type (Santa Clotilde)

TdP:

- TdP has contributed to this task by providing a traffic model and a long haul model based in real traffic and socio-economic evolution from localities with typical characteristics of Peruvian rural jungle, and the traffic evolution forecast in a 4-year period.

- Activity 4A2: Femtocell network optimization and monitoring

The specific activities per partner were the following:

UPC:

- Existing monitoring procedures: Review of the literature to know the existing mechanisms and protocols that are being considered for monitoring the network.
- ON/OFF HNB: Development and evaluation of techniques for switching ON/OFF HNBs under the objective of minimizing the power consumption while still guaranteeing a given quality of service in terms of blocking probability. In this regard, a HNB can be switched off when the traffic load is low (assuming that the exact traffic profile is known beforehand), see Figure 2. In case there is inaccurate traffic load knowledge, a Bayesian approach has been taken to define new robust thresholds over the traffic in order to switch ON/OFF the HNBs.
- Dynamic cell expansion: The HNB-based network should react autonomously to the actual traffic demand. In this sense, two approaches are followed:
    - User association: We are taking into account how the users are associated to the serving cell in order to have a load-balanced system. The criteria might consider the number of current associated users, remaining battery level or allowed interference in the uplink (UL) transmission, including the UL performance on the user-association decision.
    - Coverage area: When an HNBs is switch ON/OFF, it imposes certain actions to be carried out by neighboring HNBs in order to maintain the coverage area. We are studying mechanisms for varying the power devoted to the pilot signal as a function of the dynamic topology of the network.

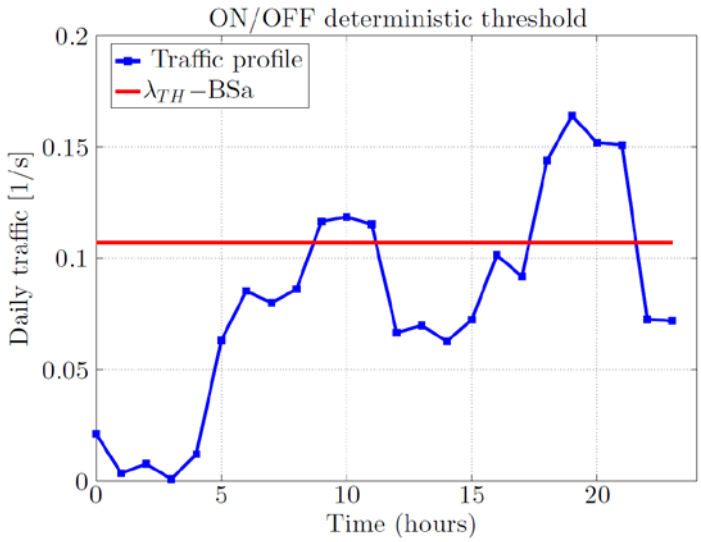


Figure 2. On/off threshold example for a given traffic profile

URJC:

- URJC is responsible for the development of distributed algorithms for frequency and primary scrambling code (PSC) assignment and the optimization of the access network in the medium term. The initial findings after the literature review and potential alternatives worth investigating for TUCAN3G scenarios were detailed in M42. Regarding the first problem (frequency and PSC assignment), existing algorithms have been analyzed and tested using simulations. The preliminary results point out that greedy algorithms focused on avoiding collision with one-hop neighbours will work well unless the number of femtocells is too high or the number of frequencies and PSC codes are very small. Novel algorithms tailored for TUCAN3G for the scenarios where greedy schemes may not perform well are under development. Moreover, the algorithms have to consider the mechanisms to avoid two-hop reuse, to be able to avoid problems when the femtocells need to perform handovers. Regarding the second problem (comprehensive medium-term optimization of the access network), the preliminary work revealed that for the algorithms to be optimal/efficient, the schemes that operate (optimize) the access network in the short-term needed to be known. The reason for this is that the medium-term performance of the network depends heavily in the short-term schemes. This was a problem, because such algorithms are developed in subtask 4A3. The same is true for the comprehensive network optimization, because the performance of the overall network depends heavily on the schemes that operate each single femtocell. To handle these issues, two actions were taken. The first one was to incorporate some of the results of 4A3 into 4A2 (even though this entailed increasing the duration of activity 4A2). The second one was a stronger collaboration between URJC (responsible of the optimization of the overall network) and UPC (responsible of the optimization of a single femtocell). The strategy was successful and advanced algorithms that optimize the network in the medium-term and account for the short-term operation of the network are currently under development.

IPA:

- IPA provided input on areas of network optimization and product capability, and contributions towards power consumption assessment and remote on/off switching. Work on possible LIPA/SIPTO type architectures was undertaken prior to traffic modeling indicating the deployment. It developed a model for data bandwidth use in uplink and downlink for various configurations. It is working on looking at techniques for UE-assisted HetNet configuration of PSC, frequencies, neighbor cells and mobility optimization. It has also produced a discussion document (also for WP6) after input from modeling by UPC on candidate techniques for producing a 3G data-only femtocell overlay to a 2G circuit-switched only cell, driven by wishes and predicted traffic at the Sta Clothilde site. This is ongoing work with TdP and its network suppliers and feasibility is not yet guaranteed.

- Activity 4A3: Access and transport network interoperability

The specific activities per partner were the following:

UPC:

- Single-HNB channel state-aware packet scheduling: Preliminary procedures have been proposed for the power and code allocation in both uplink (UL) and downlink (DL) in the case of mixed traffic, i.e. voice and data traffic. In the proposed schemes, voice traffic is prioritized over data traffic. Power and codes are assigned first to the voice users to guarantee the voice service to these users. The remaining resources are assigned to data traffic. The distribution of codes and power among data users is done to maximize the weighted sum-rate achieved by the users with a data connection. Admission and congestion control procedures will be considered as a next step.

URJC:

- URJC is responsible for: the development and analysis of different alternatives for traffic offloading; the development of real-time scheduling algorithms aware of the network and battery (energy) state of the system; and the design of resource-allocation schemes for the access network aware of the state of the transport network. Most of the work was focused on the first problem (development of solutions for traffic offloading).). The 3GPPP proposed two different alternatives for traffic offloading: SIPTO and LIPA. After discussing with other partners, SIPTO-based offloading solutions were discarded. . Moreover, alternatives not proposed by the 3GPP (such as enterprise networks and hybrid 2G-3G networks) were also analyzed. Preliminary simulation results showed that: 1) although beneficial, offloading is not able to avoid congestion unless the amount of local traffic is too high and 2) focus should be placed on development of offloading mechanism for voice traffic. The reason is twofold: local traffic is more likely for voice than for data and, due to encapsulation, voice traffic can easily saturate the transport network. Last but not least, from a legal perspective, voice offloading may be problematic due to legal interception requirements. These issues are currently under further investigation. Regarding the second problem (real-time scheduling and access-control schemes), only very preliminary algorithms were tested. Advanced algorithms are currently under development. Collaboration with UPC (responsible for the design of basic algorithms that serve as input for the algorithms to be designed by URJC) has been intense. Regarding the third and last problem (interaction with the transport network), the focus has been on designing an interface that enables the access network to access information of the transport network. The design of algorithms that use the information of the transport network for real-time optimization of the access network is currently under development.

IPA:

- IPA is working in coordination with URJC and their related WP5 task on dynamic bandwidth management schemes for the backhaul and how much the backhaul state knowledge can be implemented into the current product schema for deployment. Ongoing work will also consider aspects of caching, offloading and Lawful Intercept.

TdP:

- TdP has analyzed the proposed LIPA/SIPTO techniques in our core network. TdP is also analyzing the possibility to use voice over 2G network and data over 3G network in the same locality with both services.
- TdP has provided web caching traffic offloading optimization techniques applicable to TUCAN3G project in Telefonica´s transport network, and also shared some technical tests results of bandwidth savings.

Liaison with other WPs

Results from 4A1 have been brought to the definition of materials and deployment to be used in the deployment platform in WP6. Also, the dimensioning task outputs the required backhaul. This figure is used to select the most appropriate technology for the transport network in WP5. In general, all results from 4A1 will be fed to the business case study in WP3. The influence of 4A2 and 4A3 on other activities is deferred to the second period.

Deviations from the workplan

- Activity 4A2 has been extended to M18 (June 2014): The reasons behind this delay are purely technical due to the interplay between activities 4A2 and 4A3, which requires formulating both activities simultaneously, an aspect which was not contemplated at the time of writing the proposal. This delay will have no impact in other WPs or in the project budget.

- Modification of PM allocation of TdP: In Dec 2013, TdP introduced to the WP4 partners one technique based on web-cache optimization that can reduce the data traffic backhaul demands and is especially suited for VSAT-based networks. The benefits of this solution are documented in M43, showing experimental results. After some discussions that delayed the delivery of M43, we agreed that this technique should be considered for WP6, provided that TdP is allowed to move 1 PM from WP4 to WP6. This change is not substantial in the work envisioned in WP4.

WP5: Transport network optimization

Use of resources

Participant	UPC	URJC	PUCP	UCAU	FIT	IPA	TdP	EHAS	TIWS	CREP	KIN	Total
PM		11,95	1,9	1,42					2,0			17,27
5A1		3,2	1,5	0,50					1,0			6,2
5A2		8,25	0,4	0,92					1,0			10,57
5A3		0,5										0,5

Progress and results

WP5 concentrates its activity in months M4-M22, so the first year has had activity in months M4-M12 belonging to activity 5A1 (driving to deliverable D51), activity 5A2 (producing milestone M52 and continuing towards deliverable D52 that will be finished in month M15) and the initiation of the first tasks of activity 5A3.

5A1 has successfully analysed the performance of the different technologies considered for wireless backhaul in rural 3G networks: VSAT systems, WiLD (WiFi for long distance) systems and WiMAX systems. D51 contains a significant number of results obtained through analytical and empirical tools showing that both WiLD and WiMAX alternatives may offer long-distance point-to-point links with enough capacity and limited delay for rural backhaul networks. VSAT is also evaluated and seen as a worst case for those networks or nodes too isolated as for any other alternative. The next Figure shows the comparison of capacity that can be obtained in long point-to-point links while keeping the delay under 5 ms.

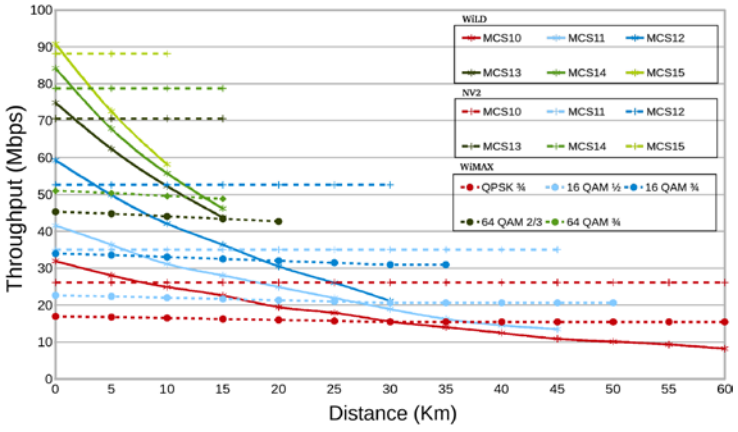


Figure 3: Comparison between different modes of operation of WiMAX and WiLD systems, all limited for operation at delays under 5 ms.

5A2 has studied how those technologies can be combined in multi-hop networks for a cost-efficient backhaul of several rural HNBs. If links are not dedicated to a HNB but they are shared for several nodes in a multi-hop network, it is fundamental that the traffic is shaped in order to maintain all links and systems working in unsaturated conditions. This implies the insertion of a traffic controller between any two links and between the backhaul network and any external entity connected to it such as the operator's core network or the HNBs. This drove to the network architecture represented in the next Figure.

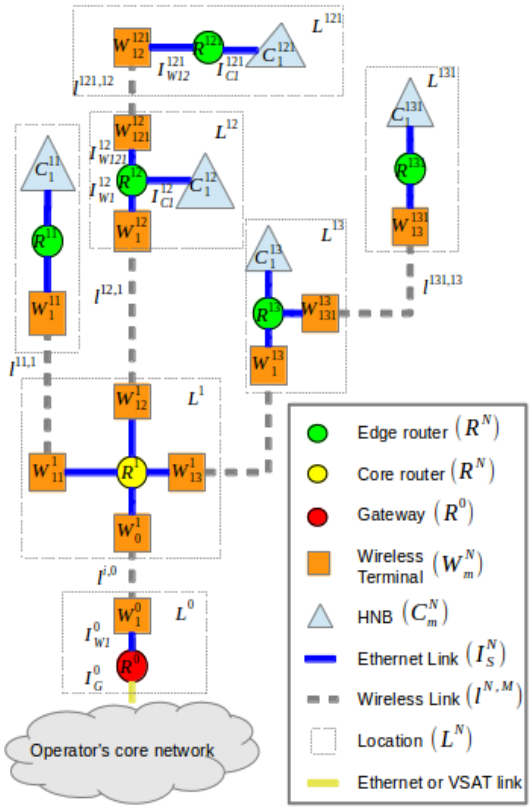


Figure 4: Backhaul network architecture

In order to assure different priorities to different traffic classes, different strategies may be implemented in traffic controller nodes. The main proposals are pointed out so that they can be tested and compared in the second part of 5A2. Those results will be included in D52.

- Activity 5A1: Usage terms of WiFi, WiMAX and VSAT links

The specific activities per partner were the following:

URJC:

- As the leader of the work package, URJC realized detail theoretical and simulation based studies on applications of WiFi and WiMAX collaborating with other partners. Simulations on performance and behavior of these technologies over the regional conditions and long distances were completed with NS3 simulator. On the other hand, some hardware tests were also realized to compare the simulation results with theoretical expectations. Finally, after a detailed review of all results with comparison of real links in Peru, conclusions were shared with partners and published with D51 deliverable.

PUCP:

- PUCP has made trips to areas where target networks are deployed in order to tests and measure real PtP links. PUCP has also reviewed the information available and prepared one report for non-technical readers (document presenting relevant information from 5A1 to WP3) and another report for technical readers (document presenting relevant information from 5A1 for WP6).

UCAU:

- Description of the IP layer functionalities for QoS provisioning.
- Contribution with the Chapter 6 "Added functionality at the IP layer" of D51.

TIWS:

- TIWS has contributed with the description of requirements of IP interfaces of satellite modems and also the IP functionalities usually included.As a conclusion, implementation of IP interface on satellite modems do not differ from the implementation on other equipment, but in the satellite communications industry it is common to implement additional IP functionalities on satellite modems, usually neither open nor standardized, and focused on enhancing performance of IP communications through a satellite link, where latency and jitter values are different that the ones expected in terrestrial links.
- TIWS has made also its contribution to deliverable D51, including: paragraph 2.3, collecting information from standardization bodies and scientific literature to help to foresee the performance; and paragraph 5, about expected performance in satellite communications systems. As a conclusion, satellite communications industry is dominated by proprietary standards developed by main hardware manufacturers, while the few available standards are less used, usually because of the better performance of the first ones for specific applications.

- Activity 5A2: Heterogeneous transport network architecture for the backhaul

The specific activities per partner were the following:

URJC:

- URJC worked on the high level architecture with possible combination of WiFi, WiMAX and VSAT technologies. Thus, it dedicated important tasks in this activity to define the interfaces in this heterogeneous environment to be able to run all technologies together. Laboratory is planned including all possible elements in any TUCAN3G network from satellite links to femtocells, so that experiments may include every possible combination. While WiFi, WiFi-based TDMA systems and WiMAX may be extensively tested with real systems, satellite links and femtocells are foreseen to be incorporated during the first quarter of the second year. In the meantime, computers using high quality traffic generators are used as a replacement for femtocells.
- A backhaul network architecture was provided by milestone M52, which requires the theoretical aspect of the expected architecture. In addition, access control mechanisms and possible internal traffic management systems were described for possible implementations. The outcomes from M52 are used as the basis for D52. The first experiments in laboratory for validating the proposals in M52 are being designed already in the 12th month. Specifically, a testbed including WiFi and WiMAX links, with traffic control routers, is designed representing a situation like the real Napo testbed that will be deployed in WP6. The testbed is being prepared for testing both MPLS and DiffServ multi-hop QoSo control. The results of this testbed will be presented in the next quarter in deliverable D52.

PUCP:

- PUCP has worked together with URJC and UPC in order to define and purchase the hardware equipment for URJC laboratory and the femto cells model to install.

UCAU:

- Study of the requirements to design the WiMax-WiFi interface.
- A test bed was installed for evaluating end-to-end QoS support in a WiMAX+IP plus WiFi-EDCA+IP link configuration. Scripts for traffic injection were developed, and evaluation tests were started.
- Remote tests made on the heterogeneous WiFi-WiMAX testbed at URJC, in order to define and verify the mapping and coupling of these two technologies.
- Collaboration in the definition of tools for traffic measuring and simulation.
- Contributions to sections 2.4 and 4.1 of M52.

TIWS:

- TIWS has made its contribution to M52. It reports how VSAT systems, acting as gateways from the rural transport network to the Internet and the operator's core network, should interface WiLD/WiMAX/femtos for optimal QoS support. As a conclusion, there are different QoS

implementations developed by hardware providers that can fit the requirements of 3G backhauling under the scope of TUCAN3G.

- TIWS has also launched the installation process of two different VSAT stations for lab testing with the 3G femtocell and the other wireless communication technologies. TIWS will provide hardware, bandwidth and technical support for the satellite part of these tests.

- Activity 5A3: Transport network optimization

The specific activities per partner were the following:

URJC:

- URJC has identified the variables that may be controlled in each node of the backhaul network, in order to determine which of them can be considered in optimization problems. In connection with 5A2, restrictions associated with performance and QoS that must be guaranteed have been also identified.

Liaison with other WPs

- WP5 interfaces with WP4 as far as the backhaul network studied is used to transport the traffic generated in the access network. Although the research has been precisely defined in each work package in order to maximize the autonomy of each WP, two basic connections have been kept and both teams have fluidly exchanged information during the whole year. These two connections have been (1) the accurate definition of the traffic generated in the access network, and (2) the possible exchange of control information between backhaul and access network in order to make possible the implementation of access control mechanisms.
- On the other hand, WP5 also interfaces with WP6 because the proposals generated in WP5 for the backhaul may be partially tested in demonstrators that are to be deployed in WP5. For the results of the first activity, one task was defined for extracting relevant information for WP6, and for the second activity several communications have been kept with WP6 leaders to define the details of the two demonstrators to be deployed in WP6 so that WP5 results can be applied.

Deviations from the workplan

D51 and M52 have been finished with a delay of one month each, while the initial tasks of 5A3 have been slightly delayed. No other deviations are foreseen.

WP6: Demonstration platform

Use of resources

Participant	UPC	URJC	PUCP	UCAU	FIT	IPA	TdP	EHAS	TIWS	CREP	KIN	Total
PM		0,6	5,34			0,36	1,43	1,0	0,25			8,98
6A1			3,0			0,2	0,5	1,0				4,7
6A2		0,6	1,84			0,16	0,85		0,25			3,70
6A3			0,5				0,08					0,58
6A4												
6A5												

Progress and results

During the period under review, it has been possible to perform only those activities that were not directly linked to the implementation of financing committed by FITEL. Despite this, and taking into account the importance of performing the laboratory tests on URJC, PUCP has purchased the major equipment required for this purpose, advancing its own funds to be returned after the disbursement of FITEL. With this effort, extensive tests have been done by URJC, using the purchased equipment.

The relationship with existing users of the target network is pretty good and they have collaborated extensively with the delivery of information and realization of activities carried out in the field.

Most of the activities at this stage has been the responsibility of PUCP. Some delays in the completion of 6A1 activity were mainly due to the reformulation of the original idea of using the network as it is installed in Napo; after analysing the operation of that network, it was concluded that it was more appropriate to vary the original design and install a separate network, which implied a complete design and a modification of the original plan. All partners have done their respective task with the limitation indicated above about FITEL funding

Finally, in this period D61 was elaborated and presented.

- Activity 6A1: Technical and operational design

The specific activities per partner were the following:

PUCP:

- PUCP has carried out coordination activities with GOREL and other public entities in the areas in which it is planned to develop the demonstration platform; these institutions gathered information about target networks. Also, some sensitization materials have been prepared and the realization of the sensitization workshops and reunions in the areas of intervention has been completed. PUCP has collected information and agreements and made field visits and preparation of the respective reports. PUCP has completed the systematization of the activities about coordination with local actors (6A1.1) sensitization (6A1.2) and gathering information (6A1.3). Finally, PUCP has completed the design of modifications to be made in target networks.

IPA:

- IPA has had preliminary discussions on product solutions and some further details about product performance, plus the logistics of delivery. It is an outstanding issue as to how to weatherproof the units. Work linked to WP4 is being looked at to see if it is possible to introduce a data-only 3G picocells overlay to the 2G CS only cells in Santa Clothilde

TdP:

- TdP signed a commitment with PUCP to operate the 3G network after the project has ended to assure service operation.

EHAS:

- EHAS has provided to PUCP the quotation of the equipment and materials for the test laboratory.
- EHAS also worked on the identification of resources and services to be shared with the new telecommunications system in the selected networks. This work has been included in D61 with a description and technical characterization of the services already deployed in the Napo network (that would share the backhaul with the femtocells).

- Activity 6A2: Compatibility tests

The specific activities per partner were the following:

PUCP:

- PUCP has coordinated its activities with FITEL in relation to the execution and concretion of the amount contributed by the partner. This is a very complicated and long process that continues until now that a schedule is already defined for this purpose. PUCP has made the quotation and then the purchase and delivery of most equipment for URJC Laboratory, the purchase of femtocells is still pending. PUCP has completed the elaboration of detailed list of equipment for demonstration platform and has worked in the respective quotations of the equipment and materials. Also, PUCP has coordinated itself with Telefonica in order to prepare the homologation and importation of femtos and femto-controller.

URJC:

- URJC delivered the detailed description of the compatibility between backhaul and access networks. According to the topology published in M52, the interactions between access and transport networks were suggested to be realized through IP routers including DSCP marking for physical interconnection.
- On the other hand, URJC is working together with PUCP on purchasing the necessary equipment for the site deployments.

IPA:

- Product interconnectivity specifications have been provided. IPA is working to enable equipment to go to the Madrid test lab for backhaul testing. Work in this area was delayed until the funding issue is resolved.

TdP:

- TdP has contributed to this task by providing the compatibility test for operation, manage and configuration to connect IP Access RNC to TdP´s voice and data core network and the integration guide to install and integrate IP Access Equipment in TdP´s Node in Lima for the validation of the model designed by TUCAN3G in a real scenario.

TIWS:

- TIWS has made its contribution with the draft of "Protocols for assessing the compatibility of interconnection between the transport network VSAT and femtocells".

- Activity 6A3: Pilot network deployment

The specific activities per partner were the following:

PUCP:

- PUCP has coordinated its activities with the beneficiaries of existing networks and has made a first version of a detailed installations plan (Gantt). Also, M61 has begun to be developed.

TdP:

- TdP is working with PUCP to develop the preliminary plan for installation and configuration of core network equipment.

Liaison with other WPs

Many activities of WP6 are linked to previous activities of other work packages and, for this first stage, have been fundamental the contributions of WP2 through the deliverable D21, of WP4 through D41 and of WP5 with D51. On the other hand, delays in funding of FITEL basically have originated delays in the implementation of activities in WP6 but also in some other work packages as testing femtocells in WP5 and others that require this information. Clearly, the final activities of the work packages WP3, WP7 and probably also WP4 and WP5 are related to intermediate or final result of deployment of the demonstration platforms and therefore they will have a delay in implementation.

Deviations from the workplan

The main deviation from the original work plan corresponds to a postponement of activities due to delays in FITEL funding. On the other hand, a slight modification to the original design is the implementation of a separate demonstration platform in the Napo network, which initially had been planned in another way. In any case, it does not imply any change in the results or final objectives of WP6 or the entire project.

WP7: Dissemination and knowledge utilisation

Use of resources

Participant	UPC	URJC	PUCP	UCAU	FIT	IPA	TdP	EHAS	TIWS	CREP	KIN	**Total**
PM	1,45	0,35	1,2	1,48		0,1	0,20	0,52		0,6	0,2	6,1
7A1	1,2	0,35	1,2	1,20		0,1	0,20	0,52		0,6	0,2	5,57
7A2	0,25			0,28								0,53
7A3												

Progress and results

A web site, including an RSS channel, has been established (Figure 1), as a platform to disseminate the progress and the outcomes of the project [http://llocs.upc.edu/www-icttucan3g/]. Several public materials (e.g. project flyer, posters, public deliverables, publications, etc.) are available on the webpage to promote the public interest. Furthermore, considering branding as a key point for dissemination activities, a logo and standard templates have been provided to the partners to produce their own material.

Figure 5 – TUCAN3G website main page

A specific half-day technical workshop is being organized, focused on European and Latin American stakeholders. The plan is to organize it within an international conference, in order to maximize the impact and facilitate participations. Three possible conferences have been pre-selected: ICTD (International Conference on Information and Communication Technologies and Development); Extremecom (Extreme Conference on Communication); and the IFIP WCC (World Computer Congress).

As the project has begun to achieve its early outcomes, some papers have been submitted and accepted in several specialized conferences: SPAWC 2014 (15tn IEEE International Workshop on Signal Processing Advances in Wireless Communications), in Toronto (Canada); and EUCNC 2014 (European Conference on Networks and Communications), in Bologna (Italy). Also, two presentations were made at important events addressed to researches and decision takers: ICT 2013 in Vilnius (Lithuania) and the European Development Days 2013 in Brussels; one more presentation was made at a local event in Colombia.

In the standardization arena, the project has been monitoring the activities of 3GPP RAN Working Group 3, the ITU-D Study Group 2, the HiperMAN and BRAN Plenary meetings of ETSI-BRAN, and the IEEE Working Group for WLAN Standards. UPC was invited by the Spanish Ministerio de Industria, Energía y Turismo to join to the Spanish delegation at the ITU-D SG2, and an oral presentation of TUCAN3G activities description was made at the 4th meeting in September 2013. A strategy to contribute to ETSI-BRAN starting in June has been defined.

- Activity 7A1: Dissemination

The specific activities per partner were the following:

UPC:

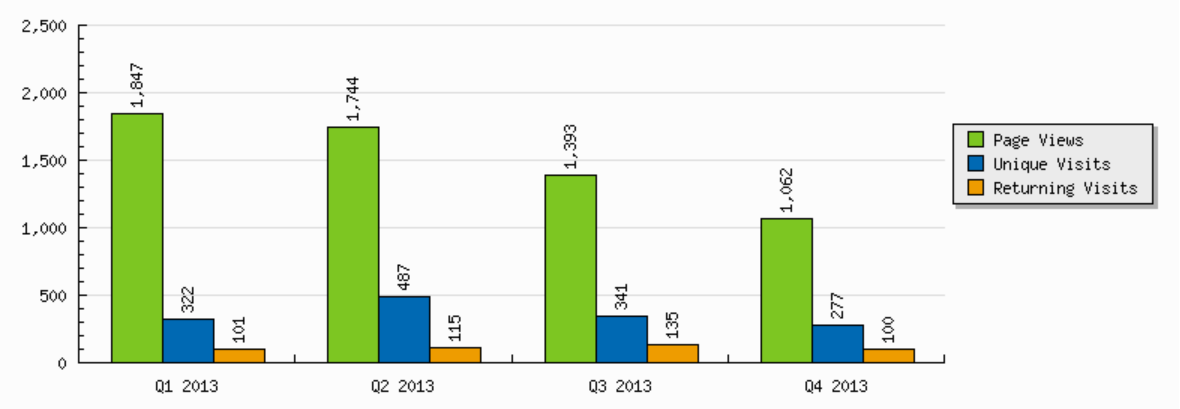
- UPC has generated press releases that have been transformed in 5 press articles.
- UPC has disseminated TUCAN3G activities at the ICT 2013 conference in Vilnius (6-8 November) within the networking session on ICT for Societal Challenges.
- UPC participated in the ITU Study Group-1 meetings in Geneva in September 2013.
- Preparation of two papers on the activities of 4A1 and 4A2.
- An RSS channel has been setup associated to the project website, and a Twitter account @tucan3g.
- Development of project website. An interactive web server has been setup, with public, private and reviewers sections (www.ict-tucan3g.eu). The statistics associated to the website are shown in Figure 6, where the page visitors are defined as:

  Returning Visitors - Based purely on a cookie, if this person is returning to your website for another visit an hour or more later

  First Time Visitors - Based purely on a cookie, if this person has no cookie then this is considered their first time at your website.

  Unique Visitor - Based purely on a cookie, this is the total of the returning visitors and first time visitors - all your visitors.

  Page Load - The number of times your page has been visited.



	Page Views	Unique Visits	First Time Visits	Returning Visits
Total	6,046	1,427	976	451
Average	1,512	357	244	113

Quarter	Page Views	Unique Visits	First Time Visits	Returning Visits
Q4 2013	1,062	277	177	100
Q3 2013	1,393	341	206	135
Q2 2013	1,744	487	372	115
Q1 2013	1,847	322	221	101

Figure 6 – Statistics of TUCAN3G website visits

Publications in conferences

- "Dynamic Base Station Switch On/Off Strategies for Sustainable Wireless Networks", accepted in SPAWC 2014, Toronto, June 2014.
- "3G Access Network Dimensioning in Isolated Rural Areas Based on Femtocells", accepted in EUCNC 2014, Bolonia, June 2014.

URJC:

- URJC participated to the conference "Technology, Innovation and Social Change" with the invitation of INSEAD, UPM and Fundación Banesto in 25-26th of April 2013. In the roundtable, TUCAN3G is presented as an opportunity to offer cellular communication in rural areas of developing countries.
- URJC presented in ITU Study Group-2 Q10-3/2 ("Telecommunications/ICT for rural and remote areas") and Q25/2 ("Access technologies for broadband telecommunications including IMT for developing countries") meetings in Geneva in Sept 2013.
- In addition, URJC actively contributed the project dissemination strategy discussions.
- During the first year, no publications were generated by URJC. However, it is expected that during the second year several publications per each activity will be generated. One M. Sc. Two theses related to 4A2 and 4A3 are currently under direction.

Publications in journals

- "A dual IEEE 802.11 and IEEE 802.15-4 network architecture for energy-efficient communications with low-demanding applications", submitted to EURASIP Wireless Communications and Networking.

Publications in conferences

- "Assessing IEEE 802.11 and IEEE 802.16 as backhaul technologies for rural 3G femtocells in rural areas of developing countries", EUCNC 2014.

PUCP:

- PUCP has contributed with the milestone M712, it has looked for dissemination opportunities in Perú and has updated project information in its web site.
-

UCAU:

- Collaborative elaboration of the work plan for WP7, with detailed description of tasks for each activity: inputs, outputs, schedule, PM, and responsible.
- Coordination of and contribution to M712 "Dissemination and standardisation plan".
- Contribution to D71 "First interim dissemination/standardisation report and plan".

IPA:

- IPA developed its dissemination strategy based on creating a case study and white paper, linked to conference presentations and press releases once the deployment has taken place. A webinar may be an additional hosted item once key learnings from the deployment are available. IPA discussed the existence of the TUCAN3G project with the Chair of the Small Cell Forum Rural Special Interest Group which has so far focused on deployments that are rural by European standards. There is now interest in expanding the scope of the group to consider more remote deployments such as conceived by TUCAN3G, and remote deployment considered for the Small Cell Forum Release 5 work. We hope to be able to present the work to this group once the demonstration TUCAN3G network is deployed

TdP:

- TdP has coordinated with internal departments in order to initiate the publications related to TUCAN3G project. External publications will start after the pilot implementation.

EHAS:

- EHAS has reviewed possible events and selected a set of 3 events where it could be interesting to co-locate the half-day technical workshop.
- EHAS has continued to organize the technical workshop. In the 3rd Plenary Meeting it was agreed that this event will be held on the first semester of 2015, so EHAS has identify and contacted responsible organizers of some appropriate congress in this period to co-locate the workshop.
- EHAS has contributed to the dissemination of TUCAN3G organizing a lab with UPC for the forum European Development Days about science and innovation for development (Brussels, 27 Nov: http://eudevdays.eu/topics/science-and-innovation-development, http://eudevdays.eu/topics/ict-4-social-change).

CREPIC:

- CREPIC designed a strategy for the social appropriation of knowledge that includes the following activities: web information development and dissemination of the project with different target

audiences. On the following website (http://www.crepic.org.co/tucan/index.php) CREPIC has been working on comics that show the development of the project; a banner was designed with the information of the project and all of the activities in which CREPIC has participated were published. The project was socialized on academic settings as the First Research Congress held in Popayan. The project has also been socialized with rural communities in the Department of Cauca that keep similar characteristics to the community in which the technology will be implemented

KINNO:

- KiNNO participated to the conference "Globalization of Technology Transfer" with the invitation of TII in 5-10th of May 2013 in Beijing, China. In the presentation, "Technology transfer between different levels of the pyramid, insights from EU- Latin America collaboration**",** TUCAN3G is presented as an example of technology transfer between different continents and developed to developing countries.

- Activity 7A2: Standardisation

The specific activities per partner were the following:

UPC:

- Definition, together with IESI, TdP and IPA, of a roadmap for contribution to ETSI-BRAN starting in June 2014; and ITU-D. Contacts done to participate in ITU-D meetings in Sep 2013 and Sep 2014 under the auspices of Spanish Ministerio de Industria. Launch subcontracting of standardization activities.

UCAU:

- Keeping track of the activities of the IEEE 802.11 Working Group.

- Activity 7A3: Use of knowledge

The specific activities per partner were the following:

KINNO:

- KINNO has designed an execution strategy for 7A.3, Use of Knowledge, which includes Identification of research areas of Sub -products produced by the TUCAN3G Project.

Liaison with other WPs

The dissemination and standardisation activities are fed in principle by the results of WP3 (Business case), WP4 (Access network), WP5 (Transport network) and WP6 (Demonstration). Presentation in events and at the ITU-D SG2, as well as publications in the media, have been made with information from the overall project.

Deviations from the workplan

No deviations so far

2.3 Project management during the period

Consortium management tasks and achievements

UPC has performed the following tasks associated to the quality project management:

- The consortium agreement (CA) was prepared by UPC and circulated among the partners. It took a few iterations to reach an agreement, and the final document was accepted and signed by all partners in February 2013.
- The execution of the project has been tracked in conformity with the objectives described in the GA and following the quality rules agreed in the CA.
- UPC has established a link between the consortium and the EC, representation of the project towards external bodies.
- UPC has setup a helpdesk to assist participants in the management aspects of the project.
- Continuous financial management, which included timely distribution and follow-up of the project funding along the first period and for the preparation of the first project review.

- Effective review of the generated documents, delivery to the EC and update of the project website.
- The project handbook (corresponding to document D11) has been prepared and distributed, with the goal of defining quality rules during the project execution. It has been subsequently updated with modifications of the contact information about the personnel participating in the project.
- UPC has prepared and made available document templates for presentations, deliverables, milestones, meeting minutes and QMR.
- UPC has promoted collaboration among partners in the most effective and user-friendly way.
- Project achievements have been contrasted with the objectives described in the GA.
- Four Quarterly Management Reports have been elaborated during this period, with contributions from all partners, and submitted to the EC.
- The project coordinator attended the 10th and 11thconcertation meetings. During these meetings, the RAS cluster workshops were attended. UPC, URJC and PUCP participated in the preparation of the white papers on 5G.
- The project coordinator attended the ICT Summit in Vilnius in Nov 2013.

URJC has performed the following tasks associated to the technical project management

- URJC has successfully set web-based technical management software to be able to track activities on-line as suggested in D22. This type of activity tracking tool was essential in this project as partners cannot easily meet in other than plenary meetings due to their different time zones.
- Even though initiation of the activity tracking was problematic due to technical issues such as determining the correct tool with respect to requirements of the project, the large number of users, etc., currently a reminder is sent to all partners with actual status of each activity. This reminder is sent per work package once a month by emails while users are given approximately 1 week to update their activities and asked to report if they have any risky point to be able to discuss in the risk council.
- It also includes the overall status of the work package to be able to create complete visibility within the partners.
- In addition, URJC has accomplished its objectives on milestones and deliverables revisions favourably and helped to get a rigorous quality on the document preparation within partners from different disciplines.
- On the other hand, its contribution on the risk council has helped to identify the possible risky points and get precautionary actions whenever it is possible.
- Under UPC's general management, URJC has contributed to the decision making from the technical management point of view with participation of all partners.
- Finally, URJC has provided its full contribution to the plenary project meetings, while it has also created discussion areas around the previously identified questionable points in PCC meetings.

Problems occurred and envisaged solutions

Delays have occurred in this period due mainly to four reasons:

- Underestimation of efforts for some of the activities, which has been solved by increasing efforts of the partners involved to catch up.
- The difficulties of FITEL to allocate personnel. This has been solved by reallocating efforts from FITEL to other partners, namely EHAS and KINNO.
- The legal issues associated to the transfer of the external funds from FITEL (295.000 USD) has forced the organisation of a public tender to which PUCP is contending. The result of this tender will be public in July 2014 and has delayed the purchase of equipment in WP6. So far, the problem has been solved by partially advancing funds from PUCP. The exact extend of the issue will be evaluated in July 2014.
- Interaction between English speaking and Spanish speaking partners. EHAS has taken the lead in translating and communicating between the two communities, especially for tasks in WP3.

The project objectives have not been reduced whatsoever.

Changes in the consortium

- No changes were needed.

List of project meetings

- Three regular Project Coordination Committee meetings organised during this period:

Kick-off meeting in Lima, hosted by PUCP, February 2013
2nd PCC meeting in Madrid, hosted by EHAS, June 2013
3rd PCC meeting in Madrid, hosted by EHAS, November 2013

– The following meetings have been organised:

WP2
- Phone conf on WP2 coordination meeting, Mar 2013
- Phone conf on WP2 coordination meeting, Apr 2013
- Phone conf on review activities 2A3.1 y 2A3.11, Apr 2013
- Meeting in Popayan, review of progress of the activities 2A3.1 y 2A3.2, Apr 2013

WP3
- Phone conf on WP3 coordination meeting, Jan 2013

WP4
- Meeting in Popayan, discussion of the work to be done in activity 4A1 and definition of a Table of Contents for deliverable D4.1, Apr 2013
- Phone conf on topics related with network planning. The objective was to identify which information TdP should provide to characterize the traffic in different kinds of locations, July 2013
- Phone conf on internal discussion to define a set of concrete tasks to be developed within activity 4A2, July 2013
- Phone conf on internal discussion on topics related with network planning, Sept 2013
- Phone conf on internal discussion to define a set of concrete tasks to be developed within activities 4A2 and 4A3, Oct 2013
- Phone conf on the definition of scenarios within the framework of 4A2 for the development and evaluation of techniques to save energy.
- Phone call on discussion about the work to be carried out by TdP in activity 4A3 and evaluation of a proposal from TdP, Jan 2014
- Phone call on the review of the status and the work to be done on activities 4A2, 4A3, and 4A4, Jan 2014

WP5
- Meeting in Distrito Telefonica (Madrid), checking the contribution of TIWS, Jan 2013
- Meeting in Distrito Telefonica (Madrid), general review of the deliverable D51, Sept 2013
- Content definition for M52, Nov 2013
- Meeting at URJC on the Site Survey for the installation of two VSAT stations (lab testing), Dec 2013
- Meeting at URJC on a general review and follow-up, Jan 2014.
- Phone call on the technical definitions for D52, Jan 2014

WP6
- Meeting in FITEL premises: WP6 coordination meeting, Apr 2013
- Phone conf on the CREP proposal for dissemination/sensitization activities related to 6A1.2 and 7A1, Sept 2013
- Phone conf on 6A2.1 internal discuss about agreement with FITEL, Nov 2013
- Meeting at FITEL premises, internal discuss about agreement. FITEL changes process for funding and a first version of schedule was elaborated, Nov 2013.
- Meeting at Telefonica del Peru premises, discussion about networks interconnections, Dec 2013
- Meeting at Telefonica del Peru premises, 6A2.1 and 6A2.6 internal discuss about procedure for equipment importation and installation plan, Jan 2014

WP7
- Meeting in Popayan: review of the proposed CREP for dissemination component, Apr 2013
- Phone conference on the potential contributions to ETSI BRAN, Jan 2014

Project planning and status

- The delays in the milestones and deliverables are not affecting WP6 development. The initial planning was loose enough to accommodate the delays streaming from the organisation of the tender by FITEL. In general the project is performing within the contractual framework and there are no major deviations so far.

Changes to the legal status of any of the beneficiaries

- No changes.

Project website and internal communication

- The project website was setup in August 2012. Since then it has been continuously updated (see WP7 activities above). An RSS channel has been included.
- Email reflectors have been setup to organise and facilitate the exchange of information between partners.

Use of foreground and dissemination activities within the Programme

- TUCAN3G has participated in the two concertation meetings organised by the Programme in Brussels.
- TUCAN3G submitted 3 papers at the EUCNC 2014, in Bolonia.

Cooperation with other projects

- TUCAN3G participated in the definition of the 5G white paper generated in RAS cluster.

3 Deliverables and milestones tables

Table 1. Deliverables										
Del. no.	**Deliverable name**	**Version**	**WP no.**	**Lead beneficiary**		**Dissemination level[3]**	**Delivery date from Annex I**	**Actual / Forecast delivery date**	**Submitted (Yes/No)**	**Comments**
D11	Project handbook	a	1	UPC	R	CO	1	26-Feb-2013	Yes	
D21	Socio-economic scenarios, technical specifications and architecture for the proof of concept	d	2	EHAS	R	PU	4	3-June-2013	Yes	
D22	Operational technical handbook	d	2	EHAS	R	PU	4	3-June-2013	Yes	
D23	Parameters and basic conditions for the market research and the business model	d	2	EHAS	R	PU	4	3-June-2013	Yes	
D41	UMTS/HSPA network dimensioning	ai	4	TdP	R	PU	6	11-Nov-2013	Yes	Delayed as a consequence of an underestimation of efforts at the time of writing the proposal. The problems faced were more challenging than expected.

[2] Please indicate the nature of the deliverable using one of the following codes: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

[3] Please indicate the dissemination level using one of the following codes:

PU = Public
PP = Restricted to other programme participants (including the Commission Services).
RE = Restricted to a group specified by the consortium (including the Commission Services).
CO = Confidential, only for members of the consortium (including the Commission Services).
EU restricted = Classified with the mention of the classification level restricted to "EC Restricted"
EU confidential = Classified with the mention of the classification level confidential to "EC Confidential"
EU secret = Classified with the mention of the classification level secret to "EC Secret"

Table 1. Deliverables										
Del. no.	**Deliverable name**	**Version**	**WP no.**	**Lead beneficiary**		**Dissemination level[3]**	**Delivery date from Annex I**	**Actual / Forecast delivery date**	**Submitted (Yes/No)**	**Comments**
D51	Technical requirements and evaluation of WiLD, WIMAX and VSAT for backhauling rural femtocells networks	a	5	URJC	R	PU	7	9-Oct-2013	Yes	Delayed due to Summer break.
D61	Situation report of the deployment area, sensitization results and state of transport networks	e	6	PUCP	R	PU	7	8-Mar-2014	Yes	Delayed activities in WP6 as a consequence of the lock of FITEL funds, not solved until Juny 2014.
D31	Market survey	f	3	FITEL	R	PU	8	25-April-2014	Yes	Delayed due to the difficulties in collecting surveys in those rural areas, and also to communication difficulties among partners due to different mother tongue.
D71	First interim dissemination/standardisation report and plan	b	7	UCAU	R	CO	12	1-Feb-2014	Yes	

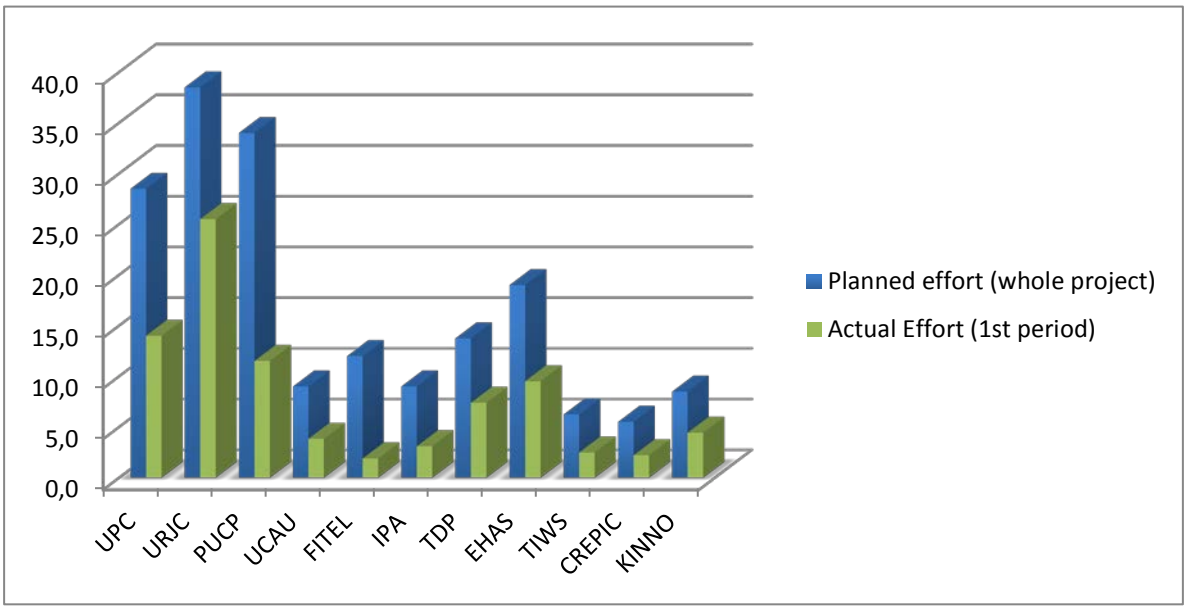
Table 2. Milestones							
Milestone no.	**Milestone name**	**WP no.**	**Lead beneficiary**	**Delivery date from Annex I**	**Achieved (Yes/No)**	**Actual / Forecast achievement date**	**Comments**
M711	TUCAN3G public WEB site	7	UPC	M1	Yes	M1	
M20	QMR1	1	UPC	M4	Yes	M4	
M712	Dissemination and standardisation plan	7	UCAU	M6	Yes	M7	
M21	QMR2	1	UPC	M7	Yes	M7	
M42	Procedures for UMTS/HSPA network optimization and control	4	UPC	M8	Yes	M10	
M22	QMR3	1	UPC	M10	Yes	M10	
M52	Transport network architecture and interface to the access network	5	URJC	M10	Yes	M12	
M32	Portfolio of products and services	3	TdP	M11	Yes	M17	Delayed due to the difficulties in collecting surveys in those rural areas, and also to communication difficulties among partners due to different mother tongue.
M43	Multiple flows control management	4	UPC	M11	Yes	M14	Delayed due to changes in the personnel of the partners involved.
M61	Upgraded transport networks	6	PUCP	M12	Yes	M14	Delayed activities in WP6 as a consequence of the uncertainty in the provision of FITEL funds.

4 Explanation of the use of the resources and financial statements

4.1 Summary of PM usage per beneficiary

Overview Person-Month Status

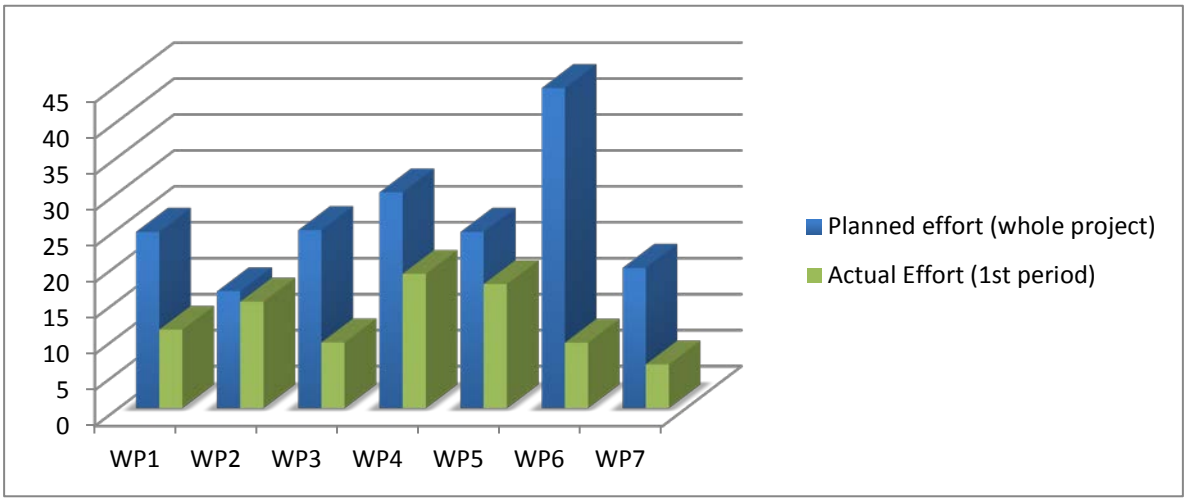
In the following bar diagram and table it is shown the amount of effort spent during the first period, from 1 to 12, per beneficiary compared to the planned effort for the whole project.



	Planned effort (whole project)	Actual Effort (1st period)	% over planned effort
UPC	28,5	14,0	49%
URJC	38,5	25,5	66%
PUCP	34,0	11,5	34%
UCAU	9,0	3,8	43%
FITEL	12,0	1,9	16%
IPA	9,0	3,1	34%
TDP	13,8	7,4	54%
EHAS	19,0	9,5	50%
TIWS	6,3	2,5	40%
CREPIC	5,5	2,2	40%
KINNO	8,5	4,5	52%
TOTAL	184	85,9	47%

4.2 Summary of PM usage per workpackage

In the following bar diagram and table it is shown the amount of effort spent during the first period, from 1 to 12, per work package compared to the planned effort for the whole project.



Project Efforts (PM) per WP	Planned effort (whole project)	Actual Effort (1st period)	% over planned effort
WP1	24,5	10,9	44%
WP2	16,25	14,8	91%
WP3	24,75	9,1	37%
WP4	30	18,7	62%
WP5	24,5	17,3	70%
WP6	44,5	9,1	20%
WP7	19,5	6,1	31%
TOTAL	184	85,9	47%

4.3 Summary of costs claimed per beneficary

Personnel, Subcontracting Indirect and Other major direct costs items for each Beneficiary for the Period

The expenditure breakdown and type of costs per each Beneficiary during months from 1 to 12 is shown in the tables below.

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: UPC
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
	Personnel costs	87.954 €	senior researcher 87.954€ contributed to the following WPs: WP1:.3,40 PMs WP2: 0,51 PMs WP4: 8,80 PMs WP7: 1,30 PMs
	Subcontracting		
	Durable Equipment		
	Travel and subsistence	12.708 €	Kick-off meeting Lima (Peru) 9-17/02/2013 attendees : M. Carol,J. Vidal, A. Agustín, A. Pascual 8.720€ Plenary meeting (Madrid) 18-20/06/2013 attendees: A. Pascual, A. Agustin, J. Vidal, J.A. Rubio 1.201€ Plenary meeting (Madrid) 20-22/11/2013 Attendees: J. Vidal, O. Muñoz, J.del Olmo, T. Pascual, A. Agustin, A. Pascual 2.019€ ICT event Vilnius 2013 6-8/11/2013 Attendees J. Vidal, 768€
	Consumables	127 €	poster printing for the ICT Event (Vilnius) booth
	Other project specific costs	900 €	zero emissions certificate needed to present TUCAN3G at European Development Days 2013 (Brussels)
	Indirect costs	72.016 €	Actual indirect costs
TOTAL COSTS AS CLAIMED ON FORM C		173.704 €	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: URJC
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
2,4, 5,6, 7	Personnel costs	77,172€	RTD: 2,13 PM (WP1,2) Associate Professor 8,223 € 1,8 PM (WP4) Associate Professor 7,583 € 1,67 PM (WP2,5) Associate Professor 7,492 € 1,75 PM (WP4,5) Associate Professor 7,426 € 1,2 PM (WP4,5) Associate Professor 4,967 € 0,2 PM (WP5) Associate Professor 401 € 7,55 PM (WP4,5) Researcher 24,096 € 4,5 PM (WP1,4,5) Researcher 5,347 € 3,75 PM (WP1) Researcher 8,333 € Demonstration: 0,15 PM (WP6) Associate Professor 596 € 0,45 PM (WP6) Researcher 1,437 € Dissemination: 0,25 PM (WP7) Associate Professor 843 € 0,05 PM (WP7) Associate Professor 224 € 0,05 PM (WP7) Associate Professor 204 €
	Subcontracting	0	
	Durable Equipment	0	
	Travel and subsistence	1.974 €	Lima, Perú, TUCAN3G Kick-off meeting, 9-17.02.2013 – 1,526 € (1 atendee: Francisco Javier Simo) Geneva, Switzerland, 4th Meeting ITU-D study Group 2, 17.09.2013 – 448 € (1 atendee: Andrés Martínez)
	Consumables	230 €	Adaptators required for the laboratory in URJC Fuenlabrada (Madrid) campus
	Other project specific costs	€	
	Indirect costs	47,624 €	Special transitional flat rate, % for indirect costs : 60
TOTAL COSTS AS CLAIMED ON FORM C		127,000 €	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: PUCP
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
WP1, WP2, WP5, WP6, WP7.	Personnel costs	14.732€	Researcher - A 3.492,60€ (1.55 PM) Contributed to the followings WPs: WP1, WP2, WP5: Coordination WP6, attendance plenary meeting; collaboration in collect information for D21 and collaborate in systematization of 5A1 activity results for non technical and technical readers. WP7: Search for dissemination opportunities contribution M712. Additionally A (PUCP) has invested 0.94 PM (1.944,19 euros) in Demonstration (WP6) to be reimbursed by the **FITEL** in the future, as defined in the agreement. The activity is shown below: WP6: Collaboration in activities for D61. Researcher – B 555,75€ (0.3 PM) Contributed to the followings WPs: WP1, WP2, WP5: Collaboration on systematization of 5A1 activity results for non technical and technical readers. Additionally B (PUCP) has invested 1.89 PM (3.454,74 euros) in Demonstration (WP6) to be reimbursed by the FITEL in the future, as defined in the agreement. The activity is shown below: WP6: Participation in information gathering, sensitization workshops and coordination with local actors in Napo. Researcher – C 5.984,58€ (3.01 PM) Contributed to the followings WPs: WP1, WP2, WP5: Collaboration in collect information for D21 and systematization of 5A1 activity results for non technical and technical readers. WP6: Participation in information gathering, sensitization workshops and coordination with local actors in Balsapuerto. Researcher – D 2.574,45€ (1.3 PM) Contributed to the followings WPs: WP1, WP2, WP5: Measurements in real PtP links and Collaboration on collect information for D21. Additionally D (PUCP) has invested 0.74 PM (1.495,53 euros) in Demonstration (WP6) to be reimbursed by the FITEL in the future, as defined in the agreement. The activity is shown below: WP6: Definition of modifications in target networks and global design. Researcher – E 397,54€ (0.2 PM) Contributed to the followings WPs: WP1, WP2, WP5: Collaboration on systematization of 5A1 activity results. Additionally E (PUCP) has invested 0.53 PM (989,36 euros) in Demonstration (WP6) to be reimbursed by the FITEL in the future,

			as defined in the agreement. The activity is shown below: WP6: Equipment quotation, buy equipment for URJC lab. Researcher – F 1.726,84€ (0.9 PM) Contributed to the following WP: WP7: Dissemination of the project at national level and search for dissemination opportunities.
	Subcontracting		Not applicable
	Durable Equipment	0€	Not applicable
WP1, WP6.	Travel and subsistence	9.783€	Spain, Madrid, 17-21.06.2013, Working meeting with project partners (2 attendees) – 4.036,47 Spain, Madrid, 19-24.11.2013, Meeting with project partners (2 attendees) – 4.298,34 Iquitos, Perú, 12.06.2013, Network Diagnostics (1 attendee) – 65.66 Tarapoto – Yurimaguas, Perú, 9-14.06.2013, Meeting with local stakeholders and evaluation of installed network (1 attendee) – 512.02 Mazán - Santa Clotilde, Iquitos, Perú, 26.07-01.08.2013, Field survey, project socialization in communities and signed consent for land use session (1 attendee) – 551.85 Yurimaguas – Balsapuerto, Perú, 3-8.12.2013, Field study for interconnection network operator (1 attendee) – 318.61
	Consumables	0€	
	Other project specific costs	0€	
	Indirect costs	14.708€	Special transitional flat rate, 60%
TOTAL COSTS AS CLAIMED ON FORM C		39.223€	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: UCAU
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
WP1	Personnel costs	1.953 €	Researcher. 0,40 PM.Technical coordination of WP7
WP2	Personnel costs	1.000 €	Researcher. 0,25 PM. Contribution to the description of the operational scenarios for rural areas of Colombia (D23)
WP5	Personnel costs	3.276 €	Researcher. 1,42 PM. Description of the IP layer functionalities for QoS provisioning and study of the requirements to design the WiMax-WiFi interface (D51). Evaluation of end-to-end QoS support in a WiMAX+IP plus WiFi-EDCA+IP link configuration (M52, D52)
WP3	Personnel costs	1.182 €	Researcher. 0,31 PM. Review and final translation and localization of research questions (D31)
WP7	Personnel costs	5.858 €	Researcher. 1,20 PM. Coordination with all partners the writing for "Dissemination and standardisation plan" M712. Contribution to "First interim dissemination/standardisation report and plan" D71.
WP7	Personnel costs	635 €	Researcher. 0,28 PM,. Keeping track the activities of the IEEE 802.11 Working Group
WP1	Travel and subsistence	2.085 €	Trip to Lima and Iquitos (Perú) to attend Kick off Meeting and WP7 partners meetings 10-02-2013/18-02-2013, Gustavo Ramírez.
WP1	Travel and subsistence	2.804 €	Trip to Madrid (Spain) to attend the 2nd project plenary meeting and WP7 partners meetings (16-06-2013/23-06-2013, Álvaro Rendón.
WP1	Travel and subsistence	1.620 €	Trip to Madrid (Spain) to attend the 3rd project plenary meeting and WP7 partners meetings (15-11-2013/25-11-2013, Gustavo Ramírez.
WP5	Consumables	1.622 €	Components for the test bed for evaluating end-to-end QoS support in a WiMAX+IP plus WiFi-EDCA+IP link
	Indirect costs	13.1167 €	Flat rate 60%
TOTAL COSTS AS CLAIMED ON FORM C		35.112 €	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: IPA
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
	Personnel costs	€26046	senior researchers€26478 – Dr Kit Kilgour, Dr Nick Johnson, Dr Kimon Nicolaides contributed to the following WPs: WP2:.0.89 PMs WP3:.0.5 PMs WP4: 1.28 PMs WP6: 0.36 PMs WP7: 0.1 PMs
	Subcontracting	0	If any, as specified in the DoW
	Durable Equipment	0	
	Travel and subsistence	€3947.50	Peru, Iquitos, Amazon & Lima, Project Kick off meeting, 9.2.-17.2.2013 (1 attendee) – GBP 1651.84 = Euro 2000 Spain, Madrid, 18.-20.6.2013, Project Plenary meeting (2 attendees) – GBP 1033. = Euro 1251.43 Spain, Madrid, 20..-22.11.2013. Proj□ct Plenary meeting (1 attendee) – GBP 574.84 = Euro 696.07
	Consumables	€	Explanation
	Other project specific costs	€	
	Indirect costs	€20722	Your cost method: Actual indirect costs
TOTAL COSTS AS CLAIMED ON FORM C		€50716	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: TDP
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
	Personnel costs	18511€	Omar Tupayachi Emerson Carbajal Antonio Ueunten contributed to the following WPs: Cost Per PM: 2505€ WP2:.1.25 PMs WP3: 1.88 PMs WP4: 2.61 PMs WP6: 1.43 PMs WP7: 0.22 PMs
	Subcontracting		
	Durable Equipment	0	
	Travel and subsistence	4600€	Spain, Universidad Politécnica de Mad□id, 19.06.-20.06.2013, Plenary Meeting (1 atendee : Antonio Ueunten Oyama) – 2.300 Spain, Universidad Politécnica de Madrid, 21.11.-22.11.2013, Plenary Meeting (1 atendee : – Emerson Carbajal Paucar) – 2.300
	Consumables	€	
	Other project specific costs	€	
	Indirect costs	4620€	Standard flat rate
TOTAL COSTS AS CLAIMED ON FORM C		27731€	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: EHAS
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
1 2 3 6 7	Personnel costs	23.971,00€	Researcher 1.259,00 € Researcher 15.108,00 € Researcher 3.777,00 € Researcher 2.518,00 € Researcher 1.309,40 € contributed to the following WPs: WP1: 0,50 PMs WP2: 6 PMs WP3: 1,50 PMs WP6: 1 PMs WP7: 0.52 PMs
-	Subcontracting		-
2,3, 6,7	Durable Equipment	271,18€	2 Laptops
1 7	Travel and subsistence	2.623,00€	Perú, Iquitos and Lima, 09.02.2013-25.02.2013 attending Kick-off Meeting of TUCAN3G and WP2 meetings (1 attendee) – 2.232€ Belgium, Brussels, 26.11.2013-27.11.2013, attending European Development Days Forum to present TUCAN3G in a workshop (1 attendee) – 391,00€
-	Consumables	€	-
-	Other project specific costs	€	-
	Indirect costs	16.118,00€	Transitional flat rate
TOTAL COSTS AS CLAIMED ON FORM C		42.983,00€	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: TIWS
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
	Personnel costs	31,189 €	Enrique Gil Frades (senior researcher) and Mari Carmen Gómez (senior researcher) contributed to the following WPs: **0**,25 PM WP2, 2 PM WP5, 0,25 WP6
	Subcontracting		
	Durable Equipment		
	Travel and subsistence	0 €	
	Consumables	€	
	Indirect costs	€	
TOTAL COSTS AS CLAIMED ON FORM C		31,189 €	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: CREPIC
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
	Personnel costs	3.725 €	personnel costs to contribute to the following WPs: **0**,51 PM WP2, 1,1 PM WP3, 0,6 WP7
	Subcontracting		
	Durable Equipment		
	Travel and subsistence	0 €	Perú, Lima, 11.-15.2.2013, Project meeting (2 atendees) Spain, Madrid, 19.-20.6.2013, Project meeting (2 atendees) Spain, Madrid, 21.-22.11.2013, Project meeting (1 attendee)
	Consumables	€	
	Indirect costs	6.771	
TOTAL COSTS AS CLAIMED ON FORM C		18.056 €	

TABLE 3.1 PERSONNEL, SUBCONTRACTING AND OTHER MAJOR COST ITEMS

BENEFICIARY: KINNO
PERIOD 01.02.2013-31.01.14

WP	Item description	Amount	Explanation
	Personnel costs	17,539.92 €	Senior Researcher 1: 6,768.00 € (WP3: 0.94MM) Senior Researcher 2: 3,600.00 € (WP2: 0.5MM) Researcher 1: 2,973.75 € (WP3: 0.61MM) Researcher 2: 604.77 € (WP7:0.2MM) Assistant: 3,592.40 € (WP2:0.5MM, WP3:1,7MM) In Total: WP 2-Requirements and specifications:1 MM WP 3-Business case study: 3.5 MM WP 7-Dissemination and knowledge utilization:0.2 MM
	Subcontracting		If any, as specified in the DoW
	Durable Equipment	0	
	Travel and subsistence	7,210.88 €	Lima, Peru – Project Meeting (10/2/13-18/2/13), 2 Persons, € 5,022.74 Madrid, Spain – Project Meeting (18-21/6/2013), 1 Person, € 1,073.34 Madrid, Spain – Project Meeting (20-23/11/2013), 2 Persons, € 1,114.80
	Consumables	€	None
	Other project specific costs	€	None
	Indirect costs	14,849.88 €	60% Flat Rate
TOTAL COSTS AS CLAIMED ON FORM C		39,599.68 €	

Budgeted vs. actual costs per partner

		Funding for the project	Cost claimed	%
1	UPC	213.120 €	146.598 €	68,8%
2	URJC	207.580 €	95.124 €	45,8%
3	PUCP	124.914 €	28.798 €	23,1%
4	UCAU	62.520 €	20.345 €	32,5%
5	FITEL	33.480 €	0 €	0,0%
6	IPA	90.250 €	38.953 €	43,2%
7	TDP	42.518 €	17.021 €	40,0%
8	EHAS	102.880 €	33.421 €	32,5%
9	TIWS	28.497 €	18.603 €	65,3%
10	CREPIC	44.820 €	14.572 €	32,5%
11	KINNO	65.420 €	35.823 €	54,8%
	TOTAL	**1.016.000 €**	**449.258 €**	**44,2%**

Effort and Costs Deviations

Below are reported the explanations of those Partners which considered their deviations actual vs. planned effort and costs particularly significant or that wished to comment which could be considered a deviation if the effort and cost distribution were linear along the project life span:

1	UPC	UPC is requesting the 69% of its funding for the whole project in the first period and the 50% of its person months. In terms of effort, the expenditure is on-line according with the distribution of workload planned for UPC in the project. The deviation in the resources expenditures is due to two main facts: the actual personnel costs rate per person-month are higher than the budgeted in the proposal, however UPC assumes this differences and express its compromise to continue with the foreseen activities until the end of the project. The second factor can be explained by the increase of the actual overhead rate compared with the one used at the proposal stage, varying from 74,6% to 81,88%.
4	UCAU	UCAU spent the 42% of its Person-month, which is in line with the foreseen activities, however the requested contribution is less, amounting to the 32,5% as they assume the difference between the budgeted personnel cost and the actual.
6	IPA	IPA planned original 5.11 PM but has consumed only 3.11 PM in this period. Three main factors have influenced this difference: – the progress of WP3 was impacted by changes within the partner originally leading the WP, management impacts, and subsequent delays as they have been replaced in the role, so although the WP now has a new WP leader and plan issued we are in the process of catching up – there have been some delays in WP4 within IPA here as a result of some staff changes and departures. We have subsequently brought some systems researchers onto the project but are in the process of catching up – delay in PUCP being given the funds to order equipment – most of IPA's WP6 work is on maintenance and deployment of the IPA system in Peru, and this has been set back by the inability of the purchase order to be issued to us, which in turn impacts our ability to progress. A secondary factor is some slow response turnaround, possibly due to the length of the communications chain through purchaser – installer – installer's core network suppliers, with the additional language issue.
9	TIWS	TIWS is claiming the 65% of their funding and just the 40% of the effort. This deviation can be

		explained due to the fact that TWIS didn't include all eligible items to calculate its Person-month ratio. However TIWS expressed its commitment to carry out the foreseen activities along the project.
11	KINNO	Additional effort than the one originally planned (4.45 PM as compared to the original 1.7 PM) has been performed by KINNO in order to better plan, coordinate, finalize activity 3A1 and deliver D31. The complexity of designing and executing a market research in rural areas demanded additional man effort in order to successfully implement the task, as communication matters came up. Moreover, the transformation of data collected into a harmonized set and the analysis of them requested extra allocation of resources internally.