Bottom-up Broadband Pilots in Europe (C4EU 5.1.2: Report on Selection of Opportunities and Projects - b)

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Abstract

This report describes the first pilots that have been selected for execution in the BuB4EU branch of the Commons for Europe project. The selection criteria that have been used are introduced and then a brief description of the pilots is provided. The pilots are: "Open Sensor Network", "Free Europe WiFi", "Northern Quarter Network", "FFTx" and "Mobile Node".

Index Terms

Bottom-up-Broadband (BuB), wifi, fiber, sensor networks, BuB pilots

The authors are with Universitat Pompeu Fabra

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I. INTRODUCTION

This report presents the advancements in the pilots carried out in the BuB4EU branch of the C4EU European project. Section II explains that it is a collaborative document and how to contribute. The selection criteria that were used to choose the pilots are described in III. Sections IV, V, VI, VII and VIII introduce the pilots considered in the project. The concluding remarks are offered in Section IX.

The appendices contain the project charters prepared for each of the students for each of the pilots.

II. ABOUT THIS DOCUMENT

This report has been produced using open source tools such as LaTeX [**?**] and *git* [**?**]. LaTeX is widely used in academia to prepare print-class documents. It automatically takes care of numbering, cross-referencing, tables of contents, bibliography, etc. *Git* is a high performance distributed revision control which is used in many open source projects, such as the linux kernel. Git makes it easy and safe to collaborate as each contributor works on his or her own personal copy. Good contributions can be easily shared with others, and it is always possible to revert to a previous version.

Our git repository is publicly available in *github*:

https://github.com/jbarcelo/C4EU-deliverables

Anyone who is familiar with LaTeX and *github* can contribute to this document. The firs step is to make a copy (a *fork* in *github* jargon). The contributor can work in this copy and make changes to improve the document. After that, it is necessary to request that these changes are merged into the original copy of the document (a *pull request* in github jargon).

If you see anything that can be improved, feel free to contribute. This document is alive in the sense that it will keep evolving as long as contributors make changes and improve it.

The system automatically keeps track of all the contributors and their contributions. It is possible to see who is contributing more actively and which are the exact changes made by each contributor. And everything is public on the web.

III. SELECTION CRITERIA AND PILOT SELECTION

Out of the twelve pilot proposals that were collected in the first call for pilots [**?**], we selected a few of them to be considered within the C4EU project. The pilots we are focusing on are the Open Sensor Network pilot (OSN), the Free Europe WiFi pilot (FEW), the Fiber From The X pilot (FFTx), the Northern Quarter Network pilot (NQN) and the Mobile Node pilot (MON).

A first selection criteria was the existence of a community that backed the pilot. For the Open Sensor Network pilot, it exists a closely related initiative called Smart Citizen (www.smartcitizen.me) that has rised around 18,000 Euro in crowdfunding, and therefore we believe there is interest from the part of the citizenship for these kind of technologies.

The ProvinciaWiFi solution in Italy has a huge user base that gives credit to the model. For this reason we believe that the extension of the model to other cities and countries may enjoy the same success.

The FFTx pilot provides bottom-up-broadband to only a dozen of families right now. However, as this bandwidth is distributed using the wireless community network, it benefits a considerably larger number of users. The fiber connections are so fast (1 Gbps) that the owners are happy to share it with others.

Another criteria for selection has been the diversity of technologies. Tab. I taken from [**?**] summarizes the advantages and shortcoming of the different technologies. At this stage of the project, SuperWifi is not yet mature enough to serve the goals of the BuB initiatives, as it is still in a research stage.

Regarding the distribution of the pilots with respect to technologies, there is one pilot for sensor nodes (OSN), two involving WiFi (NQN, FEW), two involving fibre (FFTx, NQN), and one involving a mobile mesh node (MON). There are already some of the pilots that mix different technologies and the vision is that in the future, as they evolve, the different pilots and technologies can be seamless combined as in Fig. 1.

We have also chosen pilots that can cover multiple cities in Europe. With the exception of the pilots involving fiber (NQN, FFTx) which by its very nature are localized, the others can be tested and demonstrated in any of the participating cities.

TABLE I

TECHNOLOGIES UNDER CONSIDERATION [**?**]

Technology	Characteristics
Fibre Optics	Mature technology, wired, very high throughput, relatively expensive, does not create nor suffer interference, reliable.
WiFi	Mature technology, wireless, high throughput, more economic than fibre, limited by interference and spectrum saturation.
Sensors	New technology, wireless, low throughput (for battery-powered devices), open data.
Super-WiFi	Future technology, wireless, medium throughput, longer propagation distance and better penetration compared to WiFi, co-existence with incumbent networks.

IV. THE OPEN SENSOR NETWORK PILOT

This pilot is focused on deploying a sensor network which would gather real time data from the environment, such as air quality, noise pollution, etc. This information would be then uploaded to an open data portal to make it publicly available. The ultimate objective of this project is to let developers use this data to build applications that can improve the daily lives of the citizens.

Since this project follows a *BuB* approach each user shall have its own node (or several), which, at the same time would add resources to this network. In case not all nodes aren't connected to the Internet there must be a protocol to interconnect these nodes.

As a power supply there shall be at least two options because each node should have some degree of independency. After all, there is not a predefined environment for these sensors to work on.
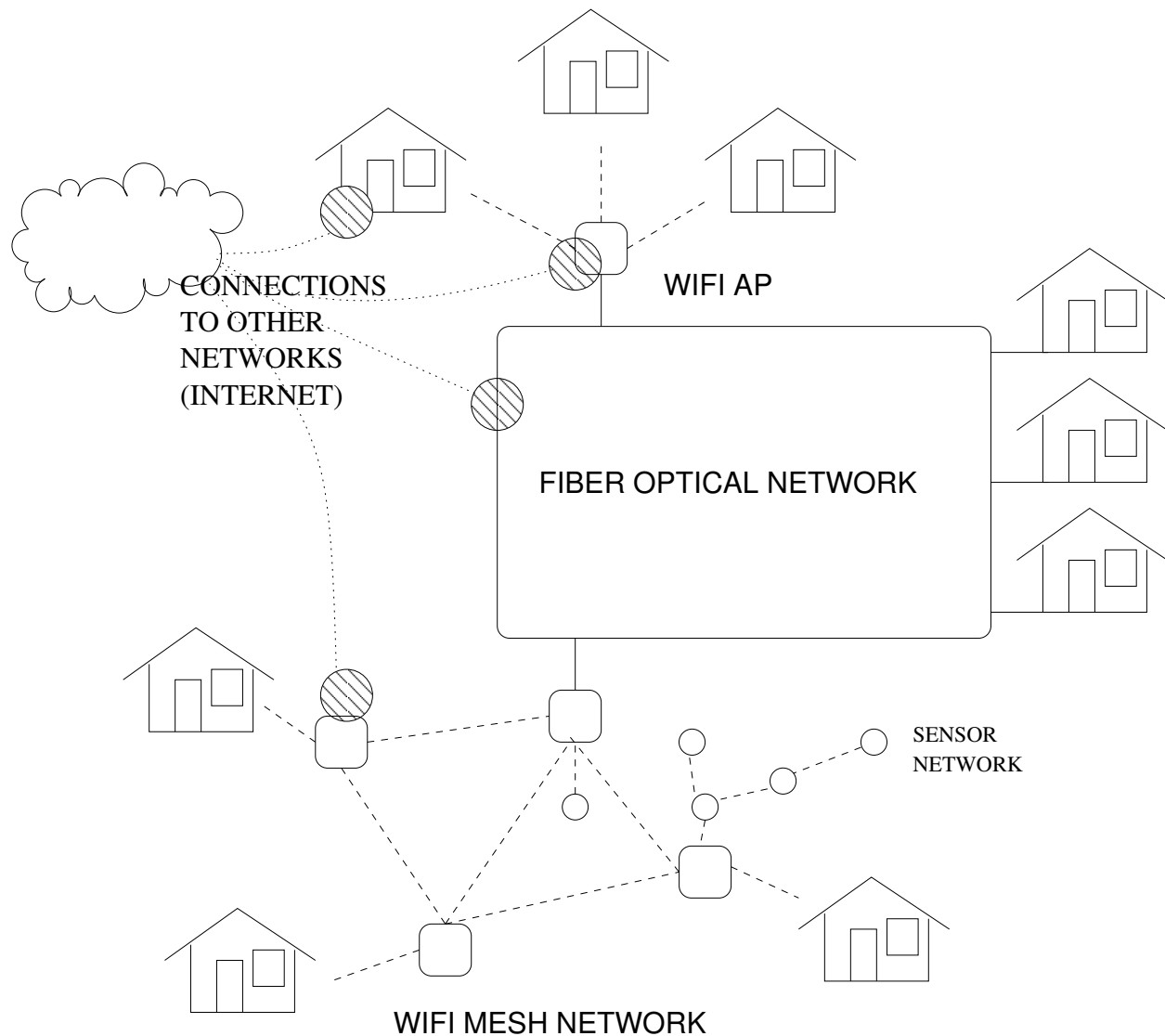
Fig. 1. A hybrid BuB deployment combining different technologies.

For this purpose common wireless protocols such as Wi-Fi, Bluetooth and ZigBee have been compared since this decision will have direct impact on the project future. Although Wi-Fi and Bluetooth have good data rates they are not designed to have a low power consumption which is a key aspect. Also, ZigBee has a low complexity and the best range —around 550m—, apart from admitting several topologies. Its data rate would be its only drawback, but sensors don't transmit data this often hence Zigbee has been chosen to become the working protocol.

Several sensor board options were available. The university already had Crossbow Telos B nodes which run the TinyOS operating system. This option has many advantages such as built-in multithreading and low-level option tuning. Also, it is open source. Another good choice is Arduino, an open source prototyping system which is commonly used nowadays and has a very large community. Since it is designed with simplicity in mind it lacks the complete set of features that TinyOS can provide, and consequently it is more lightweight, which sinergizes with the project purpose of deploying a battery-powered wireless sensor network.

V. THE FREE EUROPE WIFI PILOT

The Free Europe WiFi project is based in the original idea that our Italian colleagues are working on. It is called Provincia WiFi, and tries to offer free WiFi internet connection to any Italian citizen. By now it is only available in some regions of that country, so the idea is to extend it to whole Europe. So, our work is to start establishing a similar project in Spain, always having full interoperability with the original project. Thereby, we want to take the next step to extend it to Europe.

In summary, the final idea is: being a European citizen, it is possible to connect to any of the various access point of our network, in order to enjoy of a free internet connection, in every country that participates in the project.

Notice the complexity, not only technical of the project, but also on every European country telecommunication laws. Every region has its own laws in reference of telecommunication organizations, and in the way citizen use the service. From keeping data from the connected users, to meet the rules of the market it's just an example.

This pilot is being carried out by Nacho Justel.

Because of this wide range of different possibilities, it is difficult to create a totally generic prototype, so in order to design it there are many factors to consider.

Talking about the technical aspects of the system, it base its functionality on OpenWISP. OpenWISP (Open Wireless Internet Service Provider) is a software platform that can be used to provide a full, complete WiFi service. It is actually divided into five different modules that will be explained below:

1 **OpenWISP User Management System:**

It is a Ruby on Rails application, that interacts directly with the users. By using this module, the user can get access to the OpenWISP global system to get internet access, password recovery if needed and manage his account.

This module is directly related with third party modules as the FreeRadius server with a MySQL database to sign-up/sign-out and save user information. Once the user is registered in the service, and every time he tries to connect to the network, he will be asked to introduce his username and password to start surfing Internet. This application has been designed to be integrated with RADIUS authentication solutions.

At this moment, OpenWISP User Management System is being developed to be integrated into FreeRADIUS v2.1, so other implementations are not currently supported.

Some of its features are:

- User registration via mobile phone, ID card or credit card (Paypal IPN).
- User interface supporting most common browsers including mobile web browsers.
- Password recovery via mobile phone or email.
- Statistics of generated traffic per user.
- User administration via dedicated admin interface.
- Admin interface supports role based administration (operator, admin, superadmin).
- Via admin interface, new users can be added, modified, enabled/disabled or monitoring traffic per user/nationality and logins/registration.
- English and Italian language translations at the moment.

2 **OpenWISP Geographic Monitoring:**

It is a Ruby on Rails - HTML 5.0 based, web GUI that allows the management staff to get information about the geographic information of the deployed access points. It renders a geographic map of the status your networks: access point up/down/unknown (if an access point has an "unknown" status, then it would not be able to download the configuration to connect to the system from the OpenWISP Access Point Manager.

3 **OpenWISP Captive Portal Manager:**

It is a captive portal written from Scratch with Ruby on Rails. It allows the user surfing the Internet by enabling rules in the server firewall. This module is the operation center of all the system, so all the data that is generated or has as destination the system, will pass through this module.

Its main features are:

- Multiple captive portals (one per physical or virtual interface).
- RADIUS / Local authentication.
- Experimental traffic shaping per user.
- Multiple OS support.
- IPv6 support can be easily implemented.

4 **OpenWISP Access Point Manager:**

It is a Ruby on Rails based web GUI. This module allows the management staff to configure, monitorization and support of deployed access points.

It also stores value information about the network, as the amount of traffic each VPN generate, MAC addresses, geographical addresses and network setting, among other data. The access points download the configuration and settings from this module to establish a connection to the gateway.

5 **OpenWISP Firmware:**

It is a set of scripts (shell and web cgi) that sits on top of OpenWrt[1]. OWF is a no visible module of the system. It is the firmware that every access point has installed to be able to connect to the network. Every time a new access point is connected to the network, it will download the settings from the Access Point Manager, as before explained. If an access point is rebooted without network connectivity, will get no configuration until it could establishes a connection with the OpenWISP Manager, so then, the configuration will be sent to it.

OpenWISP firmware provides a daemon for retrieving the configuration of some

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[1]OpenWrt is a linux distro for embedded devices that provides a fully writable file structure system with package management. This allows to customize devices keeping freedom from vendor configuration.

components at the manager:

- WiFi (currently only for madwifi-ng and ath9k drivers).
- Networking.
- Data layer traffic shaping.
- OpenVPN (data layer, TAP).
- Unix cron jobs

Far from only providing a daemon, it also has a web GUI where:

- Configuring basic net structure
- Network parameters.
- Configuring basic OpenWISP server settings.
- Performing test and technical fails menu.

Also there exists another application based on Ruby/Sinatra that communicates or interacts with the other modules using RESTful services. It is called **OpenWISP Middleware**.

This module has different tasks to do depending on the other module that is talking with.

- By communicating with the OpenWISP Captive Portal Manager, it personalizes the captive page for a group of different access points.
- On the other hand, by interacting with the OpenWISP User Management System, OpenWISP Geographic Monitoring and OpenWISP Access Point Manager, it provides very useful information in a full duplex way.

By the moment, we are designing the technical aspects of the spanish implementation of the project, so as soon as we get the design, we will start programming the code to make a first deployment.

VI. THE NORTHERN QUARTER NETWORK PILOT

This project consists, roughly speaking, on the design, implementation and testing of an optical fiber network in the Northern Quarter (NQ) area of Manchester. This network will provide public free Wi-Fi in that area of the city. The project will be led by the Manchester Digital Development Agency (MDDA), and all the designs and implementations will follow a model they have already developed.

The NQ is home to a wide range of SMEs from many sectors and is a good place for starting businesses to begin their activity and have a trading presence on a centric place of an important city. Providing public WiFi to the NQ will allow businesses to increase their revenues by increasing the number of customers and will give them a way to promote a big range of activities and/or events taking place in the zone. In addition, it is likely that this facts help to support the economy of the NQ area and of the whole city. As mentioned, the NQ area is like a small village in the centre of Manchester where most of the small businesses know each other, and work together to strengthen the economy of the city. This is an important relationship that can be intensified by the implantation of that network, and so the economy will be boosted.

One of the most important aspects of the project, apart from designing and deploying the network, is defining a good pricing model for commercial use. It is a basic point, because it is crucial that the network becomes self-funding and sustainable after the conclusion of the C4EU project. It is, somehow, a critical aspect, and the success of the pilot will strongly depend on the success of the pricing definition.

VII. FFTx

The Rubi pilot consists of the design, implementation, testing and documentation of optical fiber in Rubi, but by some troubles, it has occurred delays in the implementation of fiber in Rubi, therefore without leaving aside this pilot we will realize a project called FFTx. This project will consist to implement the optical fiber under the Bottom-Up Broadband (BuB) model. The FFTx name is because the study includes the main fiber deployments -FFTH/FFTF/FFTP Fiber From The Home/Farm/Premises-.

To begin the project, we will do a study the BuB model, an investigation of existing fiber types and the advantages that they have over others transmission media. We will do too a comprehensive study on how the optical fiber in Gurb was implemented -Gurb is a municipality where has been successfully implemented the optical fiber under the BuB model-. Finally we will look for the possibility to carry out the implementation of optical fiber under this model in different municipalities (e.g. Rubi).

As you can see, the project has been divided in several tasks, each of them with an aim, but the part that consist of simulating the implementation of the optical fiber in

different municipalities it is very important because if we can find the commons to develop and deploy this technology under the BuB model it would be a great contribution to our community.

VIII. THE MOBILE NODE PILOT

Within this pilot the main idea is to create a free transmission workstation that can be used in the urban space and contributes to the digital mesh through other networks. The project will consist on creating a mobile wireless workstation that builds or fits in an existent telecommunications infrastructure. It will have to be an auto-configurable device and will have the capability to interconnect with a wide range of different hardware. Furthermore, it will be able to work in many different spaces and without the need of an ISP.

The pilot is about to finish its first phase between December 2012 and January 2013. Afterwards it will start the second phase together with BuB4EU. As this phase is not completely defined, it will be interesting to have the freedom to make proposals and do some tests that can provide the mobile node with any additional value that can be useful to make it more attractive for the final users. This second phase has no steps or subphases defined yet, but it has a main goal that is intended to be achieved:

"*Design a media-station with social implications, capable of: interconnect with wireless open networks, provide Internet access to zones with a complex accessibility due to its geography, enable multimedia processes (audio + video streaming, interactions with mobile devices) and act as an integrator of a range of open hardware systems like Arduino.*"

We can find some BuB principles behind this pilot that justify its inclusion within the BuB4EU branch. The very first one is the citizen involvement with bottom-up systems. Moreover, the pilot is somehow "'open-minded'" since both the concept and the protocols are open. Finally, we find that it is cities-oriented as it tries to fix some issues, in terms

of Internet access, that currently affect several cities and towns.

With regard to the technological solution, these are the main features:

- Mesh Network: qmp.cat system and possibility to fit into infrastructural systems like guifi.net.
- Arduino: this is used for battery, signal and location meters.
- LED display: this is used for the mobile node data display.
- Power: lead batteries, in a near future it will be improved using lithium batteries.
- Design: it is one of the points in which we will work more, we look for a physical design of the mobile station.

This pilot will take between 8 and 10 months beginning at January 2013, and will have the following initial set of shareholders:

- guifi.net
- exo.cat
- qmp.cat
- ESADE
- UPF
- mobilitylab.net
- commons for europe
- Locality UK
- Creativecoop UK

IX. CONCLUSION

The first BuB4EU pilots to be executed in the framework of the C4EU European project have already been selected. Each of the students assigned to the pilots have provided a description as well as project charter document. The students will carefully document their pilots and make this documentation publicly available as a common resource to be shared by the community.

ACKNOWLEDGMENT

APPENDIX A

APPENDIX 1: FREE EUROPE WIFI PROJECT CHARTER

Free Europe WiFi - Project Charter

Ignacio Alberto Justel

November 27, 2012

1 Opportunity/Idea

This opportunity arose from the actual tendency that cities along the whole world are working on. They are trying to provide free WiFi internet connection to all citizens. The real opportunity is the need to create a community network to communicate freely anywhere in the EU. Born as a tie, to strengthen the communication of citizens of different countries within a common block, as is Europe. There is already an open system for getting free wireless internet distribution deployed in Italy, and the goal is to implement this system in Spain always keeping full interoperability. Also lay the foundation regarding documentation, to give rise to other countries to also do it.

2 Description/Purpose

A complete description of all the cases that are running at the moment in different European cities will be made in order to understand the main need that feeds this project. Achieve the implementation of OpenWISP system in Spain and their overall diffusion alternatively, to the extent possible. To achieve the correct and complete documentation on both cases, the first is currently in operation, Italian case, and about the case to be implemented, the Spanish one. Always keeping in mind writing technical information for future implementations.

3 Goal

Implement and maintenance of a free wireless internet connection for any european citizen. Create a prototype/demonstration module to offer new cities to support the project. Document all the technical aspects of the system and its implementation.

4 Objectives/Results

- Be able to understand, modify according to our case and deploy OpenWISP system.

- Create, complete and correct technical documentation about the project for future implementations.

5 Scope

The scope of the project is to be able to merge the public WiFi internet connection solutions offered by any European city.

6 Stakeholders and Sponsors of the Project

- Project Team
- Universitat Pompeu Fabra
- CASPUR
- Provincia di Roma
- Guifi.net
- DOTOpen
- Linx
- ESADE
- Fraunhofer FOKUS
- Forum Virium
- City of Amsterdam
- Waag Society
- NESTA
- Ajuntament de Barcelona

7 Risk

- Issues in disseminating this connectivity solution. Exists other solutions owned by public administration.
- Possible future problem with the FreeItalia WiFi project, in which this project is based, because of politic elections and no future continuity.

8 Schedule

Tareas

WBS	Nombre	Inicio	Fin	Trabajo	Prioridad	Terminado
1	Warm-up session	Jul 18	Jul 18	1d		0%
2	Kick-off meeting	Jul 19	Jul 19	1d		0%
3	**Initial design phase**	Jul 20	Sep 25	81d		
3.1	Legistlation approach	Jul 20	Aug 2	10d		0%
3.2	Spanish legislation initial solution	Jul 20	Jul 31	8d		0%
3.3	Network design	Aug 3	Sep 6	25d		0%
3.4	Studing OpenWisp	Aug 3	Sep 11	28d		0%
3.5	Documentation	Sep 12	Sep 25	10d		0%
4	**Early implementation**	Sep 26	Jan 21	121d		
4.1	Firmware make-up	Sep 26	Dec 4	50d		0%
4.2	Server setup	Sep 26	Nov 6	30d		0%
4.3	Router configuration	Dec 5	Dec 13	7d		0%
4.4	Lab deployment	Dec 14	Dec 27	10d		0%
4.5	Testing	Dec 28	Jan 10	10d		0%
4.6	Project Re-analysis	Jan 11	Jan 21	7d		0%
4.7	Documentation	Jan 11	Jan 21	7d		0%
5	**Final implementation**	Jan 22	Mar 18	80d		
5.1	Network deployment	Jan 22	Mar 4	30d		0%
5.2	Troubleshooting	Jan 22	Mar 4	30d		0%
5.3	Project final analysis	Mar 5	Mar 18	10d		0%
5.4	Documentation	Mar 5	Mar 18	10d		0%
6	Full documentation	Mar 19	May 13	40d		0%
7	**Project defense**	May 14	May 14	1d		
7.1	Final presentation	May 14	May 14	1d		0%

APPENDIX B

APPENDIX 2: FFTX PROJECT CHARTER

Project Charter — FFTx

Jorge A. Beltran Calderon

November 27, 2012

1 Opportunity/Idea

The optical fiber is a technology that day to day is being extended and implemented in different cities thanks to its high transmission speed and reliability. Companies need of such technology to increase the productivity and the homes used it to be better on the internet, watch high definition movies, videoconference and work.

There are populations excluded -e.g. village with low population- where telecommunication operators (ISP) do not deploy their networks to offer services because their business model does not allow them to make benefits and less if they deploy technology such as optical fiber. Therefore, a new idea of a new business model came up: Bottom-up Broadband (BuB), where the infrastructure is implemented by people who will use the service and it does not depend on the limitations of the operators. Gurb (municipality of Osona) was the first to implement the optical fiber under BuB business model with a great success because several companies and homes have broadband.

The opportunity presented is to study how the optical fiber was implemented in Gurb under this new model and simulate a possible deployment in others municipalities, so we will extend the use of fiber optic and we will provide high speeds to companies and homes.

2 Description/Intention

- Know all the features of the Bottom-up Broadband model

- Perform a detailed study of how the optical fiber was implemented in Gurb

- Try to simulate the deploy of optical fiber in towns/cities under BuB model

- The project will be called FFTx (Fiber From The Farm/Home/etc.) against the previous FTTx model (Fiber To The Farm/Home/etc.)

3 Goal

- Implement the optical fiber in villages/cities under BuB model (e.g. Rubi)

1

4 Objectives

- Understand all the features of the Bottom-up Broadband model

- Perform a detailed study of the Gurb to learn how the fiber optical was deployed under BuB model

- Simulate Gurb successful case in other municipalities

5 Stakeholders and Sponsors

- Guifi.net foundation

- *Commons for Europe*

- Universitat Pompeu Fabra

- Team of the BuB Project

6 Schedule

https://dl.dropbox.com/u/13949761/FTTx_gantt.html

6.1 Risks

The new model requires that people who will use the service pay the cost of the infrastructure and deploy, therefore it requires the participation of a large number of users and it is difficult for everyone to agree if previously they have not been well informed.

APPENDIX C

APPENDIX 3: OSN PROJECT CHARTER

Project Charter — OSN

Alejandro Andreu Isábal

November 28, 2012

1   Introduction

The opportunity of making this project possible is born through the initiative *Commons for Europe*, which at the same time was brought by one of our tutors.

More precisely this pilot –open sensor network– belongs to the *bottom-up broadband* branch, which pursues the utilization of several technologies in networks that follow this approach. That is, a network that gets bigger and better thanks to the active participation of its users.

The technologies used in *OSN* are –as its name implies– sensors and and the kind of networks that can be created with them.

2   Description

The project consists on the deployment of a sensor network which shall gather real-time environmental data. This information would be then uploaded to an *open data* portal so developers can create new applications that help improve the citizens daily lives.

3   Goal

Deploying such a *bottom-up* network with not too many nodes to prove that indeed it meets the requirements and test the utility of this type of networks.

4   Objectives

- Recollecting data from several types of sensors before december 2012.

- Point-to-point communication between two nodes before the end of the present year.

- Being able to upload information to an *open data* portal before the end of 2012.

- Communicating mesh network before the first trimester of 2013 reaches its end.

5 Scope

The correct choices have to be made in order to prove the efficiency of this kind of network inside a sensor network. That is, protocols, hierarchy, etc.

6 Shareholders

- Governmental regulation.
- *Commons for Europe.*
- Universitat Pompeu Fabra.
- Material and technology suppliers.
- Public organizations.
- Users.

7 Costs

The cost of this project by C4EU/UPF raise to 6,000€ approximately. These costs can be split into the scolarship that those pilots give to the students, amortization of the equipment, two european trips, the time that the director spends as well as fungible assets.

7.1 Investment return

This return isn't monetary since the pilot objective does not consist on selling a product. That is, thanks to the accomplishment of the pilot there will be an impact in future deployments of this kind of networks.

APPENDIX D

APPENDIX 4: MN PILOT CHARTER

Project Charter - Mobile Node

Fernando Gros González

6 de diciembre de 2012

1. Opportunity/Idea

The opportunity of carrying out this project resides in the BuB branch of the Commons for Europe initiative. This project was initially impulsed by Guifi.net and exo.cat among others and now has been introduced in this BuB4EU in order to receive this «last push». The main idea is to create a free transmission workstation that can be used in the urban space and contributes to the digital mesh through other networks.

2. Description/Purpose

The project will consist on creating a mobile wireless workstation that creates or fits in an existent telecommunications infrastructure. It will have to be an auto-configurable device and will have the capability to interconnect with a wide range of different hardware. Furthermore, it will be able to work in many different spaces and without the need of an ISP.

3. Goal

Improve the actual design of the mobile node, test it, create some documentation and find a way to make it easy-to-replicate.

4. Objectives/Results

- Improve or create a new design of the mobile node.

- Allow citizens to be able to access low-cost technology with a big social return.

- Create documentation of the whole process.

5.   Scope

Deploy and test this technology in Barcelona (Raval) and in London (Decision pending) and observe the results to replicate it in other cities.

6.   Stakeholders

- guifi.net
- exo.cat
- qmp.cat
- ESADE
- UPF
- mobilitylab.net
- commons for europe
- Locality UK
- Creativecoop UK

7.   Risks

- Prototype failures or firmware bugs that can delay the whole project.
- People unacceptance of the system or its social returns.

It is important to mention that this project is in an advanced stage and so, many of the risks that could have affected it are already mitigated.