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

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Abstract

This is the abstract

Index Terms

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

Affiliation

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I. Introduction

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II. 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 Mesh Node pilot (MMN).

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 (MMN). 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.

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.

[width=]hybrid

Fig. 1. A hybrid BuB deployment combining different technologies.

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.

III. 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.

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 projectfuture. 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.

IV. 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.

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.

$\boxed{5}$ **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 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.

[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.

- 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.

V. 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.

VI. FTTx

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 over 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 over BuB model. Finally we will look for the possibility to carry out the implementation of optical fiber over this model in different municipalities (eg Rubi).

VII. The Mobile Mesh Node Pilot

VIII. Conclusion

And this is the conclusion.

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