Emerginov: How Free Software Can Boost Local Innovation, a Win-Win Deal between Operator and Local Innovation Partners

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Abstract. This paper deals with the description of a new co-innovation method linking an operator and academic resources. This method based on the promotion of free software has been validated during Orange Expo 2010 Mauritius organized by Mauritius Telecom. The goal is to boost local innovation and ease the development of "Telcoweb" micro-services.

Keywords: Co-innovation, free software, micro-service, SMS, Voice.

1 Introduction

Lots of telecommunication services do not meet expectations on emerging markets. Most of them, usually designed for countries where network constraints are low, consists in flavoring standard American or European services. Such services are thus complex, do not correspond neither to the need of local people nor to the local usage.

However micro-services, bridging Telecommunication world (GSM is widely available in emerging countries) and web worlds (expertise and collective intelligence in the network), could have a real impact on development [1] by providing ad-hoc services for people developed by local innovation partners connected to the reality of the field. Several studies showed how SMS based service [4] could have an impact on development.

Co-innovating with local partners is indeed a good way to change this paradigm. However such co-innovation requires several conditions; local resources to develop services, a shared, open and low-cost infrastructure and finally a connexion to the telecommunication network.

Mauritius Telecom, in partnership with Orange Labs initiated such initiative with 2 universities of Mauritius. This paper will detail the infrastructure, the co-innovation process as well as the results of a first set of services developed by the academic resources within 1 month.

2   A Low-Cost IP Infrastructure

The goal of the infrastructure is to provide a bridge between GSM and IP worlds. Additionally the architecture shall be open, shared and duplicable. It may be compared to Intelligent Network because it provides added value services on top of the GSM network using the richness and flexibility of IP. Several initiatives from NGO or universities already contributed to selected FLOSS[1] (Free/Libre/Open Source software) components to build open web platforms mainly for e-learning [2] or health services.

2.1   Architecture
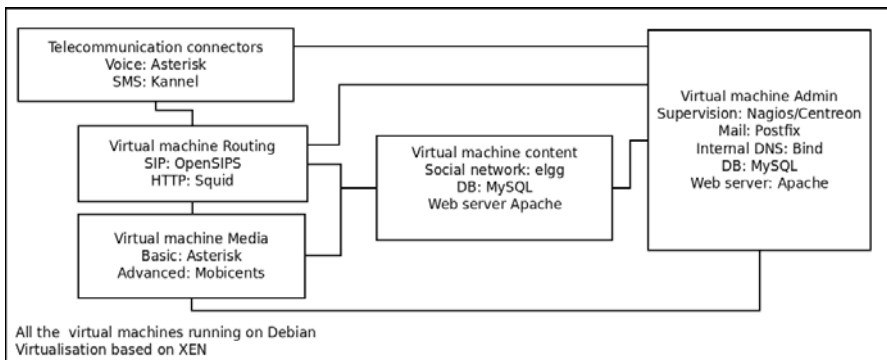
The architecture can be displayed as follow:

Fig. 1. Emerginov architecture

We distinguish 5 main parts

- **Telecommunication** functions: these functions consist in all the gateways between traditional telecommunication infrastructure (SMSC, switch) and the IP platform.
- **Routing** functions: the platform supports two signaling protocols, SIP for VoIP telecommunication and HTTP(S) for web
- **Media** functions: these functions may include the management of vocal announcements, voice mail, conference bridge, voice recognition
- **Content** function: these functions include social network, a multimedia library usable by all the developers, promoting content under creative common license or in public domain.
- **Administration** functions: mainly supervision

The telecommunication functions require dedicated hardware. All the other IP functions are virtualized to save power supply and optimize the machine usage.

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[1] http://en.wikipedia.org/wiki/Free_and_open_source_software

2.2 Promoting Free Software

Free software was the only way to achieve our goals [10] for two main reasons: the design and the adoption of the platform.

The design shall be cost-effective. It shall also integrate the possibility of a local support. Free softwares selected on the platform can all be considered as mature. Local expertise already exists and academic resources, that can be considered as future support, have also a high knowledge of the selected components.

Free software was also imperative to facilitate the adoption of the components then to simplify the developments themselves. In fact any student was able to download any of the components and could thus start developing in a local environment before pushing his/her code to the platform.

The main different components can be described in the following table.

Table 1. Main Free softwares integrated in the innovation platform

Component	Role	Comments
Debian/Xen	OS and virtualization layer	http://www.debian.org/ http://www.xen.org/
OpenSIPS	SIP router (telco part)	http://www.opensips.org/
Squid	HTTP router	http://www.squid-cache.org/
Asterisk	IP/PSTN gateway, Interactive Voice Response and Conference bridge	Asterisk is the media toolbox of the platform. Associated with tools such as audacity, sox, it provides a complete set of media applications http://www.asterisk.org/
Kannel	SMS/WAP gateway	http://www.kannel.org/
LAMP	Linux, Apache, MySQL, PHP	http://www.apache.org/ http://dev.mysql.com/
Elgg	Social network for developers	provides the links towards the forums but aims to ease the exchange of best practice regarding micro services. http://elgg.org/

Free software is an opportunity for the operator to provide innovation in emerging countries. In developed countries, the adoption of free software for telecommunication is not so easy because it modifies the traditional privileged relations between an operator and its suppliers. Support and maintenance of free softwares shall be managed through third party companies not always familiar with operator context. In Emerging countries the choice is sometimes: "free software or nothing". It requires then to internalize some risks.

2.3 Towards an Innovation Consortium

Assuming that a platform is connected to the networks (IP and telecom), the key challenge is to build a complete ecosystem with partners of innovation [3]. All the actors shall see their interest to co-innovate. An innovation consortium shall be designed detailing the rights and the obligations of each of the members.

Table 2. Innovation consortium: main roles

	Rights	**Obligations**
Operator	Provide marketing support	Provide and operate the platform
	Provide technical support	Provide legal support
	Suspend telecommunication resources	Provide telecommunication resources
	(phone or SMS numbers), in case of	Do not put any micro service to
	misuse of these resources	production before agreement with the
		innovation partner
		Do not copy or recode a microservice
		without innovation partner agreement
Innovation partner	Design of the micro applications	Respect free software licenses
	Keep the paternity of the source code	Provide source code under free license
		Discuss with associated operator first
		when moving to production

The goal is to build a shared library of business applications for emerging countries. Any innovation partner joining the consortium could capitalize on previous projects. Thus free software would not be located only into middleware but also in applicative layers. Adullact, OSOR[2] are already referencing free software business applications (400 applications on health, education, associations, administration in adullact).

3   A "Telcoweb" Development Framework to Boost Co-innovation

3.1   Co-innovating

Emerginov is a platform but not a service. Services shall come from the innovation partners. The platform can be considered as the "engineering of the innovation" .

For academic resources there are two ways for co-innovation: develop micro-services or upgrade the platform.

3.2   Developing Micro-services

The development toolkit on top of the platform relies without surprise on open standards. A micro services will deal with a very limited number of lines of code. Each service will integrate existing components and web open API. Most of the micro services will deal with LAMP (web part), Asterisk extensions (vocal part), java/C/C++ and script languages.

The telco part managed through Asterisk or Kannel gateways, will be almost transparently managed by the operator. Concrete examples of micro services will be provided in next chapter.

3.3   Upgrading the Platform

Improving the platform to provide new useful features adapted to emerging countries is an important axis of co-innovation. This upgrade can consist in adding new components or update existing components according to local context.

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[2] http://www.adullact.org/, http://forge.osor.eu

For example, it is interesting to add features dealing with local languages. In fact literacy rate is low on the region, and, in the same time, lots of languages coexist. Vocal recognition or Text To Speech functions do not exist in vernacular languages. The diversity of languages prevent any industrial from delivering such tools at a reasonable price. The operator can thus finance academic resources to work on existing FLOSS components (in this example Julius[3]) in order to adapt it to the local context.

3.4   Towards a Digital Free Software Patrimony

A mentioned below, the ultimate goal of Emerginov is to create an autonomous ecosystem where the operator and the partners of the innovation will contribute to create a shared digital patrimony with tools and content . All services will obviously not survive following the traditional Darwinian life cycle of FLOSS components. Anyway a library of micro services will be ready to be re-used and the best services could be quickly deployable in any emerging countries.

4   Field Experimentation: Orange Expo 2010

4.1   Codecamp

The Emerginov concept relied on the basic principle of free software and hence the main idea was to provide open APIs for developers and academic institutions to gain access to the so long well secured Telco platforms. The objectives were to:

- facilitate the merging of Web and mobile users.
- encourage the development of web related services using Telco architecture as base.
- use Orange as a common platform for different academic institutions and promote academic knowledge sharing.
- develop long term relationship between academic institutions an Orange as operator.

Mauritius Telecom (MT) hence initiated actions to bring the Emerginov concept into the life of Mauritians Academia.   Resources were assigned to the project as MT planned to use the Orange Expo 2010 exhibition to boost the introduction of Emerginov. It was hence an ideal platform for the demonstration of the concrete collaboration of telecommunication industry with academia to produce product and services that were wholly developed by local people to address the local market needs.

The figure below illustrates the process that were put in place to achieve the objective of MT and Orange Lab and eventually the objectives of the academia.

A stand was hence dedicated to the Emerginov concept at Orange Expo as it was going to be one of the highlight of the show, and indeed was very positively appraised

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[3] http://julius.sourceforge.jp/en_index.php

by the visitors. Students from the University of Mauritius (UOM) and the University of Technology (UTM) demonstrated six locally developed applications   which attracted over 10,000 visitors to the stand.   The best projects were chosen through and on-line voting system (GSM and Web) itself hosted on the Emerginov platform.
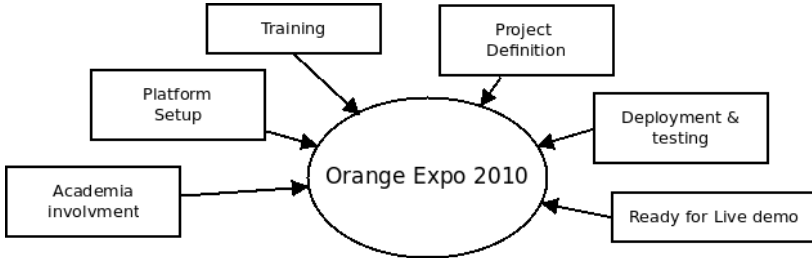

Fig. 2. Innovation process

Besides the possibility to work on research products and services using platforms based on free software, MT wants to move further ahead by providing students the opportunity to develop applications which can be used in the real world or even be marketed abroad.

Through this initiative, Mauritius Telecom wants to establish a bridge with local academic institutions and to get the opportunity to reveal hidden potentials of students and promote local developers and entrepreneurship in the ICT sector.

Table 3. List of micro applications

Name	Description	DevTime (Man-days)	Number Lines of Code
Traffic Watch (UTM)	Traffic Information on highway in Mauritius. Available on micro-browsers and full blown web browsers.	20	750
Buddy Locator (UTM)	A friend finder using GPS enabled mobile phones.	15	1000
SmsNot (UTM)	A developer SMS Notification API which helps to build web and mobile based Short Message System Applications.	15	2000
Shopping Buddy (UoM)	SMS based application providing information on shops ranked through a Facebook application. An additional administration page allows shops to provide vouchers.	15	< 2000
Call To Play (UoM)	Transform GSM hanset into a gamepad for remote control of a game through DTMF	15	< 500

4.2   List of Micro-services

Six projects that have commercial potential and usefulness in the local market have been produced within less than 1 month. the projects were mainly SMS and Web based and some even used the GPS localization API provided by Google Maps. The projects in fact followed the market trend , where we have over 2.5 millions SMS sent daily and over 1 millions mobile users and over 70 ,000 broadband connections in a population of 1.2 million people.

4.3   Focus on Traffic Watch

One of the most appreciated service developed over the platform by UTM is entitled Traffic Watch. The main aim behind this micro service was to provide information on the evolution of traffic over the highways in Mauritius. The core idea was to make traffic information available in near real-time anytime and anywhere, over mobile devices and demonstrate the prototype during the Orange Expo 2010.

4.3.1   Objectives behind Traffic Watch

One persistent problem in Mauritius is traffic jam during peak hours, especially on the main highways (M1 and M2). Currently in the local context, traffic information is only available to the public from local FM radio stations but the limitation is that, these details are aired at a specific time. If someone happens to miss the traffic news, then the latter is completely in the dark about traffic situation. All these traffic information is actually being collected by the Mauritius Police Force, and kept in a non IS based system at their central division. Another point which we noted is that traffic density changes radically in a small lapse of time. Thus, traffic news which was valid a moment ago might no longer be relevant after a few minutes.

In Mauritius according to recent statistics [7], the Mobidensity in Mauritius (mobile phones per 100 inhabitants) is now 84.3% and still rising. We segmented these 84.3% mobile subscribers, for the year 2009 and noticed that mobile internet subscribers attained 52.5%. Again, from [7] the population covered by mobile cellular telephony is defined as the number of inhabitants who live within areas covered by a mobile cellular network, irrespective of whether or not they subscribe to the service. Since 2009, 99.0% of the population is covered by mobile cellular telephony.

Based on the above description and statistics, it can be deduced that implementing a system as the Traffic Watch in our local mobile market would nearly reach the whole population. For the mobile operator, this would represent an interesting potential in terms of revenue.

4.3.2   Architecture of Traffic Watch

In an attempt to keep traffic information accessible, we devised an architecture which keeps all information in a generic format (XML). As mentioned before, availability of traffic information is one objective of the system. The architecture thus allows users to access traffic information in the following ways:

- On a micro-browser (web enabled mobile phone) which supports javascript (Safari and Opera). This is the ideal way to view traffic information with a map and different icons representing the three different states.
- A plain GSM enabled phone. Traffic information is pushed by SMS to all subscribed users.
- On a full blown Web browser. For web and special users like the content provider (Mauritius Police Force).

The system takes the form a Web application with a series of other components which are illustrated in Figure below.
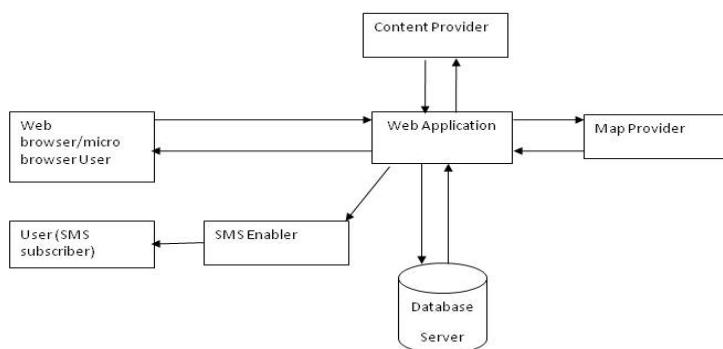

Fig. 3. Traffic watch architecture

Web Application. In the attempt to provide a fully inter-operable system, a web application has been devised, which is at the heart of the architecture above. PHP has been used as server side programming language, with AJAX techniques to request map data. The database is MySQL and is used for persistent storage.

Map Provider. The ideal application will display a map on the mobile phone web browser, which allows better interaction with the users. This is the only component which is not part of the Emerginov platform. Google Map API was chosen in this case since it has proven to be fully compatible with components on Emerginov.

SMS Enabler. The application is not only targeted towards 3G mobile phones but 2.5G and 2G as well. The SMS enabler component plays this role. It consists of the SmsNot API also developed by UTM, Kannel SMS gateway, and the operator's SMSC.

Content Provider Interface. The content provider is the Mauritius Police Force. Multiple traffic agents at the main round-abouts and junctions during peak hours, collect traffic information, which are centralized at their main operation room. This same information can be fed into the system via a specialized interface to the web application. This interface is secured with an encrypted password.

4.3.3 Flexibility of the Architecture

Any application with an XML parser would be able to read the traffic messages and do further processing if required. The architecture has been implemented in a layered approach, which allows easy integration and debugging. We have done integration with the Asterisk server, whereby policemen can record a status of the traffic that is automatically broadcasted on a web radio.

4.3.4 Limitations of Traffic Watch and Future Work

OpenStreetMap [9] could be seen as an alternative to Google MAP API as it is based on a full free software solution (unlike google). A vocal kiosk or an USSD connector could be studied.

5 Conclusions

Building a local innovation ecosystem is a key challenge for development in emerging countries. An operator is a key actor of micro-services based on mobile. Telecommunication companies are usually very present on the field unlike international web actors. Therefore an operator can bridge the two worlds, connecting end users to the richness of IP worlds. To achieve the stimulation of the eco-system, the operator shall provide an infrastructure, support and associate local actors. That is the goal of the Emerginov consortium.

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