VOIce-based Community-cEntric mobile Services for social development

Grant Agreement Number 269954

Deliverable No D5.2

m-Agro Knowledge Sharing Pilot
Roll-out Cycle 1

June 2012

PROJECT DELIVERABLE REPORT

Project	
Grant Agreement number	*2699542*
Project acronym:	*VOICES*
Project title:	*VOIce-based Community-cEntric mobile Services for social development*
Funding Scheme:	*Collaborative Project*
Date of latest version of against which the assessment will be made:	*June 2012*

Document	
Deliverable number:	D5.2
Deliverable title	m-Agro Knowledge Sharing Pilot rollout Cycle 1
Contractual Date of Delivery:	30 June 2012
Actual Date of Delivery:	26 June 2012
Editor (s):	Anna Bon, Hans Akkermans
Author (s):	Anna Bon, Hans Akkermans, Chris van Aart, Nana Baah Gyan, Victor de Boer, Mary Allen, Etienne Barnard, Stéphane Boyera
Reviewer (s):	Moustafa Zouinar, Chantal Stroek
Work package no.:	WP5
Work package title:	m-Agro Knowledge Sharing Pilot
Work package leader:	VU University Amsterdam
Work package participants:	Web Foundation, Sahel Eco
Distribution:	PU
Version/	1.0
Final:	
Total number of pages (including cover):	35
Keywords:	Market information system, web &voice technologies, African rural context

CHANGE LOG

Reason for change	Issue	Revision	Date
Document creation; chapters 1, part of 2, 4, appendix	0.1	Anna Bon	22 May 2012
Chapter 2 web interface	0.2	Nana Baah Gyan	13 June 2012
Chapter 2 technical design	0.3	Chris van Aart	14 June 2012
Chapter 3,4 general editing	0.4	Anna Bon	15 June 2012
Section speech technologies	0.5	Etienne Barnard	18 June 2012
Update after internal review by Moustafa Zouinar and Chantal Stroek	1.0	Anna Bon	26 June 2012

DISCLAIMER

This document contains description of the VOICES project work and findings.

The authors of this document have taken any and all available measures in order for its content to be accurate, consistent and lawful. However, neither the project consortium as a whole nor the individual partners that implicitly or explicitly participated in the creation and publication of this document hold any responsibility for actions that might occur as a result of using its content.

This publication has been produced with the assistance of the European Union. The content of this publication is the sole responsibility of the VOICES consortium and can in no way be taken to reflect the views of the European Union.

The European Union is established in accordance with the Treaty on European Union (Maastricht). There are currently 27 Member States of the Union. It is based on the European Communities and the member states cooperation in the fields of Common Foreign and Security Policy and Justice and Home Affairs. The five main institutions of the European Union are the European Parliament, the Council of Ministers, the European Commission, the Court of Justice and the Court of Auditors. (http://europa.eu.int/)

VOICES is a project funded in part by the European Union.

TABLE OF CONTENTS

LIST OF ACRONYMS

ASR	Automatic Speech Recognition
CSS	Cascading Style Sheets
DAO	Data Access Objects
DBMS	Database Management System
FTP	File Transfer Protocol
GSM	Global System for Mobile Communications
GUI	Graphical User Interface
HTML	Hyper Text Markup Language
JSON	Javascript Object Notation
MIS	Market Information System
NGO	Non-Governmental Organization
ORTM	Office Radio Télévision du Mali
S&F	Slot and Filler
SIP	Session Initiation Protocol
SIM	Subscriber Identity Module
SMS	Short Message Service
TTS	Text to Speech
UML	Unified Modelling Language
URI	Uniform Resource Identifier
VXML	Voice Extensible Markup Language
WP	Work Package
XML	Extensible Markup Language

PREFACE AND SUMMARY

This VOICES deliverable D5.2 reports on the intermediate results of the WP5 m-Agro *Regreening* Knowledge Sharing pilot, that is currently being deployed in Mali. The results of the first cycle, ending in June 2012, are presented in this paper.

This deliverable follows up on deliverables D1.1 and D5.1. In D1.1 an extensive field-research based discussion was given of sixteen collected use cases, and an in-depth discussion on two selected use cases and their requirements: Use Case A, nicknamed Radio Marché, and Use Case B, named m-Event organizer. In D5.1 we presented the first version of the technical design of the Radio Marché system. Radio Marché represents cycle 1 of the pilot.

This document contains the following:

In the first chapter we summarize the use case for which the Radio Marché system was designed and built.

In the second chapter we provide the technical design that was made for the of WP5 pilot cycle 1: the Market Information voice-based service system. The system's technical components are described, how they are interconnected and how they operate.

In the third chapter, we describe the implementation of Radio Marché for the local users in Mali. We describe the user feed-back after the first test phase, and the adjustments that were made accordingly. We briefly describe the Living Labs approach that was applied in the pilot.

In the fourth chapter we discuss the different issues that where encountered during implementation, and the impact they had on the implementation of the pilot, and how they were managed. Finally, we give a roadmap for fine-tuning Radio Marché and further plans.

In the Annex we give an overview of the different research projects that are currently taking place related to different aspects of the pilot. Although this is not a formal requirement of this work package, we present a list of the Radio Marché-related scientific publications, up to present.

1. RECAP OF USE CASE FOR RADIO MARCHÉ

Radio Marché is a voice-based trading system, also referred to as a market information system, designed for farmers living and working in the area around the village Tominian, in Mali. Radio Marché is meant as a tool to improve communication between the farmers and their potential customers. Radio Marché is designed according to the requirements of the following use case, based on existing procedures.

Figure 1: Logo of Radio Marché: integration of phone and radio channels to support trading

In 2010 WP5 partner and Malian NGO Sahel Eco started the Village Tree Enterprise Project*, to create a "paper-based" Market Information System (MIS) involving 20 small rural villages in the Tominian area, and four local community radio stations. This legacy system was dedicated to promoting sustainable use of forest resources, and developing small businesses based on non-timber forest products. The main product focus of the MIS is on shea nuts, shea butter, honey, wild fruits and nuts. The original MIS distributed up-to-date market information via community radio in the area. Our envisaged system thus started from this already functioning market information system (see Figure 2).

The original workflow was as such: An extension worker from Sahel Eco collects weekly market information from farmers in 20 villages near Tominian, about offerings of shea butter and honey. The information is sent by the producers via SMS or phone. The extension worker aggregates the info (product, quality, quantity, price, and contact phone number etc.) in an Excel sheet on his laptop. This info document is then sent by email from a cyber cafe to three community radio stations (ORTM Ségou, Koutiala, ORTM Mopti), whereas a hard copy of the information is physically brought to Radio Moutian in Tominian. Radio Moutian has no Internet connection. The radios broadcast the market offerings info including the phone numbers of the producers. Potential customers either phone Sahel Eco or phone the producer directly to negotiate a trade.

* See http://ictupdate.cta.int/en/content/view/full/5808 for full description of the Village Tree Enterprise project.

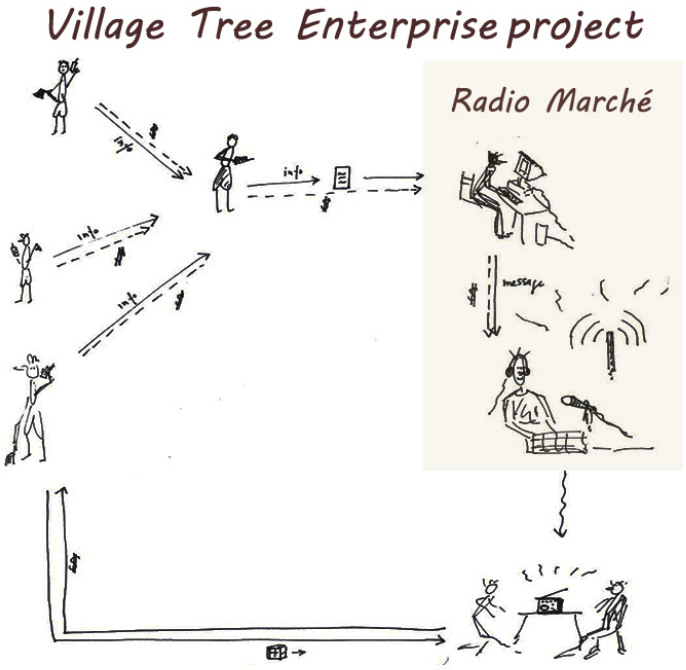

Figure 2: Use case diagram showing the total scope of the legacy market information system, as in use in the Village Tree Enterprise project, run by Sahel Eco. The grey box in the picture shows the scope of the Radio Marché system.

Actors and goals

Actors	Operational goals
Producers of shea butter and honey from 20 rural villages near Tominian	Efficiently sell at best price
Potential customers of honey and shea butter	Buy cost effectively and pay good price
Radio ORTM Ségou, Koutiala, Mopti, Radio Mountian	Broadcasts updates on price and producers
Sahel Eco coordinator (extension worker)	Collects/processes information from producers
Tree AID UK, a donor organization 4dev	Pilot funding (currently until July 2011)

1.1. Summary of key requirements for Radio Marché

- Web-based input-form for NGO extension worker to enter product offerings (honey, shea butter, nuts) received by phone or SMS from producers;
- Voice-communique generated offering;
- Phone access to the voice communiqué for radio stations on a local line in Mali;
- Communique also accessible for radio station through web;
- The audio quality OK for broadcasting over the radio;
- Server should have internet access so that data can be entered remotely by the NGO extension worker;
- The voices in the message should sound familiar (speak local dialects);
- The voices of the radio journalists must be used to ensure trust and recognition of the system.

According to the use case and the key requirements, the design of Radio Marché was set up.

Radio Marché consists of several components: a web-form where the NGO extension worker enters the aggregated offerings he receives from the farmers. This data, entered on the web-form is stored in a database. From this data a voice communiqué is automatically generated as an audio file. This audio file is accessible through mobile phone. The radio journalist calls a given phone number and hears the automated voice message. The voice message is generated using a local Malian voice. The design of Radio Marché is given in the next chapter.

2. DESIGN OF RADIO MARCHÉ

In this section we provide the design of the Radio Marché system. The design communicates the important aspects of the system's design and deployment. The design can be made from different viewpoints: the use case view, the process view, the logical view, the development view, and the physical view.

2.1. Use case view

Starting with the use case and requirements, Radio Marché provides functionality to three actors, (i) an NGO Extension worker, this is currently an employee from Sahel Eco,(ii) the Radio Station employee, who will access and broadcast the message, (iii) the person who provides technical support of the system. Each actor needs the following functionality:

ID	Actor	Description
1	NGO	Enter market information
2	NGO	Create audio radio communique
3	NGO	Check content and quality of radio communique
4	NGO	Distribute communiqué
5	NGO	Archive communique
6	NGO	Notify radio stations
7	NGO	Generate communique report
8	Radio	Acquire communique, as text or in audio format
9	Radio	Play communique on radio
10	Support	Monitor system

Combining requirements, we can draw the following use case diagram:

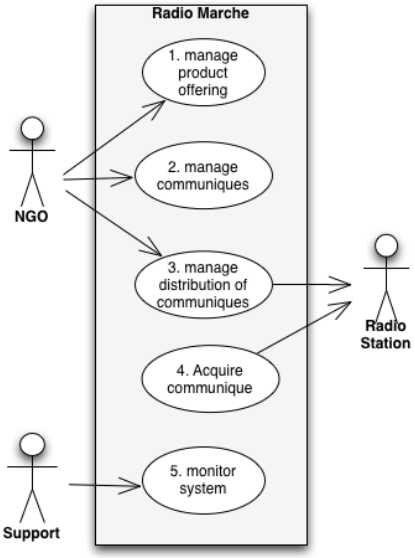

Figure 3: UML use case diagram for Radio Marché

2.2. Process view

A process view describes the processes within a system, and visualizes what occurs within the system. Whereas use cases show what the system should do, activity diagrams specify how the system will accomplish its goals. The activity diagram in Figure 4 shows high-level actions chained together to represent the processes occurring in our system. The two main actors (NGO and Radio) perform the following activities:

NGO (operator) has the following steps:

1. Managing product data by aggregating product items (including price, quality quantity, region and contact data);
2. Composing a communiqué by selecting a number of products to be communicated;
3. Generating a communiqué. Two kind of communiqués will be generated by system: a Text Format (which can be printed) and an audio communiqué (which can be transmitted, downloaded and broadcasted);
4. Checking the quality of a communiqué. Both the quality of the content and audio will be assessed;
5. Sending notification to radio stations that are relevant for this communiqué (based on region) via a channel (including SMS and email). The NGO will notify the radio station in case of a new of adjusted communiqué;
6. Wait for confirmation of a notification;
7. When a notification is not received the NGO will resend the notification; otherwise proceed to the next step;
8. The actual communiqué will be distributed, either via text or audio. Finally the communiqué will be archived.

Radio station (operator or radio journalist):

1. Receive notification of the system: a new communiqué relevant for this radio station is pending to be broadcasted;
2. Confirm notification: via SMS or email the radio station confirms receiving the notification;
3. After download, the quality of the communiqué will be checked and the communiqué will be broadcasted.

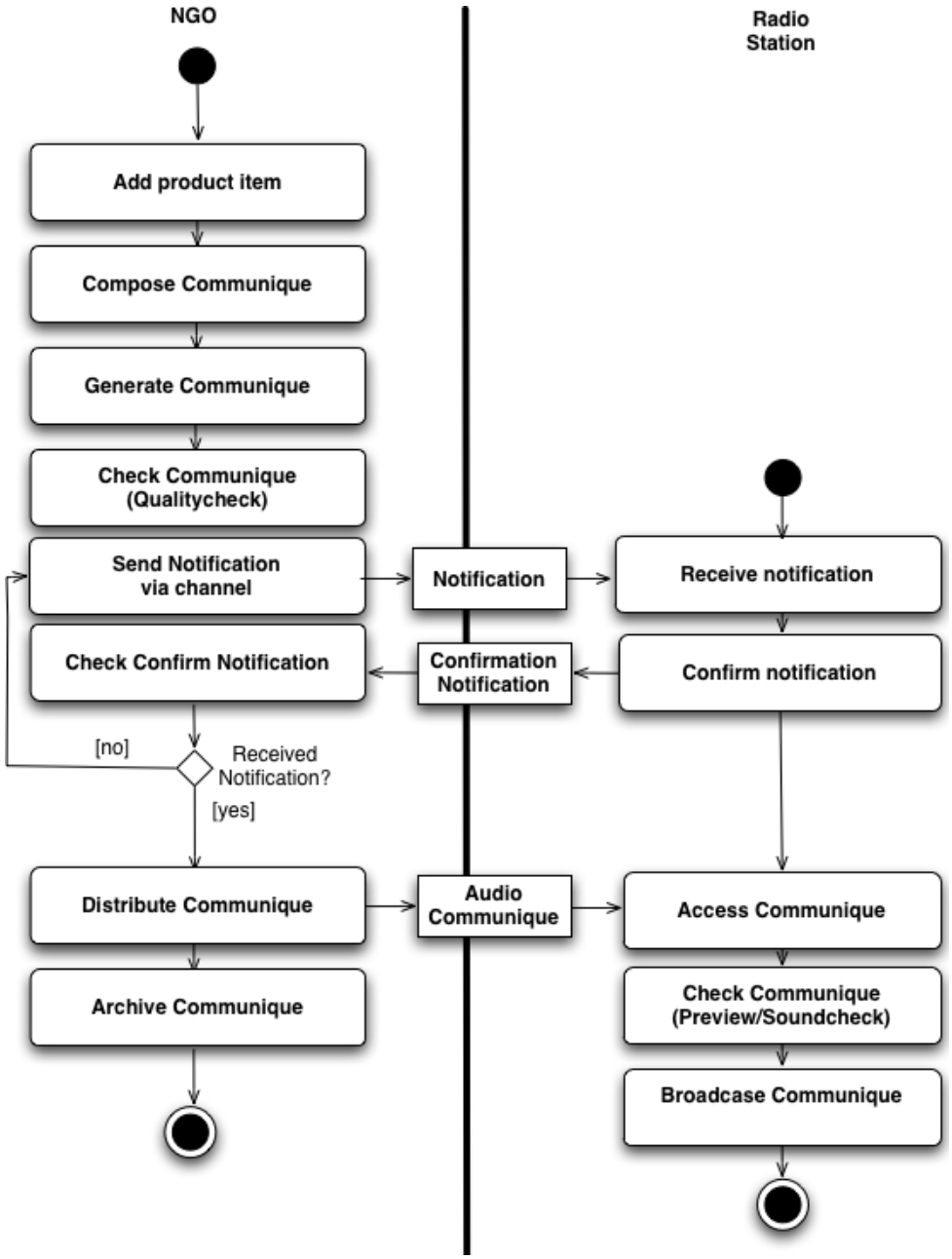

Figure 4: UML activity diagram visualising the processes in Radio Marché

2.3. Logical view

From the logical view we consider the information model (see Figure 5) and the operational tasks. The information model, which is used for the design of the database within the Radio Marché system is composed of five parts:

1. Product offering: the actual market information, represented by the objects: Product Offering, Contact, Product;
2. Text Communiques: textual representation of the market information, represented by the object: Text Communiques;
3. Voices: fragments/frame samples of human voices, represented by the objects: Voice, Language, Language Frame, Wavfile;
4. Audio communiques: audio representation of text communiques, including mapping rules, represented by the objects: Text2Speech, 1-1 Mapping, Generated, Speech Frame, Audio Communique and Audio File.
5. Workflow data in the form of the objects.

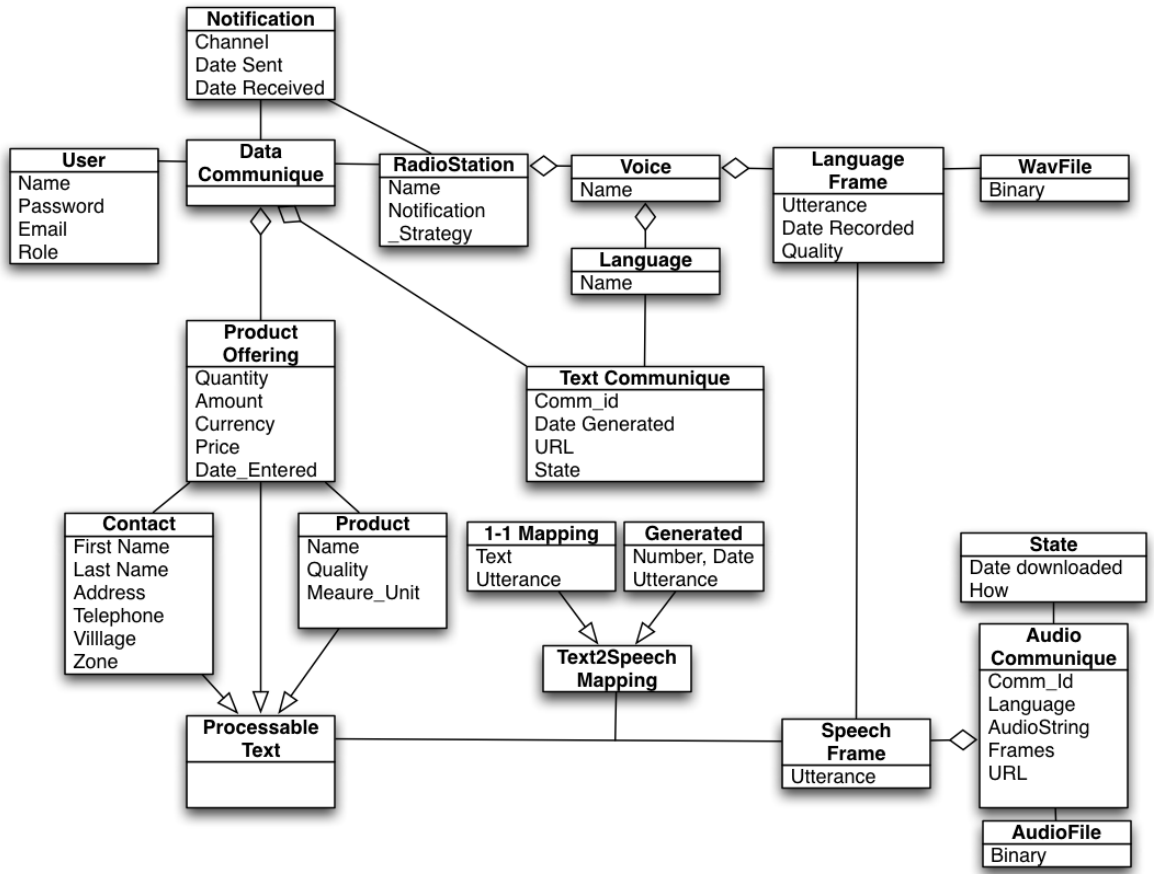

Figure 5: Information model for the Radio Marché database

Operations and tasks

The operation of Radio Marché system sees the system as composed of the following active objects: the NGO controller, 'the Communiqué Platform, Voice Platform, Radio Station. (Objects can be either persons or systems.)

NGO Controller's tasks are:

She delegates the task of generating a communiqué to the voice platform. The voice platform receives a text communiqué represented in JSON. The JSON is made up of mainly the ids of the various voice parts to be concatenated into words or sentences. The voice platform returns also a JSON which contains the status of the audio generation (SUCCESS or FAIL) and the set of URIs on the platform representing the location of the generated audio files on success or the cause of the error on failure. She manages notifications with the radio station.

Voice Platform's, tasks are:

It composes the actual audio communiqué based on the JSON input. It also consists of a voice browser (eg prophecy) that is able to navigate a document using VXML which is used to read out generated audio and also to present voice menu options to a caller.

Communiqué platform's tasks are:

It deploys audio files, deploys VXML Apps; returns Audio URI to the NGO Controller.

Radio Station's tasks are:

To acknowledge notification;

To download notification (the actual broadcast is out of scope of the Radio Marche system).

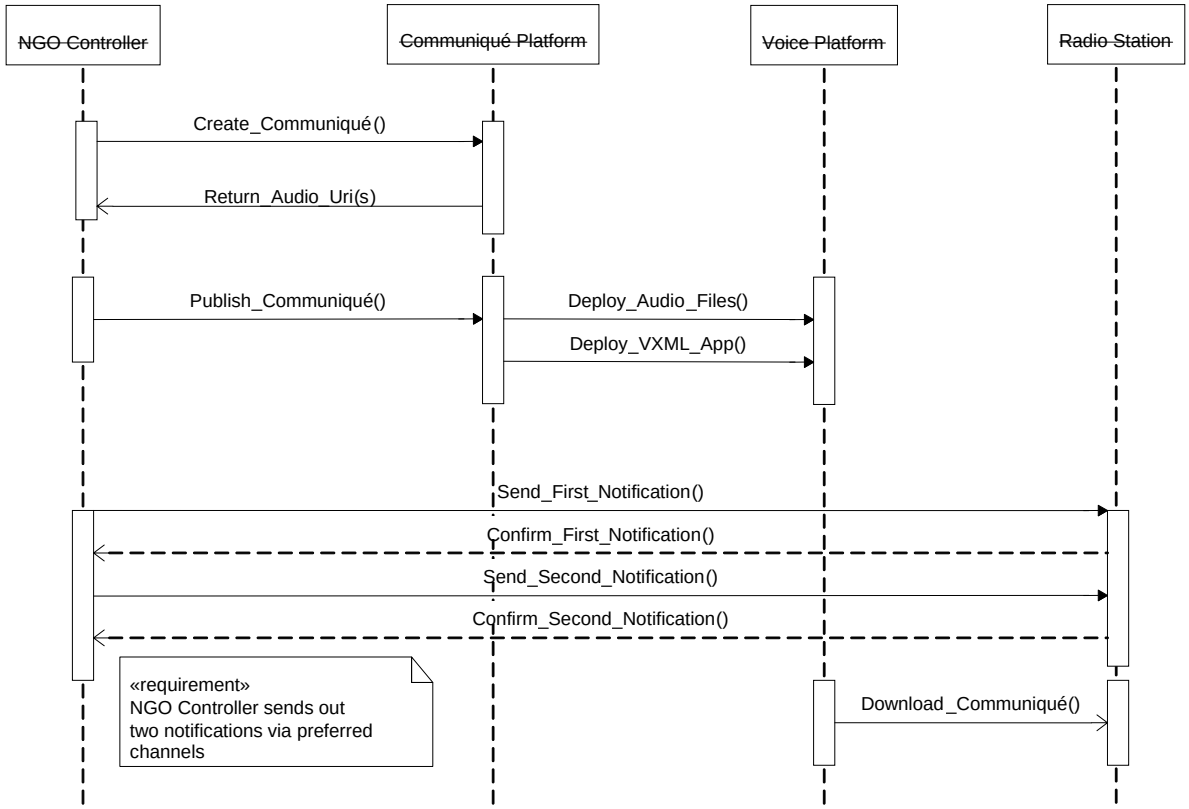

Figure 6: Operational tasks for the four “objects” in Radio Marché.

2.4. Development view

The development view describes how the system's parts are organized into modules and components. It is useful to manage layers within your system's architecture. This view typically contains package and component diagrams (Figure 7).

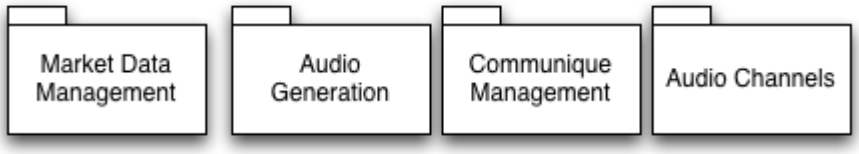

Figure 7: Radio Marché Packages

The Radio Marché system is composed of four packages:

Market Data management is responsible for the following tasks:

a. Manage product information in the form of text communiqués
b. Manage workflow flow with the radio station
c. Delegate audio generation to the Audio generation package
d. Delegate audio transport to the communiqué management

Audio generation is responsible for the following tasks:

a. Manage fragments/ sample audio frames of various voices in various languages
b. Generate audio files based on textual input

Communique management has as main tasks:

a. Distribute audio communiqué via on the available audio channels
b. Archive audio communiqués

Audio channels manage audio such as:

a. Emerginov: This option has both the web interface and a voice platform and communiqué platform running on a server (Emerginov platform) hosted by France Telecom. It also provides re-routable mobile phone numbers that users can call to reach the application (generated communiqués) in the country covered under the project (Mali in this instance).

b. OfficeRoute: This option consists of a GSM phone gateway that takes SIM cards and routes calls to any of the SIMs to predefined applications. In this case we use a SIP channel to communicate with a running Voice browser (prophecy) on a local laptop.

c. Website: Website provides another means for generated audio communiqué to be downloaded and played live on air by the radio station.

d. FTP: FTP channels would also be provided when the need arises to augment means of getting audio generated communiqué from the platform.

Market Data Management

The technical architecture of the Market Data system is composed of 4-tier architectural layers, as shown in Figure 8:

1. Views: contain HTML/CSS form templates to manage web based interaction with users
2. View Controllers: manage flow of GUI interaction with the end users. The service controllers manage communication with the external components, such as Audio Generation and Communique management
3. DAO (Data Access Objects) : layer that manages data management, shielding of chosen DBMS technology
4. Database, actual storage of data in the system including the voice-mapping: allowed 1-1 text-to-speech mapping

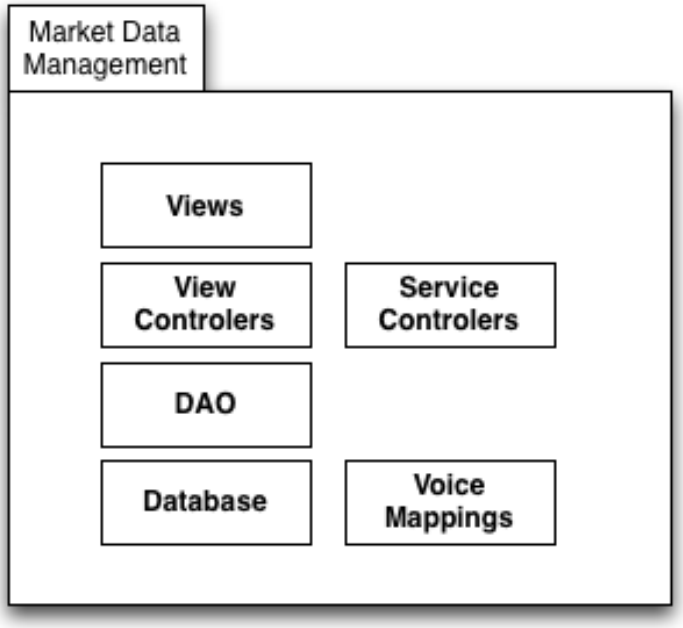

Figure 8: Market Data Management for Radio Marché

2.5. Physical view

This view describes how the system's design, as described in the three previous views, is brought to life as a set of real-world entities. The diagram below (Figure 9) shows how the abstract parts map into the final deployed system.

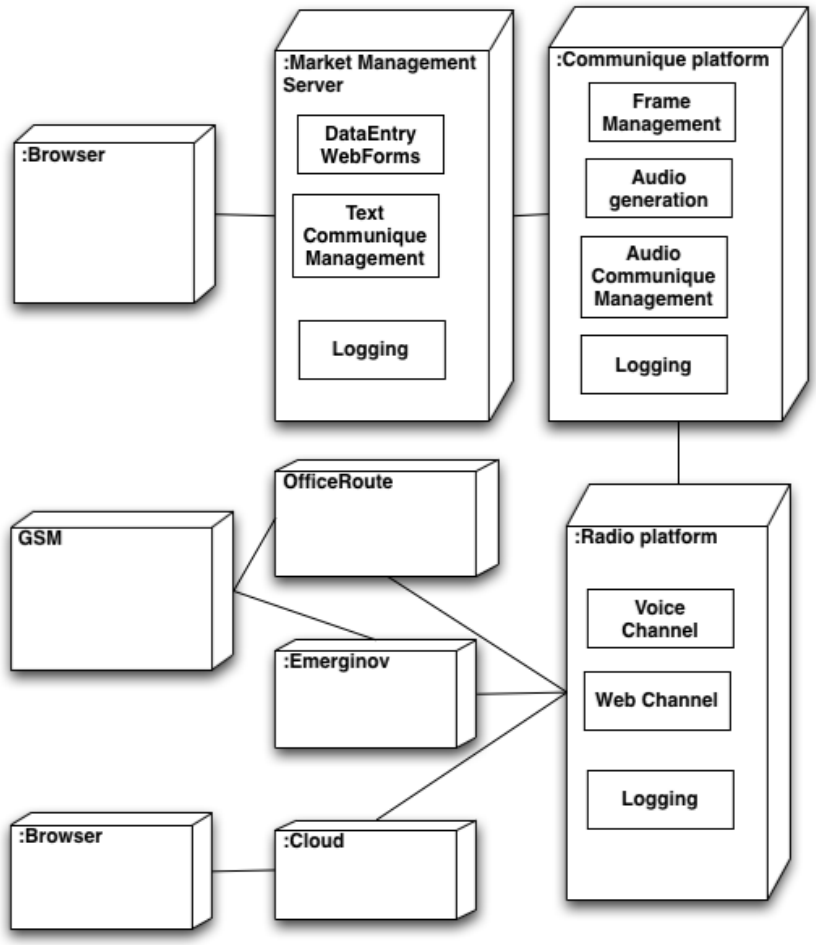

Figure 9: Deployment diagram for Radio Marché.

2.5.1. The Voice Platform[†]

In the VOICES project, WP2 provides the architecture for the voice platform. In the WP5 pilot we use this platform, named Emerginov, to deploy Radio Marché, and provide the web- and

[†] In Figure 9, the deployment diagram show: Radio Platform. In the text we refer to “Radio platform” more generically as “Voice Platform”.

phone interface. However, for reasons of sustainability, an alternative to Emerginov is also developed by the WP5 team, which we refer to as OfficeRoute. Both platform solutions have advantages and disadvantages, which still have to be tested in the local Malian production environment. The outcomes of the evaluation of the two platforms will be reported later. The design of both platforms is given in the following section.

We refer to the platforms as platform A and platform B. The access to the two different platforms is summarized in the figure below. Platform A is *Emerginov*, developed by Orange - France Telecom in WP2. This platform is hosted "in the cloud", and accessible through the Web and, for voice communication, via a local phone number in Mali. The alternative platform, (B) is a local setup, consisting of a computer running an Open Source webserver. The computer is attached to a hardware device (in casu OfficeRoute) that can send and receive phone calls using a local SIM-card. The OfficeRoute is basically a programmable GSM phone. Platform B is currently hosted at Sahel Eco's office in Bamako. Platform B is set up as an alternative platform, with a basic functionality that is required for Radio Marché to work and be accessible through mobile phone. This set up does not necessarily require an omnipresent internet connection. Since the development of the architecture of platform A, Emerginov, is done in WP 2, in the next section we will only give the technical description of platform B. In Figure 10 the access routes to the two platforms (A and B) are visualised.

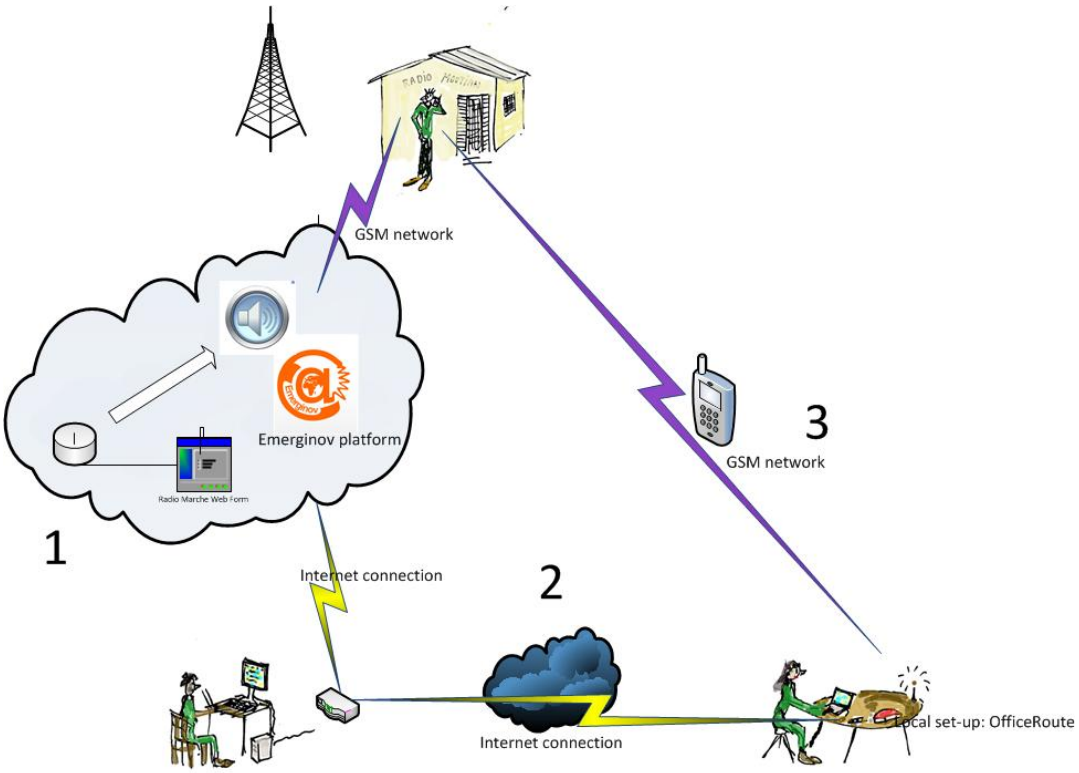

Figure 10: Two different voice platforms (A and B) for access to Radio Marché. 1: shows remote access to the web form and the Emerginov platform (A) in the "cloud", 2: shows remote access to the web form that is hosted on local platform (B). 3 shows phone connection to local platform (B).

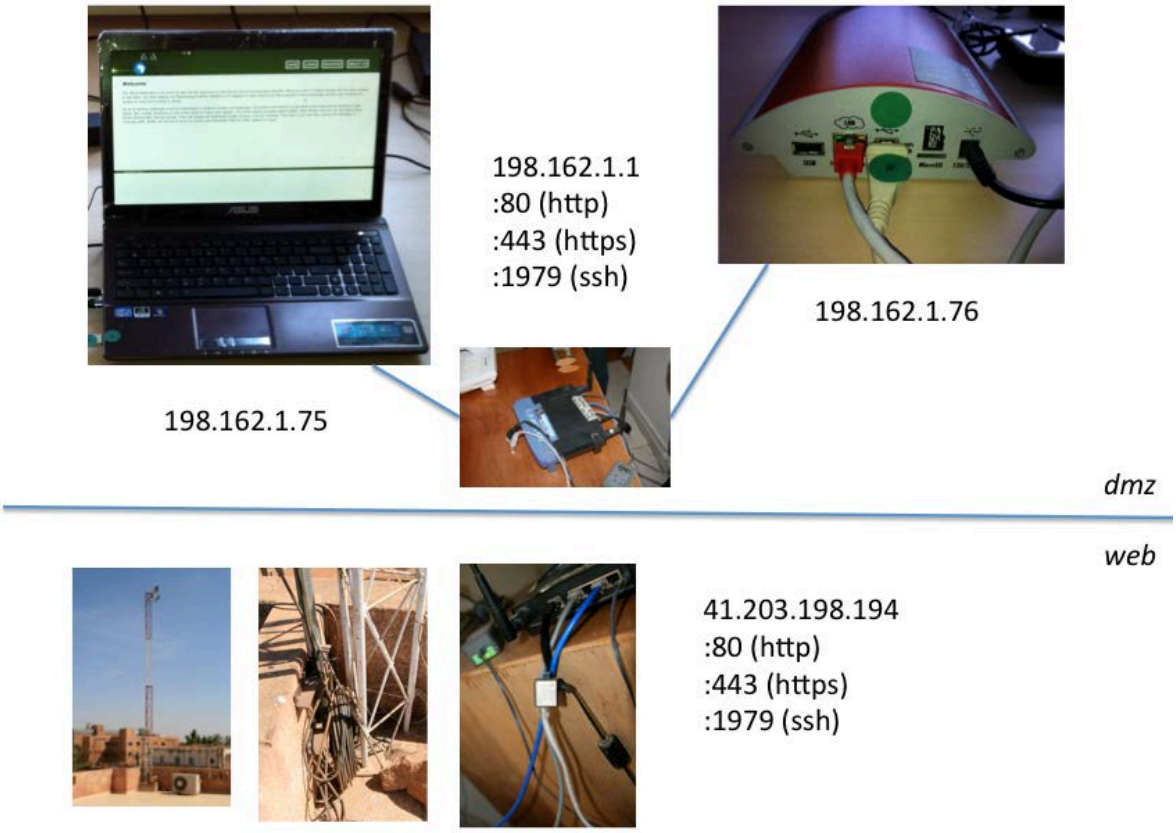

Figure 11: Showing the technical setup of local platform B:
On top: laptop, OfficeRoute device, switch. Below: network connection for phone and internet access.

2.5.2. Speech technology: three language packs

To support the pilot in WP5, both the first and the second cycle, three speech-technology packages are being developed in WP3, namely:

- An environment called ASR-Template, which supports the rapid development of Automatic Speech Recognition (ASR),
- A crowd-sourcing environment for the collection of ASR training and test corpora
- Tools for the creation of slot-and-filler text-to-speech (S&F TTS) systems.

In addition, three language packs are being developed in two of the languages that are spoken in Mali: ASR for Bambara and S&F TTS for Bomu and Bambara. These software packages and language packs will be described more fully when they are released within WP3

in September 2012; here, we briefly describe the progress that has been made with the development of the language packs.

A formal specification of the Bambara TTS application was created collaboratively by WP5 and WP3 participants. Based on this specification, a list of utterances was defined, and these utterances were recorded by selected radio announcers during a WP5 field visit to Mali. In order to create the S&F TTS language pack, the recorded utterances were time aligned and the slot and filler speech fragments were extracted for subsequent concatenation. A first version of the TTS system was created (using an alpha version of the S&F TTS tools), and a few of its outputs informally presented to a speaker of Bambara to obtain initial feedback. The preliminary results were encouraging:

The speech was found to be highly intelligible, but a number of problematic issues were identified. These issues are currently being addressed, as a next version of the TTS system is being prepared.

Development of the ASR component has also progressed according to schedule. Beta versions of both the crowd-sourcing environment and ASR-Template have been developed and basic resources for the creation of the Bambara ASR system (character and phone-set definitions, text corpora) have been gathered. Testing of these components is currently in progress; data collection will be initiated upon successful completion of the testing process.

3. DEPLOYMENT

In this chapter we describe the deployment of the Radio Marché system from the end-users perspective. The user interfaces are described for web and phone communication. Finally we briefly describe the Living Labs methodology that has been used throughout the development of Radio Marché. We refer to Deliverables 1.1 and 5.1 for a detailed description of the Living Labs approach in this pilot.

3.1. User interfaces

From the user's perspective Radio Marché has two different interfaces: one for entering data, by the NGO, and one for the radio journalist who wants to access the voice communiqué for broadcasting (See Figure 12). In the next two sections, the two interfaces are described.

3.2. Web interface

The Radio Marché web interface is designed to be as simple as possible, according to the description of the selected use case, and the remarks from the NGO end-user. It was designed to follow the existing work procedures of the legacy system. To prevent unauthorized users on the internet from accessing and abusing the system, the NGO user needs to register on the platform, the first time she accesses the system. After the registration is approved by the system administrator, the user can now log in to create and publish new communique.

3.2.1. Visual Design

This section describes the design of the Radio Marché web interface. It essentially consists of four web pages namely the home page, new products page, new communique page and the communique store page.

Figure 12: On the top of the picture the NGO staff member is entering data using the web interface. In the middle the radio journalist is the person who accesses the voice interface and broadcasts it. Below the listeners hear the communiqué on their radio.

3.2.2. The homepage of the web interface

The homepage gives a list of actions that are possible on the platform. From the page a user can do the following actions:

a. add new products for which a new communique is to be created.
b. create communiques from products already entered.
c. see a history of previously created communiques.

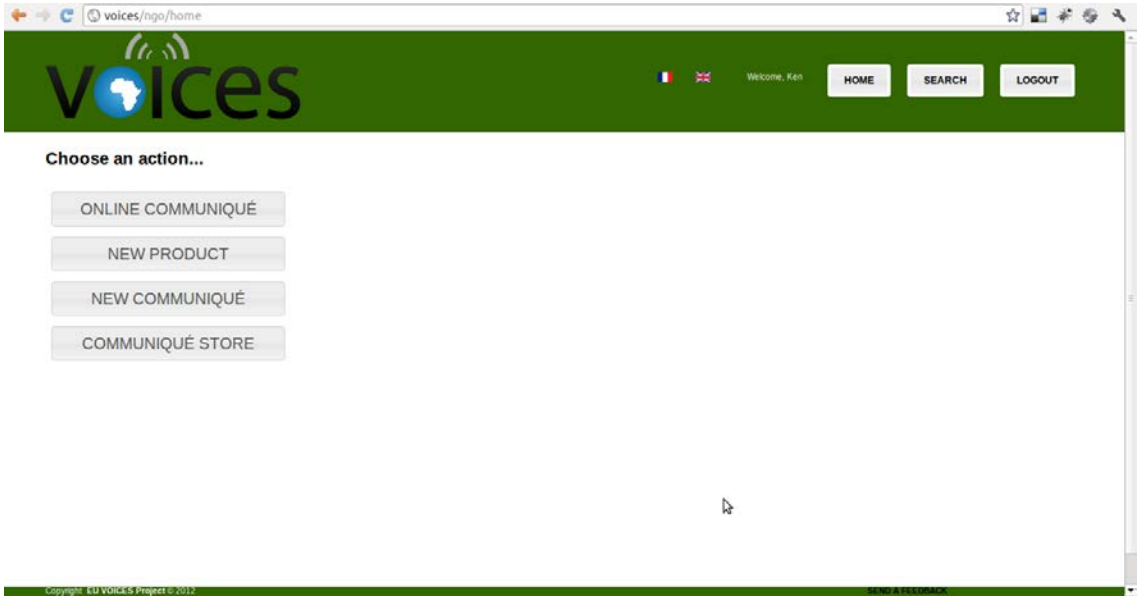

Figure 13: Screenshot of the homepage of the web interface of Radio Marché

3.2.3. New Product page

This page is designed for simplicity and user-friendliness. For example, units for weight and price of the product being entered are automatically filled to limit errors due to wrongful entries from the user. At the moment, the interface allows only entries of pre-selected products as well as the contacts who sell these products.

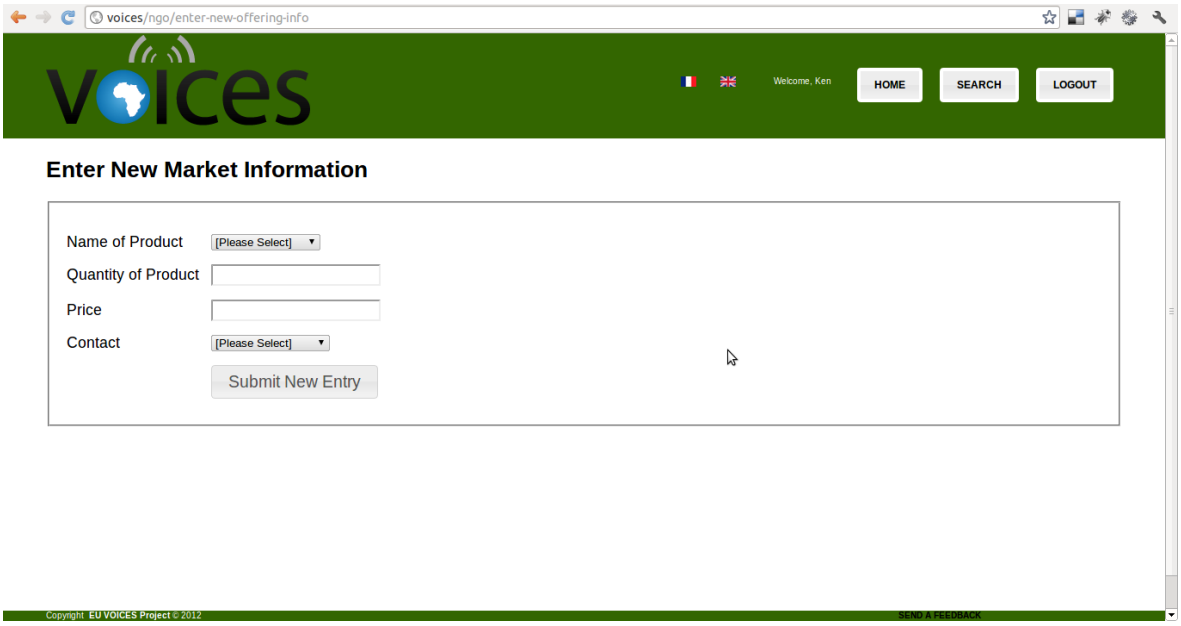

Figure 14: Screenshot of the web form to enter new market information

After entering new market offerings in the above web form, a voice communiques can be generated. The process is designed so that the generated table will resemble as much as possible the (Excel-sheet) paper-based product offerings table that existed before Radio Marché.

INFORMATION SUR LES PRODUITS FORESTIERS NON LIGNEUX DU CERCLE DE TOMINIAN N° 04 Du 23 Mai 2011							
Zone de production (commune)	**Villages**	**Nom du produit**	**Unité de mesure**	**Quantité disponible**	**Qualité du produit**	**Prix unitaire en fCFA**	**Contacts**
Mafouné	**BOKUY-MANKOINA**	**Miel**	**Litre**	**200**	**Miel non brulé et pressé avec les soins d'hygiène alimentaire**	**2000**	**Zakari DIARRA Tel.78571298**
Mandiakuy	**KONA**						

Figure 15: The table of product offerings resembles exactly the Excel-sheet type table used by the NGO in the Village Tree Enterprise system before Radio Marché was introduced.

After a communique has been successfully generated, the user has five different options: (i) listening to it for quality of the generated audio, (ii) getting an excel version of the

what products make up the generated communique, (iii) looking at the content that makes up the audio, (iv) deleting it entirely and (v) publishing it on the voice platform, if satisfied with the outcome. Publishing a communique will allow others to access the audio via phone.

3.2.4. Communiqué Store page

This page shows the history of all generated communiqués on the platform. It can also show which communique is online, as recently published.

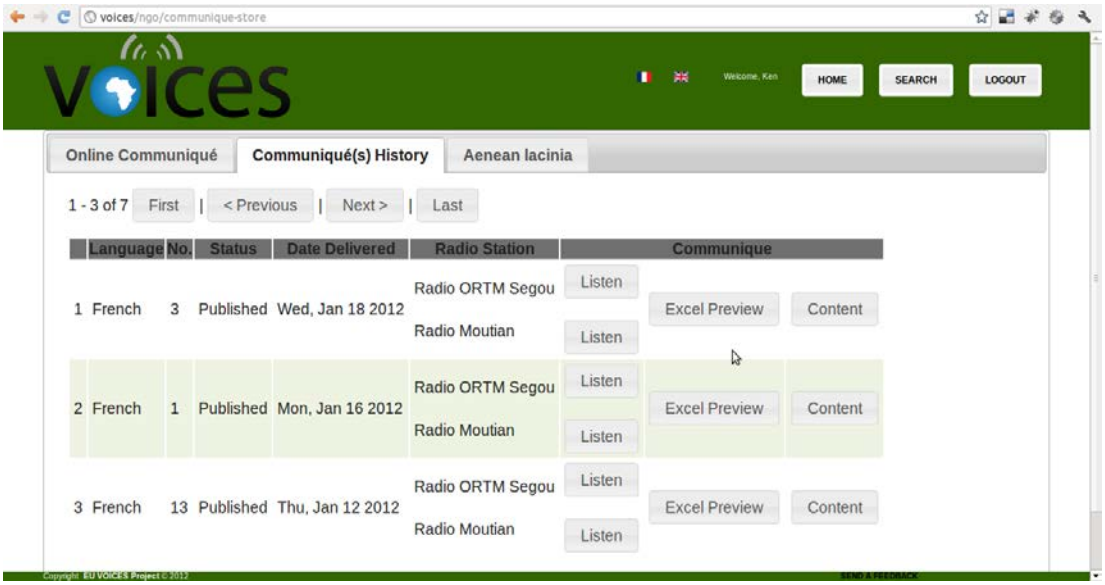

Figure 16: Communiqué history page

3.3. Voice interface

The voice interface is designed so that users can access the market data without need of a computer or an internet connection. The main users of the Radio Marché voice interface are radio journalists of two selected radio stations in Mali. They broadcast the audio messages on the radio. The translation of the market offering into speech is done using the Slot & Filler[‡] approach for the development of text-to-speech (TTS) systems. The voice communiqué is currently available in a Malian French dialect. This approach was chosen, instead of using existing French TTS system, for several reasons:

a. According to the requirements of the use case analysis, the end-users of Radio Marché prefer to hear the communiqué spoken by the well-known voices of two radio

[‡] For a description of Slot and Filler TTS, see e.g. Taylor, P.A. 2000 – "Concept-To-Speech Synthesis by Phonological Structure Matching".
http://www.cstr.ed.ac.uk/downloads/publications/2000/Taylor_2000_a.pdf

journalists of the region, speaking a familiar local dialect. This is expected to increase trust and user acceptance, i.e. contextualization of the Radio Marché system.

b. In VOICES we want to provide a framework to facilitate creation of speech systems for under-resourced local languages. For the pilot in Mali, and to ensure long-term sustainability of the Radio Marché system, the aim is to create TTS for under-resources Malian languages such as Bambara and Bomu. However, none of the current speech developers in the VOICES team speaks Bambara or Bomu. To gain experience with the development in this local setting, we are first using Malian French, which is easier to start with than a totally unfamiliar language.

c. With the gained experience of the first pilot cycle, in VOICES, we are now working on a Bambara version of Radio Marché. We work on a system that will provide the same information in a computer-generated Bambara speaking voice. Bambara is the most-widely spoken language in Mali. The Bambara communiqué for Radio Marché is expected to be operational in late 2012. This is work done in WP3. The WP5 and WP3 teams work closely together on this topic.

To build the voice communiqué using a Slot & Filler Text to Speech approach (S&F TTS) real Malian voices were recorded at the radio stations of ORTM Ségou and Radio Moutian. The automated voice reads the communiqué from the following French text:

"INFORMATION SUR LES PRODUITS FORESTIERS NON LIGNEUX DU CERCLE DE TOMINIAN N° 04 Du 23 Mai 2011, Zone de production, Mafouné, Villages BOKUY-MANKOINA, prix d'unité 2000 fCFA » etc.

For WP3, user acceptance studies of the voice communiqué for Radio Marché have been done. Deliverable 3.3 reports on our first cycle of user acceptance studies, which had three major goals:

- To obtain an initial reading on the viability of our slot-and-filler (S&F) approach to the development of text-to-speech (TTS) systems;
- To learn about specific variables, that need detailed attention if such an approach is to be used in our pilot studies;
- To trial our user-acceptance methodology, in order to ensure that we employ a realistic experimental design for such studies during the rest of the project.

The development of speech technology for developing-world users poses several challenges, including the scarcity of relevant linguistic knowledge, the lack of suitable resources, difficulties with reliable infrastructure, etc. Given the extent of these challenges, it is not surprising that relatively few speech-technology components have been tested thoroughly in developing-world environment. Whereas end-to-end evaluations of systems using speech technology is fairly common in wealthy countries such as the USA or Germany, the limited number of research reports on speech technology for under-resourced languages typically end with a technology-focused (rather user-focused) assessment of the systems developed.

With the user acceptance studies we wish to assess the usability and desirability of speech technology as evaluated by the target populations for the VOICES pilot studies. This first cycle evaluated the intelligibility and naturalness of our initial set of slot-and-filler text-to-speech (TTS) systems, which function in West-African French.

3.3.1. User evaluation study for the voice interface

To this end, ten respondents were recruited in Bamako, mainly staff members from Sahel Eco, all Bambara speaking Malians. The respondents were asked to listen to renditions of the same content by our TTS system and a recorded voice, and then to assess the two systems individually and in comparison with each other. Both naturalness and intelligibility were investigated, and subjects were also requested to provide feedback on the speed of the system.

As expected, the subjects generally preferred the recorded speech. However, all ten respondents also found the TTS-generated speech either “very easy” or “somewhat easy” to understand. The subjects generally found the speech rates to be acceptable, and for both recorded and generated speech, the subjects who were not perfectly happy with the speed were almost equally likely to prefer slower and faster delivery – thus suggesting that the current rates are the best compromise available.

The study confirmed that the basic approach used to generate the speech is viable, and thus confirms that this aspect of the project can proceed as planned. It also produced some methodological insights, which will be useful during the further usability trials that will be performed within VOICES as well as in other developing-world trials of speech technology.
More information about the user studies can be found in VOICES Deliverable 3.3.

3.4. Living Labs

Throughout the development of Radio Marché we used Living Labs as the general approach. Wikipedia gives the following definition of the Living Labs methodology:

“A living lab is a research concept. A living lab is a user-centred, open-innovation ecosystem, often operating in a territorial context (e.g. city, agglomeration, region), integrating concurrent research and innovation processes within a public-private-people partnership.

The concept is based on a systematic user co-creation approach integrating research and innovation processes. These are integrated through the co-creation, exploration, experimentation and evaluation of innovative ideas, scenarios, concepts and related technological artefacts in real life use cases. Such use cases involve user communities, not only as observed subjects but also as a source of creation. This approach allows all involved stakeholders to concurrently consider both the global performance of a product or service and its potential adoption by users. This consideration may be made at the earlier stage of research and development and through all elements of the product life-cycle, from design up to recycling.

User centred research methods, such as action research, community informatics, contextual design, user-centred design, participatory design, empathic design, emotional design, and other usability methods, already exist but fail to sufficiently empower users for co-creating into open development environments. More recently, the Web 2.0 has demonstrated the positive impact of involving user communities in new product development (NPD) such as mass collaboration projects (e.g. Wikipedia, crowdsourcing, Wisdom of Crowds) in collectively creating new contents and applications.

A living lab is not similar to a test-bed as its philosophy is to turn users, from being traditionally considered as observed subjects for testing modules against requirements, into value creation in contributing to the co-creation and exploration of emerging ideas, breakthrough scenarios, innovative concepts and related artefacts. Hence, a Living lab rather constitutes an experiential environment, which could be compared to the concept of experiential learning, where users are immersed in a creative social space for designing and experiencing their own future. Living labs could also be used by policy makers and users/citizens for designing, exploring, experiencing and refining new policies and regulations in real-life scenarios for evaluating their potential impacts before their implementations…"
"

The development of Radio Marché has followed the Living Labs methodology, in which the end-users were involved in different stages of the development process. This user-centred approach proved effective in the use case analysis for different reasons.

a. At the start of the project the team of developers had insufficient experience and thus understanding of the local African rural context to make valid assumptions on behalf of the end-users about the functionality and usefulness of the Radio Marché system.
b. By involving end-users the system can be maximally contextualised, designed according to the local needs and conditions, both technical (e.g lack of infrastructure) and cultural (e.g. language issues, trust, perceived user-friendliness).
c. We want to investigate the outcomes of working in a creative social space with a multi-disciplinary team, (which we call the "W4RA networked community") involving ICT professionals, computer scientists, NGOs, regreening specialists, radio journalists, local entrepreneurs, speech technology experts, business developers, local farmers, while collaborating closely on several aspects of the same topic.

The initial design of the system was a result of use case and requirements analysis following the Living Labs approach. In Deliverables 1.1 and 5.1 an extensive description is given of this approach during two journeys of the WP5 team through Mali, Burkina Faso and Ghana in 2010. At the end of the VOICES project the outcomes of the Living Labs approach will be reported in the final deliverable.

From the subsequent iterations during development of the system, the following points were the results of end-user involvement and feedback:

1. Phone access has to be on a local phone line in Mali. The phone lines have to be local, to save costs for the end-users. This is an important requirement for the voice platform if it is to be deployed locally in a production environment.

2. The web-form has to be user friendly. The original design has been adapted in several cycles to make it more intuitive. The message is accessible for a certain period through phone, by phoning a local number. The audio quality must be OK, the voice must sound natural.

3. The so created “communiqué” has to be issued through voice in more than one language (French and Bomu). The original communiqué is in a Malian French dialect. However, it is very important from the end-user’s perspective to create voice communiqués in local languages such as Bomu and Bambara and many other languages because many people, especially those targeted by the voice systems do not speak French. There is need for a toolbox so that development of speech systems for under-resourced local languages becomes easier.

4. Some radio stations don’t have an Internet connection. However, for the bigger stations a web interface, where they can download the communiqué, is also useful.

5. The market data that is stored in the Radio marché system is very valuable on the longer run for market development and monitoring. It is therefore useful to provide a abstraction layer to these data. We are currently looking how to apply Linked Data principles, so that the data can be aggregated across regions, and accessible on the Web, in a later stage. This is being studied by researchers from VUA, outside the scope of VOICES, but closely related to the Radio Marché project.

6. User support, hardware and software maintenance are crucial. Local users will need training.Technical trainings are needed for local entrepreneurs of service providers who want to deploy voice systems.

4. DISCUSSION AND ROADMAP FOR RADIO MARCHÉ

4.1. Problems during deployment

A number of unforeseen events caused delays in the deployment; these were related to a variety of local and global circumstances, mostly beyond control of the VOICES team. Especially the testing and user feed-back has been delayed due to the external factors, unrelated to the stakeholders.

Still, the deployment of Radio Marché has only suffered minor delay. We are confident that the implementation will continue in the next few months, in close collaboration between all stakeholders, despite the challenging local conditions.

a. Malian phone numbers were not available in the period November 2011- April 2012, due to communication issues with the Malian telecom operator. The system could have been tested since November 2011, by the radio journalists in two stations. However, the local line that should be accessible through the Emerginov platform (platform A) gave no response to the phone calls. This flaw was only noticed when the technical WP5 team visited Mali in November 2011, and spoke to the radio journalist from radio Moutian. Before that time, we did see in the logs that the radio stations were not using the Radio Marché system, but not the reason why.

b. A coup d'état occurred in Mali on March 22th, 2012, in which president Amadou Toumani Touré was removed from power. This event took place a few weeks after the last meeting of WP5 team in Mali. The political unrest that followed this event took much of the attention of the local partners. Electricity outages occurred more often; the state radio (of which ORTM Ségou is part) was occupied by the rebellions, and travelling was unsafe during a period of several weeks. Meetings related to the VOICES-project were postponed. At the moment of writing this document, the situation has improved, after installation of a transitional government. The local safety is expected to improve in the coming months, and free elections will be held. The VOICES WP5 pilot is not expecting major problems in the deployment of Radio Marché, since our local W5 partner Sahel Eco continues the work as usual.

c. Seasonal fluctuations in production of non-timber forest products. Last April, when the system was technically ready for deployment, no communiqués were issued due to absence of offerings. After the dry season, the farmers will restart their trading efforts and send new offerings to Sahel Eco.

4.2. Roadmap for Radio Marché

In the following months we expect to test Radio Marché in a production environment, by asking the radio journalists of ORTM Segou and Radio Moutian if they can use the communiqués. As soon as we have their feedback, we can plan further steps.

In the following months we will concentrate on the development of the second cycle of the pilot: the m-event use case. The results of the second cycle will be reported in the next deliverable for WP5.

The m-agro knowledge sharing pilot is opening many new research questions that can be elaborated and further developed, also beyond the lifetime of the 36 months VOICES project. A roadmap for further developments, beyond the scope of VOICES, will include at least the following points;

- Expanding the S&F TTS in Malian French and Bambara to expand the options in Radio Marché.
- Resourcing of Bomu language to create communiques in this language as well;
- Expand Radio Marché across more villages, creating new instances of the system;
- Create sms interface/icons interface for entering data directly by farmers, without intervention of NGO or extension worker;
- Linked Data principles are applied to connect market information to other resources on the Web (of Data).
- The voice platform must be inexpensive and robust, if it is deployed locally. We are currently looking at technical solutions that are as easy and inexpensive as possible.
- Sustainability: is it possible to deploy a voice system under similar conditions as Radio Marché, and make it feasible from a local business prospective?
- Training of local stakeholders how to develop and deploy voice systems is necessary to ensure sustainability and local adoption of new technologies.

5. APPENDIX

5.1. List of scientific publications related to Radio Marché

Decentralised Open Data for World Citizens by Christophe Guéret, Victor de Boer and Anna Bon. Accepted for publication. PMOD Using Open Data policy modeling, citizen empowerment, data journalism. W3C. 2012

"Voice-based Access to Linked Market Data in the Sahel" by Victor de Boer, Nana Baah Gyan, Anna Bon, Pieter de Leenheer, Chris van Aart, Hans Akkermans. Presented at the First International Workshop on DownScaling the Semantic Web, hosted by Extended Semantic Web Conference 2012.

"The Web of Radios - Introducing African Community Radio as an interface to the Web of Data" by Anna Bon, Victor de Boer, Pieter De Leenheer, Chris van Aart, Nana Baah Gyan, Max Froumentin, Stephane Boyera, Mary Allen, Hans Akkermans. Presented at the First International Workshop on DownScaling the Semantic Web, hosted by Extended Semantic Web Conference 2012.

"Radio Marché: Distributed Voice- en Web Interfaced Market Information System under Rural Conditions" by Victor de Boer, Pieter De Leenheer, Anna Bon, Nana Baah Gyan, Chris van Aart, Christophe Guéret, Wendelien Tuyp, Stéphane Boyera, Mary Allen, Hans Akkermans. Accepted for publication in Proceedings of 24th International Conference on Advanced Information Systems Engineering, CAiSE'2012, Gdansk, Poland, 25 29 June 2012.

"Is data sharing the privilege of a few? Bringing Linked Data to those without the Web" by Christophe Guéret, Stefan Schlobach, Victor De Boer, Anna Bon and Hans Akkermans: Outrageous Ideas at International Semantic Web Conference (ISWC 2011). **Jury award winning paper. 1st Place**

"The Web of Voices: how to connect 4.5 billion internet-less people to the Web" by Chris van Aart, Anna Bon, Hans Akkermans, Victor de Boer, Stephane Boyera, Wendelien Tuyp, Nana Baah Gyan: Outrageous Ideas, International Semantic Web Conference 2011 (ISWC 2011). **Public award winning paper. 3rd Place.**

"Adapting Living Labs Methodology for Information Systems in Rural Areas: The Case of Mobile Voice technologies in Mali" by Nana Gyan, Victor de Boer, Hans Akkermans, Chris van Aart, Anna Bon, Wendelien Tuyp, Mary Allen. In prep.

"Is (Web) Science ready for Empowerment" by Hans Akkermans, Nana Baah Gyan, Anna Bon, Wendelien Tuyp, Stephane Boyera, Aman Grewal, Mary Allen. ACM Web Science Conference 2011.

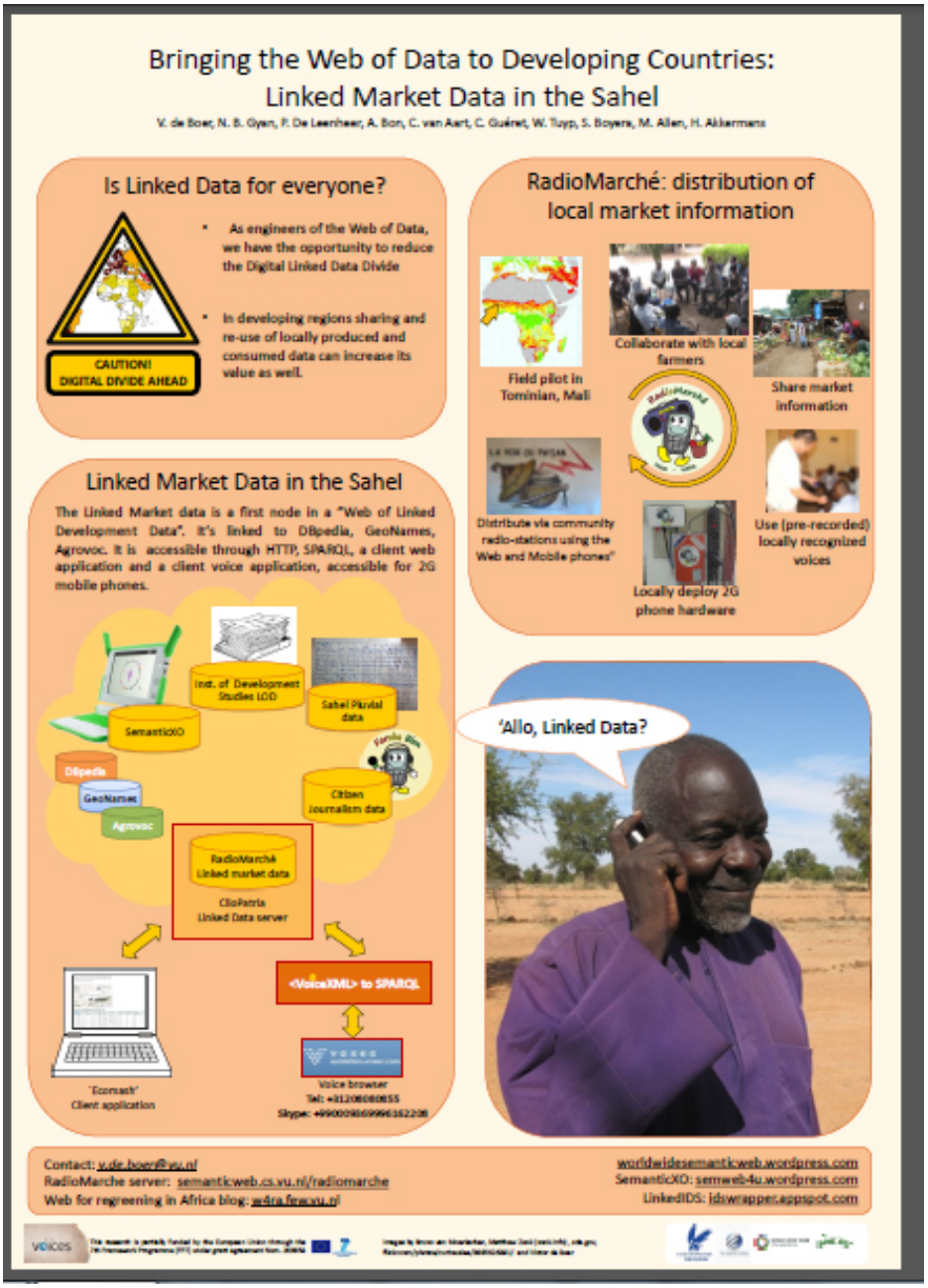

Figure 17: Bringing the Web of Data to Developing Countries - Linked Market Data in the Sahel Region. Poster by Victor de Boer, Nana Baah Gyan, Pieter de Leenheer, Anna Bon, Chris van Aart, Christophe Guéret, Wendelien Tuijp, Stephane Boyera, Mary Allen, Hans Akkermans. Presented at ESWC 2012, Heraklion, Greece. **Award winning "best poster**" at Extended Semantic Web Conference 2012.

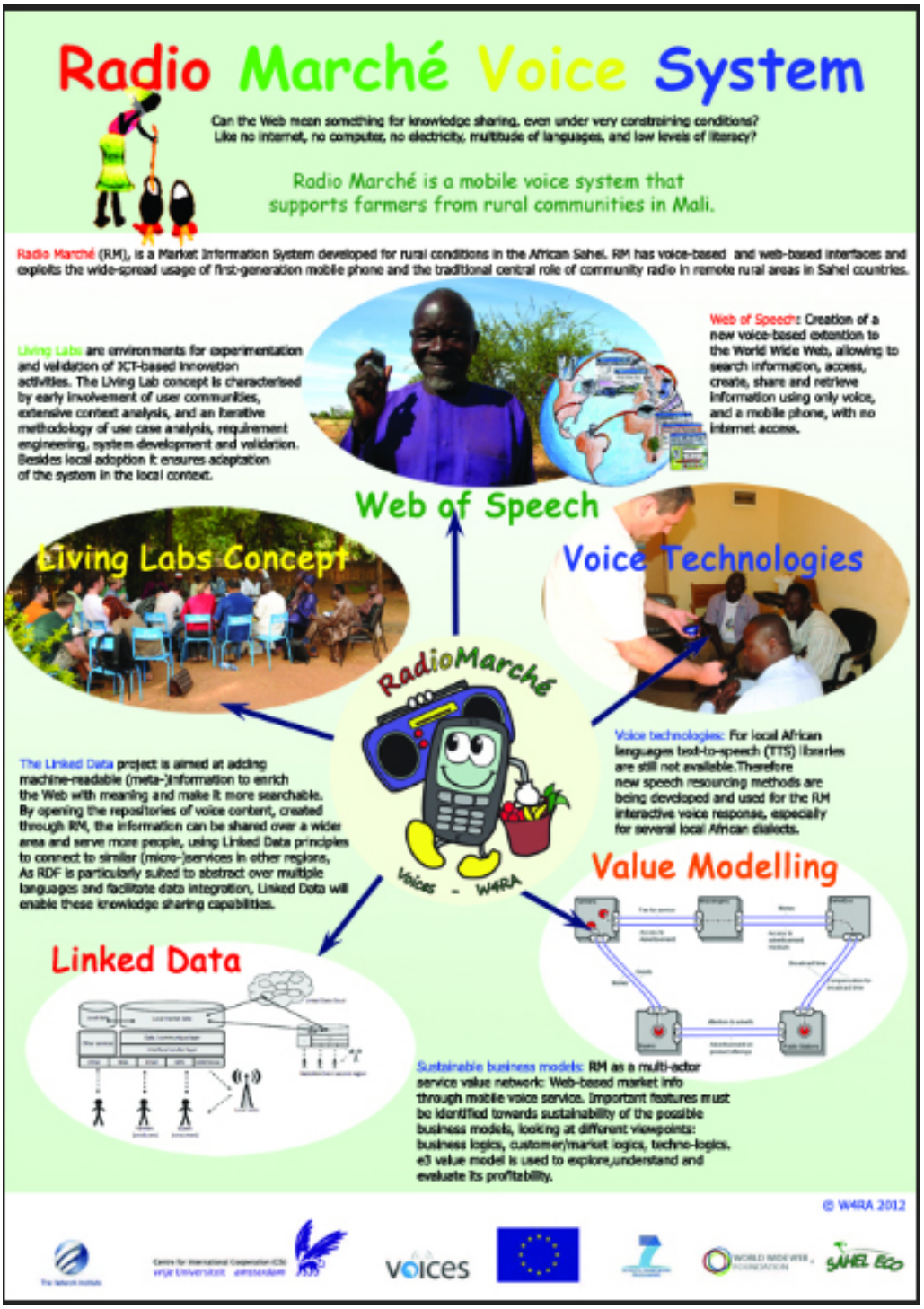

Figure 18: Different research activities that currently take place, as a direct result of the Radio Marché pilot.