



VOIce-based Community-cEntric mobile Services for social development

Grant Agreement Number 269954

**Deliverable No D5.1.**

**VOICES m-Agro Regreening Pilot Content and Specifications**

**DELIVERABLE D5.1**

Work Package 5

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## PREFACE AND SUMMARY

This VOICES Deliverable D5.1 provides the specifications and content of the WP5 m-agro regreening knowledge sharing pilot in Mali.

It follows up on deliverable D1.1 where we have given an extensive field-research based discussion of the use cases and requirements.

Out of this, two use cases were selected for the m-agro pilot, which are discussed in depth in this deliverable D5.1 together with the design and first implementation of the pilot system.

This deliverable contains the following:

First, we describe the use cases that will be involved in the m-agro knowledge sharing pilot. Use Case A (Radio Marché, Chapter 1) is part of cycle 1 of the pilot, Use Case B (m-event organizer, Chapter 2) will be part of cycle 2 of the pilot.

Next, we provide the technical design specs of the voice system for the WP5 pilot cycle 1 (Chapter 3): the Market Information voice-based service system associated with the Radio Marché use case.

Then, we discuss the user/stakeholder-oriented content and context background related to cycle 1 of the m-agro knowledge sharing pilot. It is based on a field trip in Mali that took place in November 2011 to prepare the launch of the pilot (Chapter 4), and to discuss pilot system use and test with future users: SahelEco for the market information collection and processing (Chapter 5) and radio stations for the broadcast of the market info voice communiqués (Chapter 6). Furthermore, stakeholder focus group discussions with farmers, the intended beneficiaries of the pilot system, are reported (Chapter 7).

In addition, some preliminary observations on future sustainability based on the field research in Mali are discussed in an Appendix.

Hans Akkermans and Anna Bon, editors



## **PART I: m-Agro Pilot Use Case Scenarios**

This part contains the descriptions of the use cases that will be involved in the m-agro knowledge sharing pilot. Use Case A (Radio Marché, Chapter 1) is part of cycle 1 of the pilot, Use Case B (m-event organizer, Chapter 2) will be part of cycle 2 of the pilot.

## Introduction

**Living Labs-based Approach.** Our methodology for developing, testing and deploying the Radio Marché pilot system is based on the Living Labs principles. Living Labs (LL) are experimentation and validation environments of ICT-based innovation activities. They are characterised by the early involvement of user communities, by openness in establishing a close cooperation between developers, users and other stakeholders, and by the creation of rapid learning cycles accelerating the innovation process. LL are a good match for deploying information and communication technologies in rural areas.

As part of our LL-like approach, we employ a strategy of first explicitly analysing the current situation and identifying use cases. We selected a paper-based system as the initial system. In the next step parts of the system are augmented with ICT, which is then analysed with respect to the effectiveness and local acceptance. The results of this first cycle determine the content of the next development-test cycle. By employing this iterative methodology rather than deploying a single end-application at once, we aim to promote local ownership of the system through early involvement and ensure that we understand and are able to meet all local requirements. A recent global research report by UNICEF on mobiles for development (M4D) states that among the reasons why many M4D projects fail is the lack of local content. By starting with an existing system, our development strategy presents a way of surmounting this challenge.

**Requirements and use case analysis.** The work contained in this deliverable D5.1 builds directly on the requirements and use case analysis work that is reported in VOICES deliverable D1.1 of WP1. Out of the many use cases analyzed there, two use cases have been selected (on combined grounds of stakeholder value, user interest and of technical feasibility) for implementation in the m-agro knowledge sharing pilot of WP5. These two pilot use cases are discussed in detail in the following Chapters 1 and 2.

## 1. USE CASE A – RADIO MARCHÉ

### Shea butter & honey trading service – Radio & Sahel Eco

#### Key idea

##### Current situation:

In brief, an extension worker collects weekly market information about shea butter and honey producers (sent by them via SMS or phone) in 20 villages near Tominian (product, quantity, price, and contact phone number) in an Excel sheet on his laptop. The market info document is then sent by email from a cyber cafe to 3 radio stations (ORTM Segou, Koutiala, ORTM Mopti), whereas a hard copy of the information is (physically) brought to Radio Moutian in Tominian (namely, it has no internet). The radios broadcast this info including the phone numbers of the producers.

Potential customers either phone Sahel Eco or phone the producer directly.

Current workflow. The Radio Marché envisaged m-agro pilot system in the Tominian area thus starts from an already running “legacy” MIS (SIM is the French acronym used for the Market Information System) that was set up by Sahel Eco in 2010. Sahel Eco is an NGO dedicated to promoting sustainable use of forest resources and develop 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 MIS is currently used to distribute up-to-date market information via community radio in the area.



*Model of the current value network for the MIS in Tominian, Mali*

In the current situation, a Sahel Eco staff member receives offerings from local farmer's representatives in the form of an SMS text message, containing information about offer, quantity, quality, price, name of the seller, village, phone number, etc. The SMS info is entered manually into the system. Every week, a communiqué is drafted by the staff member and from a cyber cafe sent to three radio stations (ORTM Segou, Koutiala, ORTM Mopti). Only ORTM Segou is connected to the internet, the other two radio stations receive their message by going to a nearby cyber cafe and printing out the email attachment. A fourth radio station, Radio Moutian in Tominian, has no internet access whatsoever. The staff member worker prints out a hard copy of the information which is physically brought to that radio station.

The radio stations each have an employee that reads the communiqués live on the radio multiple times per week. The radio stations are paid a fee for the broadcast. The potential buyers listen to the community radio and contact the sellers to buy.

#### INFORMATION SUR LES PRODUIT FORESTIER NON LIGNEUX DU CERCLE DE TOMINIAN

Zone de production (commune)	Villages	Nom du produit	Unité de mesure	quantité disponible	qualité du produit	prix au kg en F CFA	contacts
Mafouné	Soutè	amande de karité	kg	1800	amande ébouillantés	200	Mandiakuy Philippe TEL: 78 [REDACTED]
	Bokuy-Mankoina	miel	Litre	72	miel non brûlé	000	Zakari DIARRA TEL: 78 [REDACTED]
	Bokuy-Mankoina	Beurre de karité	kg	60	beurre issu des amandes ébouillanté	000	Zakari DIARRA TEL: 7 [REDACTED]
KOULA	Tiéblénikuy	Beurre de karité	kg	165	beurre issu des amandes ébouillanté	200	Gérard TRAORE TEL: 77 [REDACTED]

plus d'information contactez Monsieur Amadou TANGARA SAHEL ECO TOMINIAN TEL. 79 [REDACTED] NB : Pour ou le point focal de la radio que vous écoutez

*Example of a communiqué. Phone numbers are blurred for privacy reasons.*

#### Envisaged situation:

Producers (or their representatives) call directly to a service by mobile phone and leave info about the product they sell, price, their name and address.

Sahel Eco processes the information from the voice messages and creates the market info communiqués in text form via a web system, from which the spoken communiqués are automatically generated. The voice communiqués are accessible on a phone number and ready for direct broadcast by the radio stations via the mobile channel.

#### 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 Segou, Koutiala, Mopti, Radio Moutian	Broadcasts updates on price and producers
Sahel Eco coordinator (extension worker)	Collects/processes information from producers

## Context and scope

### a. Network configuration

In the diagram below an informal overview is given of the system.



Sahel Eco staff member fills in web form with information received previously by SMS from the farmer's representatives (MIS), containing info about offer, quantity, quality, price etc. name of the seller, village, phone number. The collection of the info in the villages is outside the scope of the current system. The SMS info is entered manually by the SahelEco coordinator into the system.

The information is processed to a voice-based message and sent as (automatic generated) voice content through phone to the radio, and also by email, as an audio message.

The radio station receives the “communiqué” and broadcasts it directly on the radio. The radio is paid a fee for the broadcast.

The potential buyers listen to the community radio and contact the sellers to buy. There is no direct involvement by SahelEco staff in the transaction stage.

b. Performance measures:

The audio quality of the voice communiqués over mobile has to be such that it can be broadcast over the radio.

c. Scope and context:

The scope of the system is the information going from Sahel Eco as voice message to the radio station for broadcasting. The data collection in the villages, the aggregated data sent to Sahel Eco and the posterior trading of shea butter and honey between sellers and buyers, after the radio broadcast, is left outside the current scope of the technical part of the pilot system. This is kept for further study at a later stage.

The context is a rural environment, where people communicate through voice, using simple mobile phones and where community radio is an important information hub.

d. Stakeholders:

Producers from 20 villages in the surroundings of Tominian, selling honey and shea butter.

The contact person who aggregates the offerings per village (a local extension worker or MIS contact farmer)

Sahel Eco that aggregates all offerings from the contact persons from each of the 20 villages

The local community radio stations that broadcast the messages

The potential buyers – listeners of the community radio

a. Preconditions

Some radios don't have computers nor internet and must broadcast directly from the phone

Some radios have computers but no internet

Internet connectivity in Mali is of poor quality

Used phone lines must be local lines

## Story board/Script

### Step 1

Sahel Eco receives offering by SMS from contact persons from farmer villages with offerings

### Step2

Sahel Eco enters manually the information on a web form for the Radio Marché system, on his/her computer

In the figures below an impression of the web form is shown:

VOICES - RADIO MARCHÉ MOCKUP - LOGIN

http://radiomarche.com

### Login to Radio Marche


username

password

VOICES - RADIO MARCHÉ MOCKUP - Communique

http://radiomarche.com

### Communique for Radio station Mafounde

Last communique  

Village	Contact	Product	Quantity	Measure	...
Soute	Phillippe	Amande	100	kg	
Soute	Phillippe	Buerre	20	ltr	
Bokuy-mankoina	Diarra	Amande	75	kg	
Bokuy-mankoina	Diarra	Buerre	30	ltr	

VOICES – RADIO MARCHÉ MOCKUP – Manage market data

http://radiomarche.com

### Add market data

Village: bokuy-mankoin ▼

Contact: Zakari Diarra

Product: amande de karite

Unit: kg ▼

Quantity: 1000 ▼

Quality: Good ▼

Currency: cfa ▼

Price: 20,00 ▼

Valid until: / /

Save

Step3

The Web form data are converted into voice form as a spoken communiqué

Step4

The voice message is made available to the radio through the mobile phone;

Step4

The radio station records the voice message and stores it;

Step5

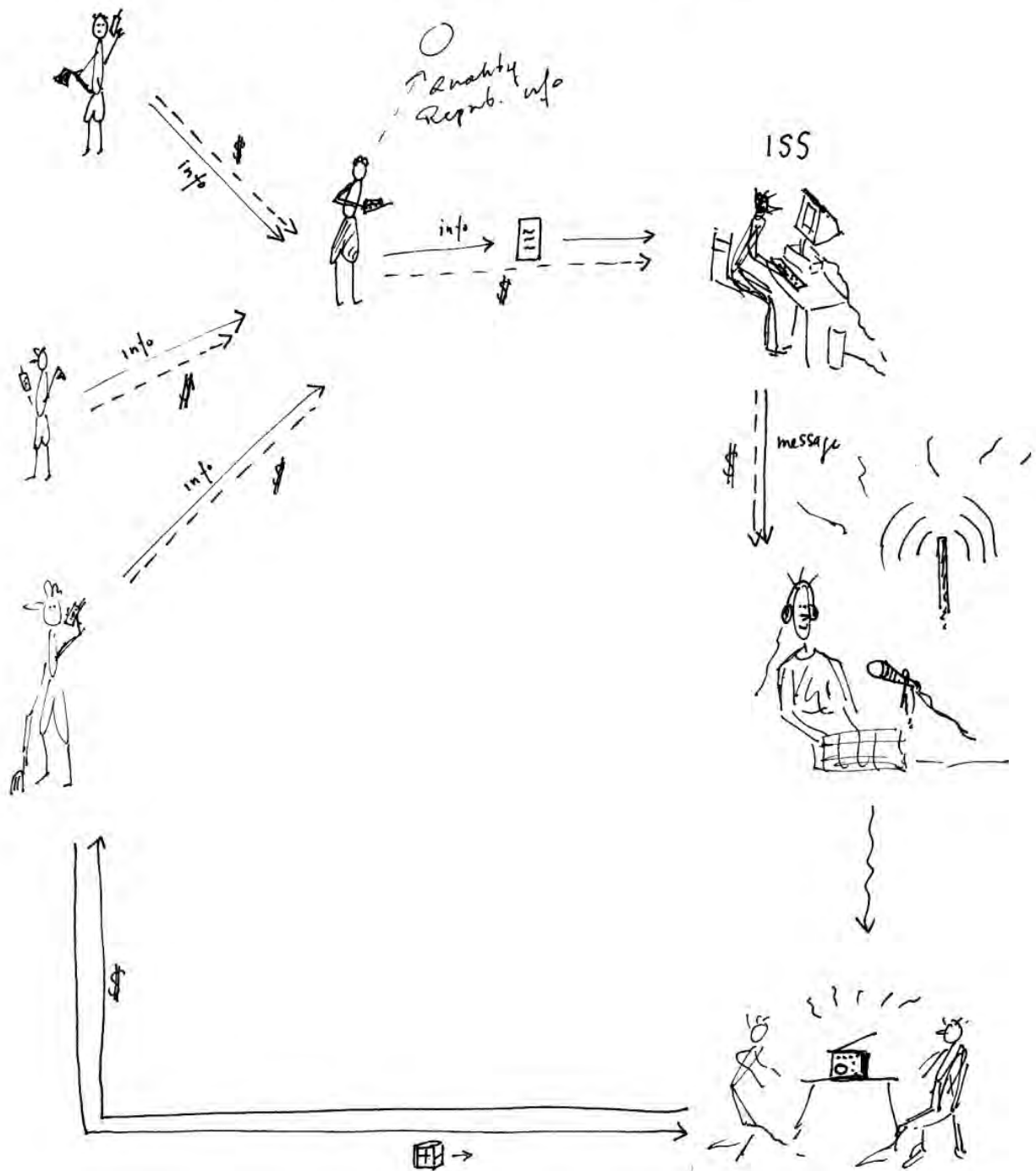
The radio station broadcasts the message on the radio.

## Interaction and communication structures

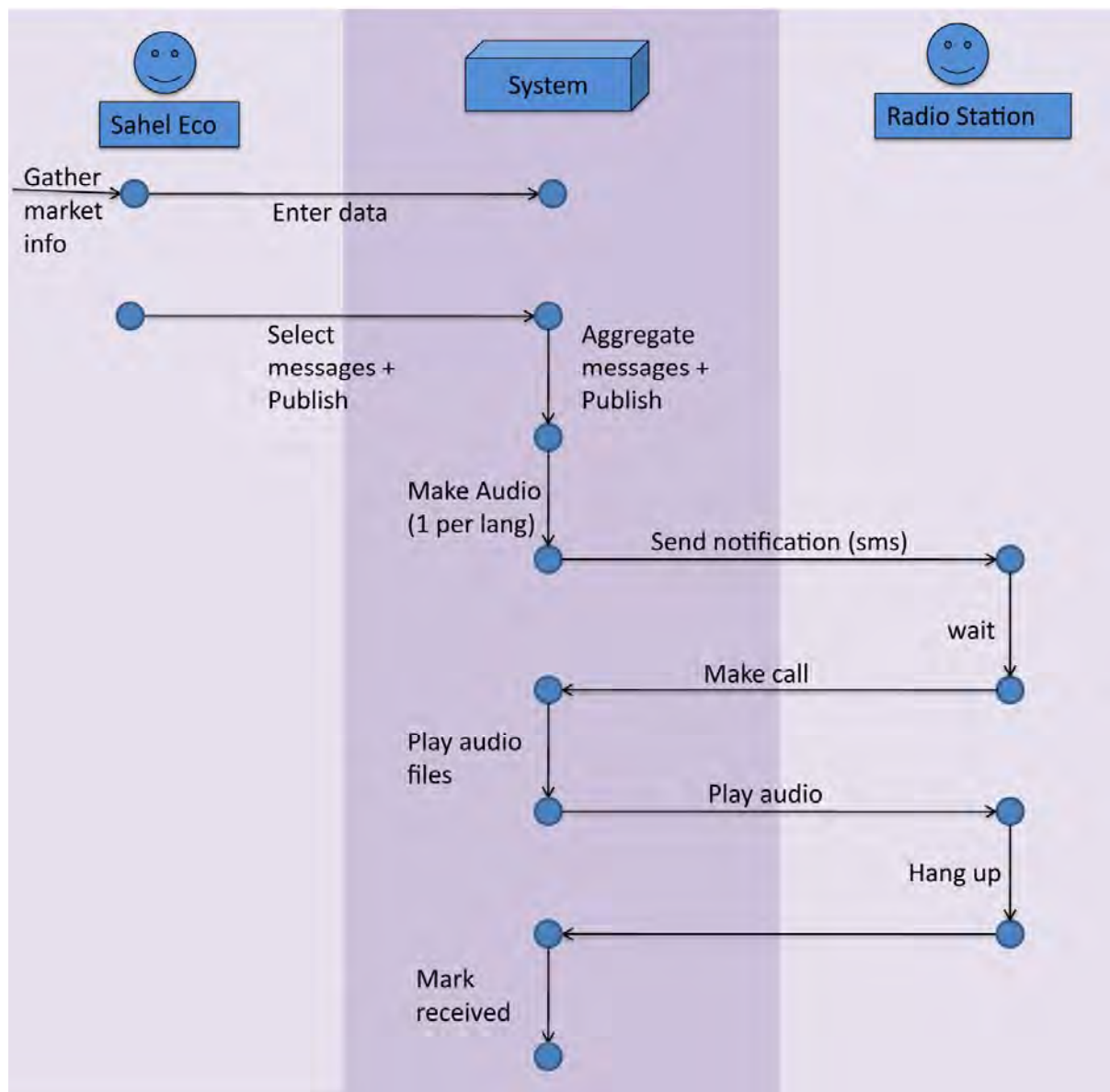
In the following diagrams interaction and communication is displayed for the stakeholders of the Radio Marché use case.

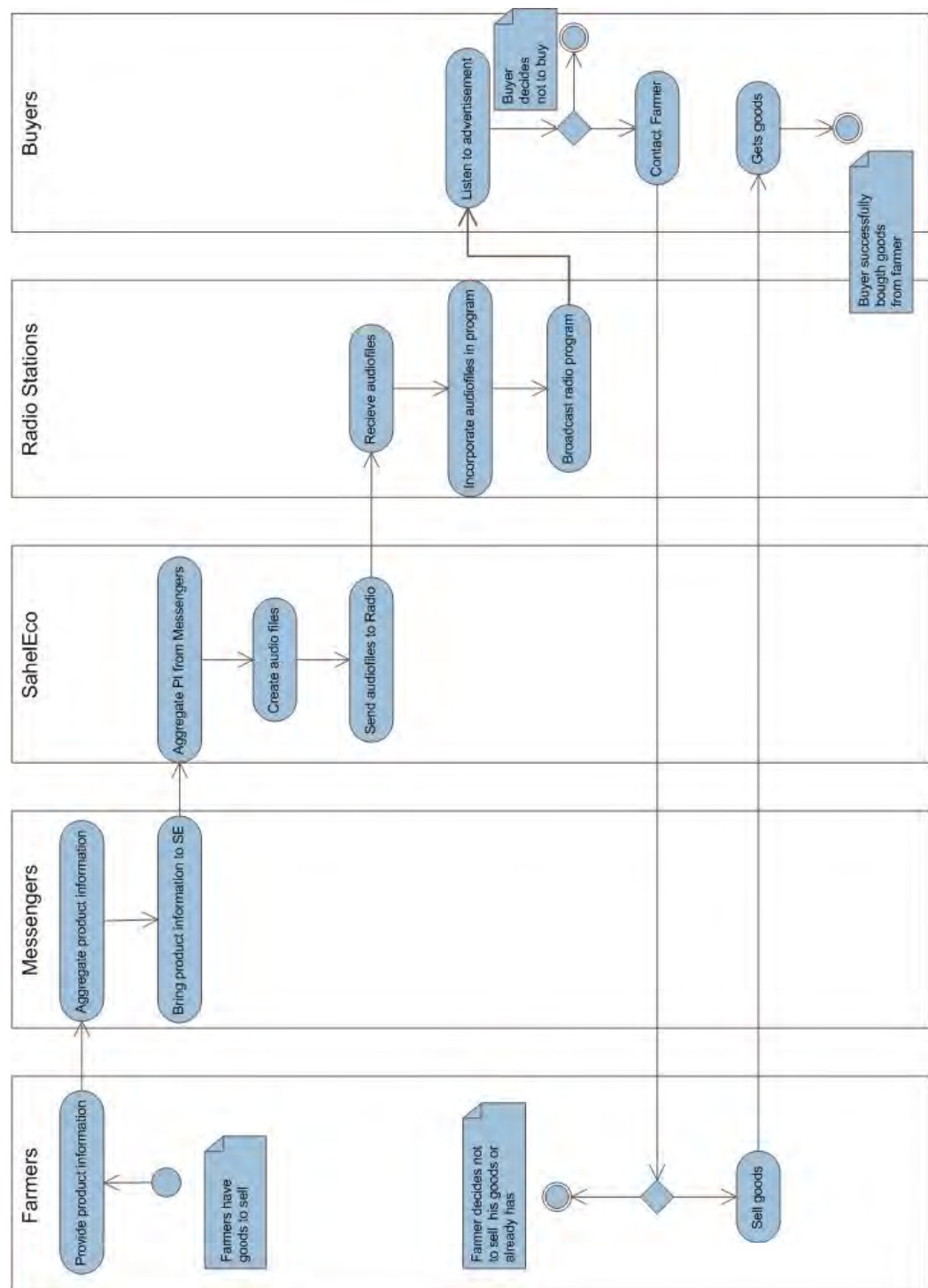


## Radio Marche Use Case - September 2011



*Sketch showing the total scope of the Radio Marché use case. In our system only the right part of the picture is chosen for the first-cycle piloting.*





Activity diagrams with swimlanes for the Radio Marché ("Sheabutter and Honey") pilot project.

## Information concepts

See the example communiqué on p. 12 of this Chapter 1.

## Technology infrastructure

See the discussion in Chapter 3, section on Physical View (Deployment).

## Cost considerations, feasibility and sustainability

See the results of the focus group discussions of Chapter 7 and Appendix B.

## Key requirements

### *Must have:*

- The Radio Marché server must have phone access on a local line in Mali. The phone lines have to be local, to save costs.
- The system has to provide a web-based input-form for the person who enters the offer.
- The web-form has to be user friendly according to the requirements set by Sahel Eco.
- The created "communiqué" has to be issued through voice in more than one language (French and Bambara). It has to be sent by email and over the phone.
- A database to store all the offerings entered.
- A module to create voice content from the entered data.
- A module to send audiofiles as phonecalls to a certain phonenumber.
- The phone connection must allow recording of the message for later broadcast.
- The message has to be accessible for a certain period through phone, by phoning a local number.
- The audio quality of the voice communiqué must be such that it can be broadcast over the radio
- User support
- Hardware + software maintenance

### *Should have:*

- Server should have internet access so that data can be entered remotely;
- A reliable data-backup facility;
- APS and backup power supply;
- The voices used to generate the message should sound familiar (local accent) in this region.

### *Could have:*

- Language support for Bambara and Bomu, as to create voice messages in these languages.
- Support for sending and receiving SMS

## 2. USE CASE B: M-EVENT ORGANIZER FOR REGREENING EVENTS

### Key idea

#### Current situation:

Sahel Eco organizes events and workshops to create awareness about regreening, farmer-to-farmer visits etc. Sahel Eco sometimes finds difficulty in making known to the people when the events take place. This goes often through word of mouth.

#### Envisaged situation:

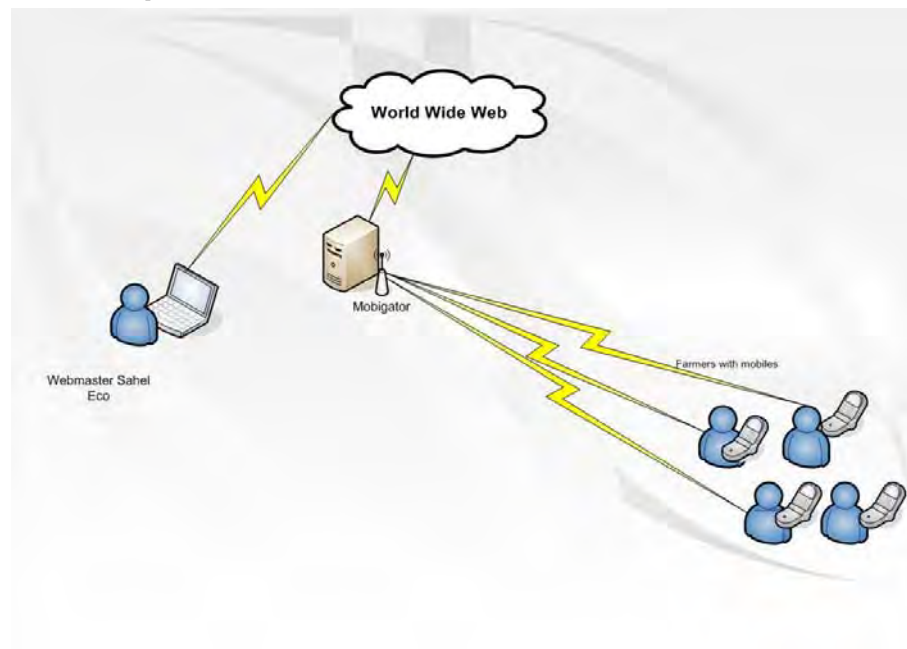
A registered number of farmers in a certain region (e.g. Tominian area, Mali) is notified by a voice message about time and place of a re-greening event. The “call for regreening event” is issued by Sahel Eco. Farmers can phone back and retrieve the info-message asynchronously. The message is (optionally) issued in several languages.

A staff member from Sahel Eco prepares a voice message telling about the event and a list of farmers, including their phone numbers. The Sahel Eco member then issues the voice message. All farmers who are on the list receive a phone-call with the message. They are asked whether they can attend the meeting. They can also listen to the message again, and leave a message. They can phone later to this phone number to retrieve the message again.

### Actors and goals

Actors	Operational goals
Farmers	Learn about regreening. Meet others who (already) practice regreening.
Sahel Eco	To reach many farmers and organize events to inform farmers more about re-greening techniques etc.

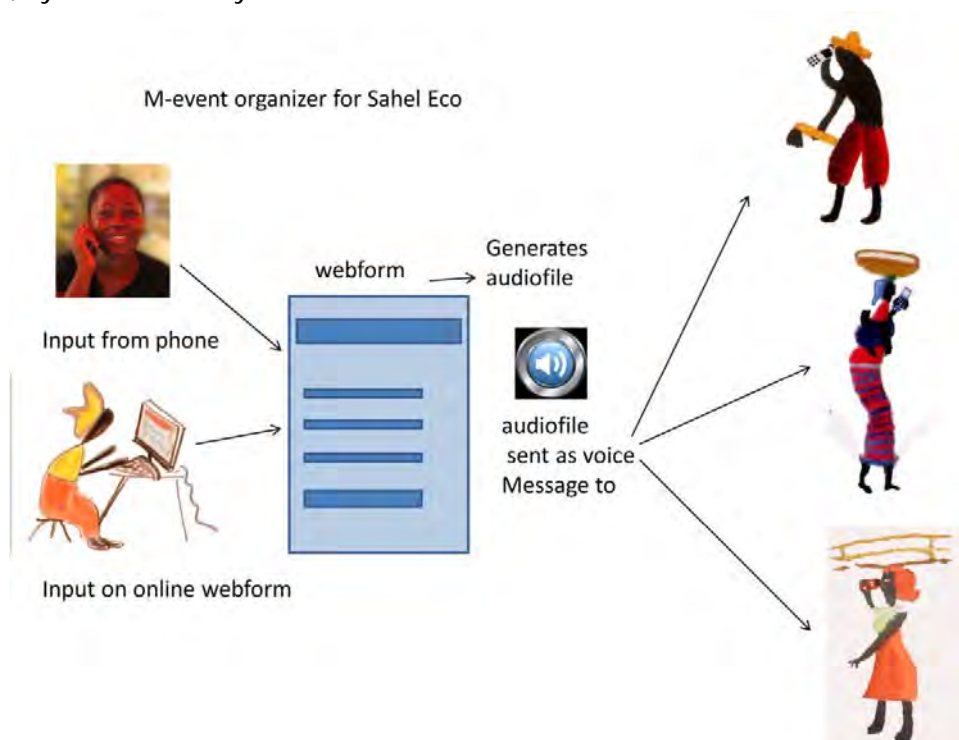
## Context and scope



*Layout sketch of possible user/system interaction*

a. In the above diagram a simplified network configuration for the m-event organizer is given. A micro-server has both Internet access and mobile access. The m-event organizing person (e.g. the Sahel Eco Webmaster) creates a message for the convocation of farmers for a Regreening event. S/he creates a user-list of farmers and their mobile phone-numbers. The message is then issued to the users. Users can phone back later to hear the message again.

b. Scope, system boundary



The scope of the system is a web-based environment with both internet, web text-based and mobile, voice-based interaction. In this particular use case it is a pilot for Sahel Eco to create a channel to communicate with its community of re-greening farmers through mobile phone.

#### c. Stakeholders and concerns

Stakeholders: Sahel Eco (staff and extension workers) and RNA farmers, other participants of SE events.

Concerns: reach the people with a message they can understand. Be able to change the message easily.

#### d. Preconditions

- System allows phone access and has a reliable internet connection, reliable power supply.
- Local phone lines are used, to avoid expensive international calls.
- Good system maintenance (hardware & software maintenance, data backup, APS, emergency power supply, end-user support, high uptime (>99%).

### Storyboard in ten steps

- Organize a regreening event:



Sahel Eco is organizing a meeting on Wednesday 20th of July in Tominian for farmers about regreening.

Sahel Eco has a list of 25 farmers and their phone-numbers.

A number of these farmers don't speak French, only Bomu.

Sahel Eco can make 25 phonecalls or issue a W4RA m-event organizing Message.

How does this work?



Aisha, staff member at Sahel Eco is going to use the m-event system.

#### Step1: Access m-event application

- Aisha, a staff member from Sahel Eco opens the m-event application and presses the m-event button
- (Her computer has a soundcard and a microphone and soundrec. software)

#### Step2: Enter users

Aisha is prompted by the system to enter



users and phone-numbers, from the people that will receive her voice message...

Step 3: Aisha enters user-list:

- Moussa Sangara, 23345565, Bambara
- Sidonie Mounkoro, 23268638, Bambara
- Jean-Batiste Dembele, 23566254, French
- ###

Step 4: Aisha enters voice message

- <<*How many languages do you want to enter?*>>
- 2
- <<*Now enter your voice message in the microphone of your computer*>>

Aisha records message after the beep, press # to finish:

- "Bonjour, il y aura un atelier pour vous informer sur le reverdissement du Sahel, le mercredi, 20 juillet à 20 heures, dans le bureau de Sahel Eco, Rue de la République, à Tominian."
- *Enter the same message in the second language, press # after you finish*
- "....."

Step 5: Aisha issues the mobile message

- *Press <send> button to send the voice message to the phone-list*
- "Your message has been sent successfully!"

Step 6: farmers receive message in their own language

Jean-Batiste      Sidonie      Moussa



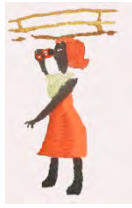
The system asks them

- "Will you attend the meeting, please press 1"
- "Are you not attending the meeting, please press 2"
- "Leave your message after the beep..."

..and the system logs this..

- Moussa – message delivered 12:30:45
- Sidonie – message delivered 12:30:45
- Jean-Batiste – <<phone switched off, message will be sent again in 6 hours>>





Step 7: User retrieves the message, later

Now Fatoumata calls to this Sahel Eco phone-number to hear the message as well. She was not on the user-list, but heard from Sidonie who gave her the phone number to call.

Step 8: Language selection

- The system receives Fatoumata's phonecall and records her phone-number in the user list.
- Fatoumata's call is answered by the system
- "parlez-vous Bambara?" appuyez sur le 1"
- "parlez-vous Français?, appuyez sur le 2"

Step 9: Fatoumata's user profile is created

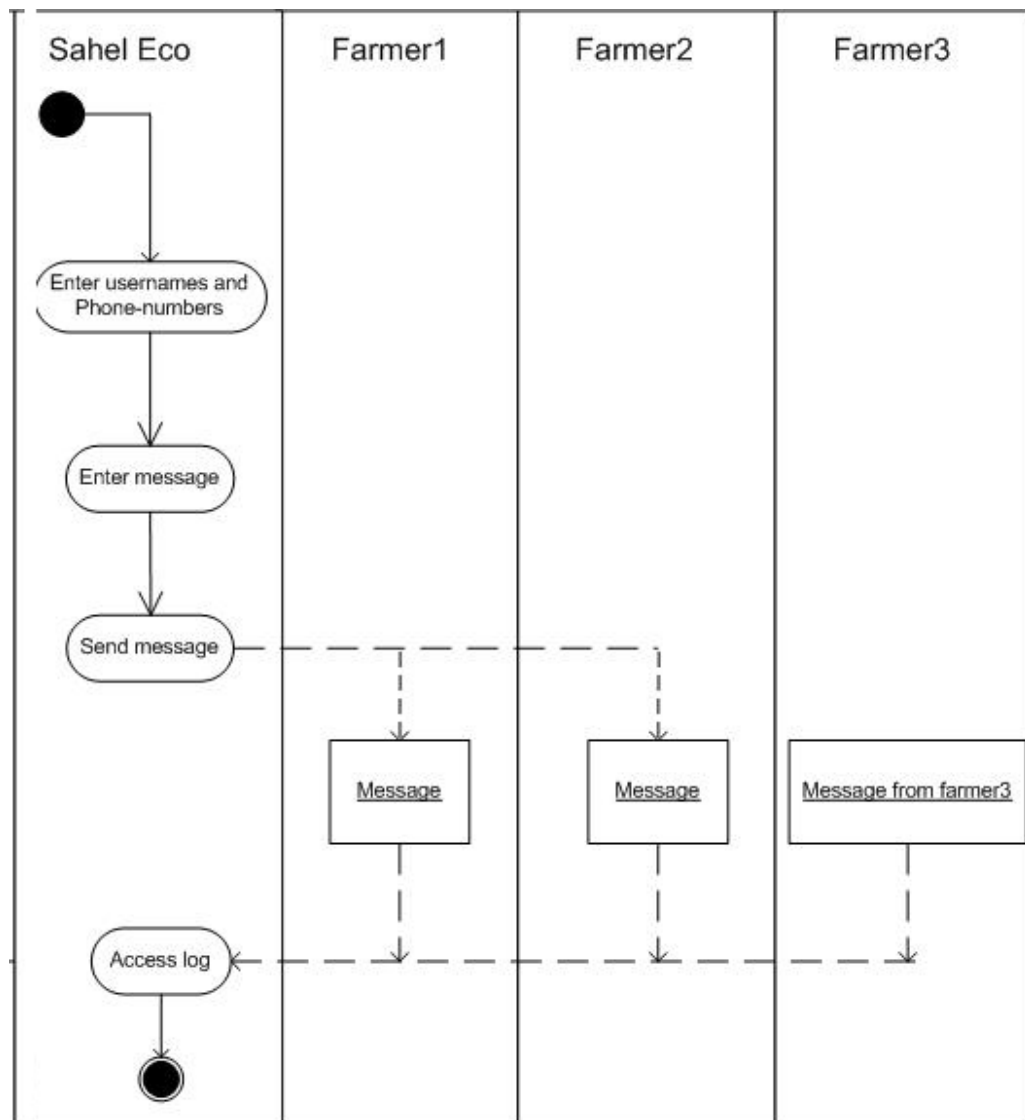
- Fatoumata hears the message in Bambara
- "there will be a regreening event, etc.
- Leave your message after the beep...
- Fatoumata's message is recorded:
- "My name is Fatoumata Traore from Finfini village. I will be at the workshop..."

Step10: Aisha, the webmaster of Sahel Eco accesses the system, next day

- Finds the new user Fatoumata,
- Her phone-number
- The time when she called
- Her language
- Her voice message in an audio file
- Aisha will also look at the user list
- To see who else has been reached by the message

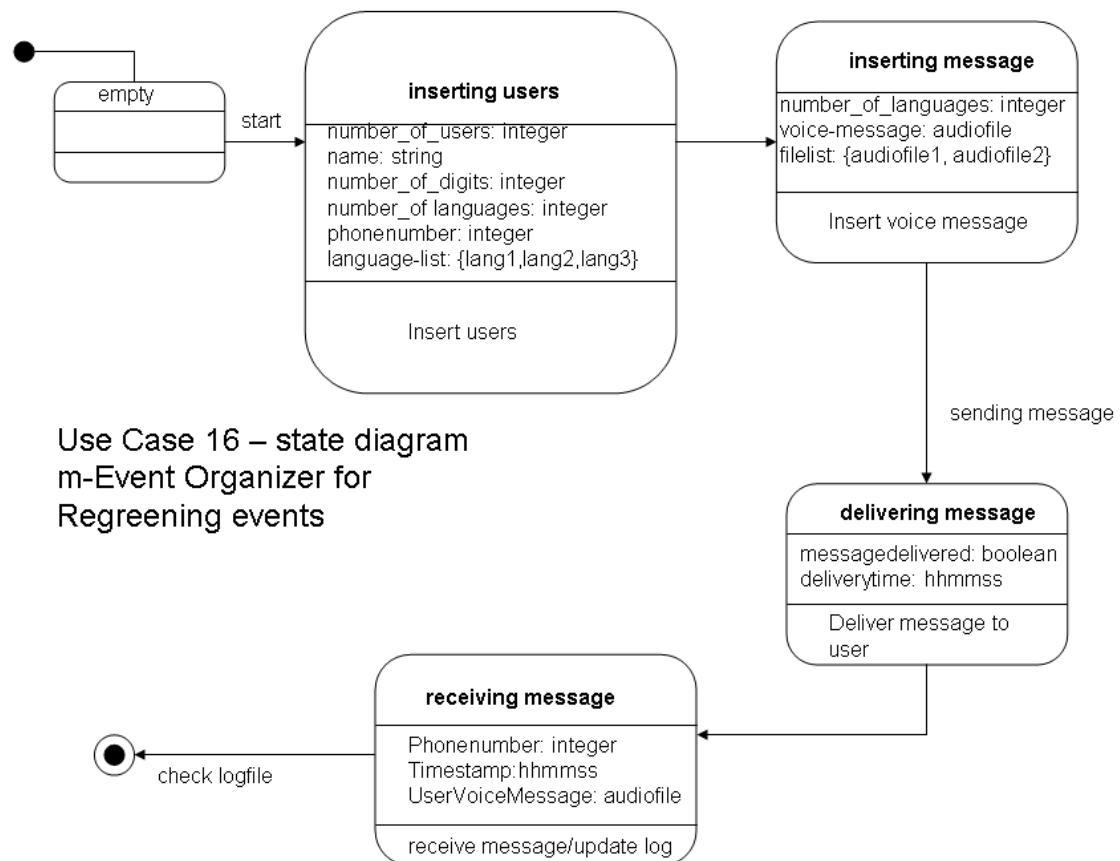
## Interaction and communication structures

In the next figure, an activity diagram is shown for the use case. The different activities, both internal (Sahel Eco) and external (communication with the farmers) are shown.



*Activity diagram Use Case B (m-event organization)*

In the following State Diagram the changes in the different states of the system are visualized.



Use Case 16 – state diagram  
m-Event Organizer for  
Regreening events

*State diagram for the m-event use case*

## Information concepts

See the above state diagram for the m-event use case.

## Technology infrastructure

The m-Event system is an extension of the pilot system and infrastructure of use case A, the Radio Marché system. See further the discussion in Chapter 3, section Physical View (Deployment).

## Cost considerations, feasibility and sustainability

The voice platform provides both phone access and internet access. To keep phone line costs inexpensive and local, the system is hosted in Mali.

During the VOICES project, we use the Emerginov platform, provided by Orange Labs and France Telecom from WP2. After the end of VOICES, it is not yet certain if this test platform will remain freely available. This will influence the sustainability of the business model. Alternative platform options will be explored as a Plan B, including local solutions for a voice platform, on top of which the voice services can be deployed.

## Key requirements

### *Must have:*

- The system is accessible by mobile phone by calling a number;
- Your phonecall is answered by the voice system;
- Sahel Eco (or webmaster) can create a voice message, delete the message, change the message;
- It is easy to create a user-list and enter user-names and their attributes (phone-numbers and optionally language prefs, group name);
- Easy to enter voice message through both web-based and phone-based;
- Dialogue system is in place to phone in and retrieve message;
- Optionally: The message is issued in a default language and in a second language; through DTMF it is possible to select the (second) language to hear the message.
- French and Bambara support

### *Should have:*

- Option to leave a message

### *Could have:*

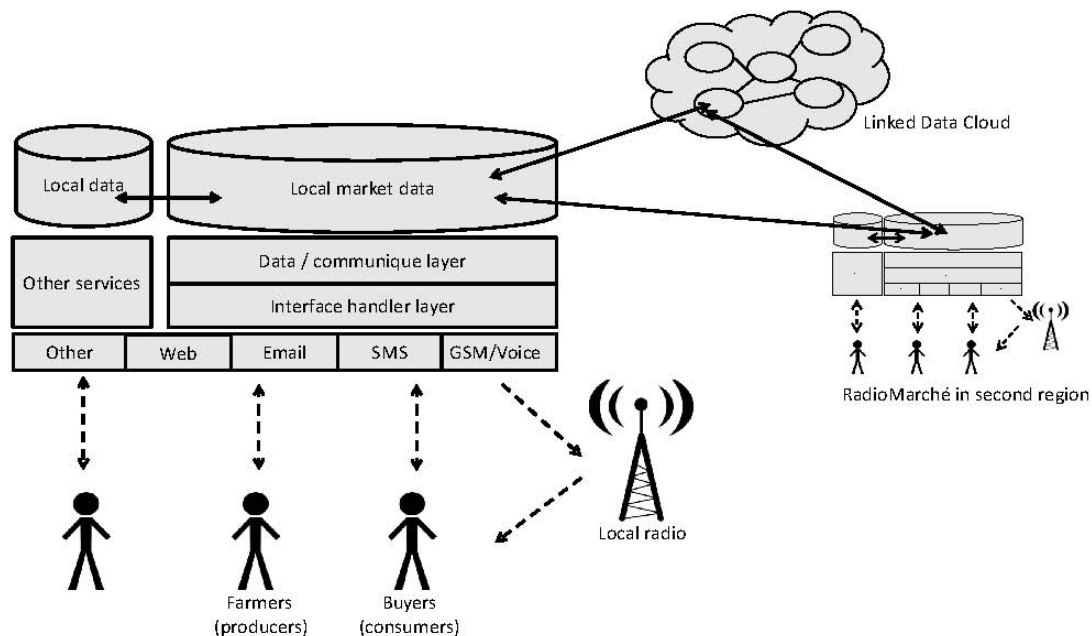
- Support of Bomu

## **PART II: m-Agro Pilot Technical Design Specifications**

This part discusses the technical design specifications of the system for the VOICES WP5 pilot cycle 1 (Chapter 3), following the UML modelling language and the "4+1 view" model of system architecture.

### 3. DESIGN

In this Chapter, we describe the overall design of the Radio Marché (RM) system. The Figure below shows a high-level overview of the system architecture.



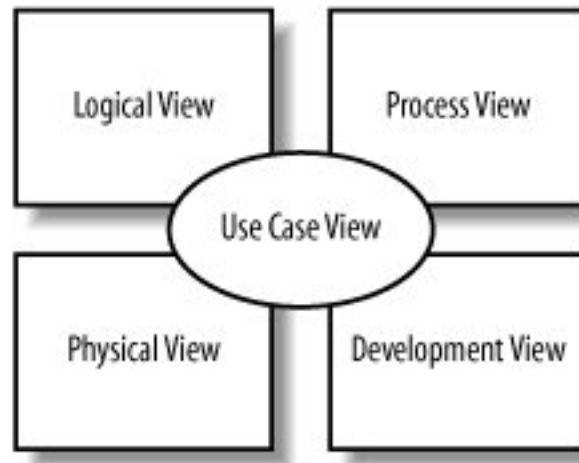
*Conceptual design of the Radio Marché system. The system provides alternative interfaces based on voice or SMS via phone or radio, enabling a wider audience to consume and contribute content. The data design is to be optimized for (i) effective aggregation with other RM instances and data sources from other domains in the Cloud; and (ii) reuse by other services.*

For describing the specifications of the Radio Marché system, we use the Unified Modelling Language (UML) modelling language.

UML can be used in three ways:

- UML as a sketch: Use UML to make brief sketches to convey key points. These are throwaway sketches they could be written on a whiteboard.
- UML as a blueprint: Provide a detailed specification of a system with UML diagrams. These diagrams would not be disposable but would be generated with a UML tool. This approach is generally associated with software systems and usually involves using forward and reverse engineering to keep the model synchronized with the code.
- UML as a programming language: This goes directly from a UML model to executable code (not just portions of the code as with forward engineering), meaning that every aspect of the system is modelled. Theoretically, the models can be kept indefinitely and use transformations and code generation to deploy to different environments.

In this document we use UML as a sketch and as a blueprint. In particular we use the Kruchten's 4+1 architectural views model (1999) to provide different views capturing specific aspects of the pilot system.



### Use Case View (Requirements)

The use case view for Radio Marché has already been extensively discussed in Chapter 1. Accordingly, it will provide functionality to three actors:

- NGO
- Radio Station
- Support

Every actor needs the following functionality:

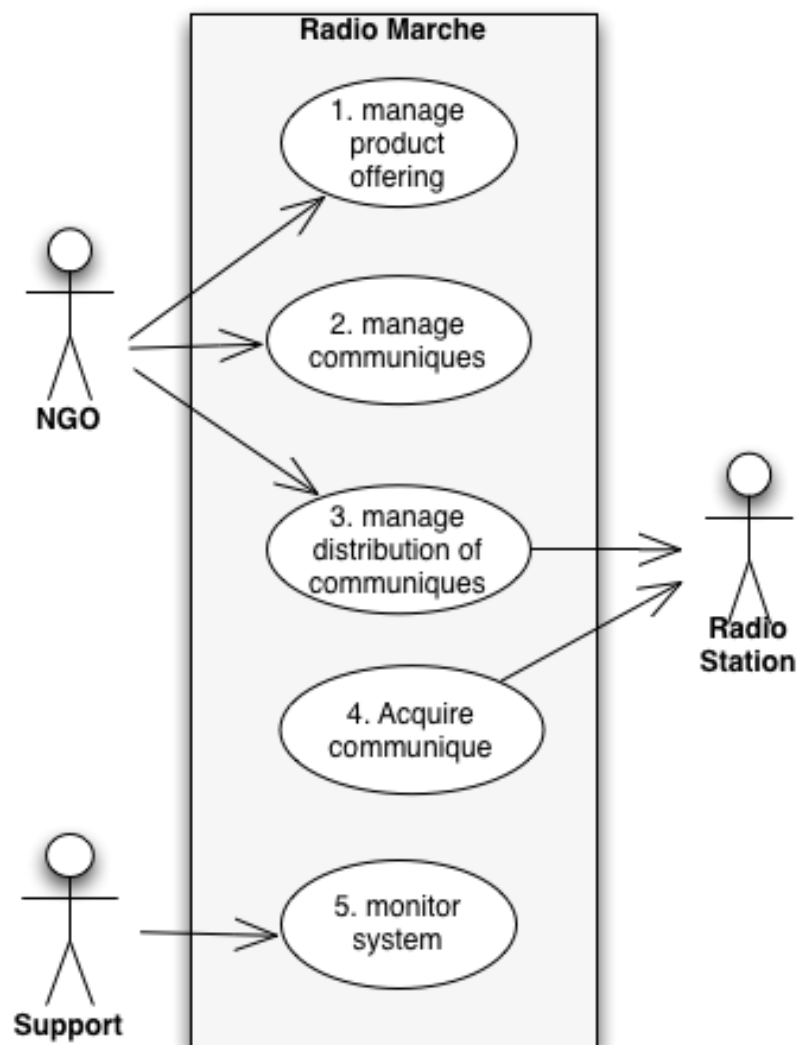
ID	Actor	Description
1	NGO	Enter Market Information
2	NGO	Create Audio Radio Communiqué
3	NGO	Check Content and Quality Radio Communiqué
4	NGO	Distribute Communiqué
5	NGO	Archive Communiqué
6	NGO	Notify Radio Stations
7	NGO	Generate Communiqué Report
8	Radio Station	Acquire Communiqué, in textual or audio format
9	Radio Station	Play Communiqué on Radio
10	Support	Monitor System

Each of these use case items may be specified in some more detail, for example ID#1:

Name	Enter (and manage) market data
Goal in Context	Input for Radio communiqués can be entered, modified and aggregated
Preconditions	Data is available in some form, mostly from SMS or spoken data transfer
Successful End conditions	System is online Data is successfully entered
Failed End conditions	System is offline

	Data cannot be entered due to ....
Primary Actor(s)	NGO
Main flow	<ol style="list-style-type: none"> <li>1. Login</li> <li>2. Select product line</li> <li>3. Enter market data</li> <li>4. Save</li> <li>5. Modify</li> <li>6. Delete</li> <li>7. Archive</li> </ol>

Combining requirements leads to the following summary use case diagram for the Radio Marché pilot system:

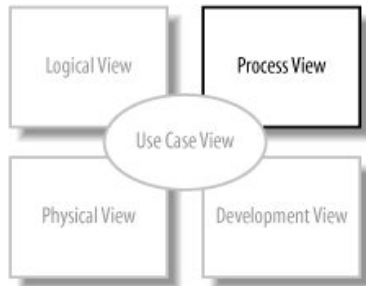


*Summary use case diagram for the Radio Marché pilot system*



## Process View (System Workflow)

The process view describes the processes within your system. It is particularly helpful when visualizing what must happen within the system. This view typically contains activity diagrams.

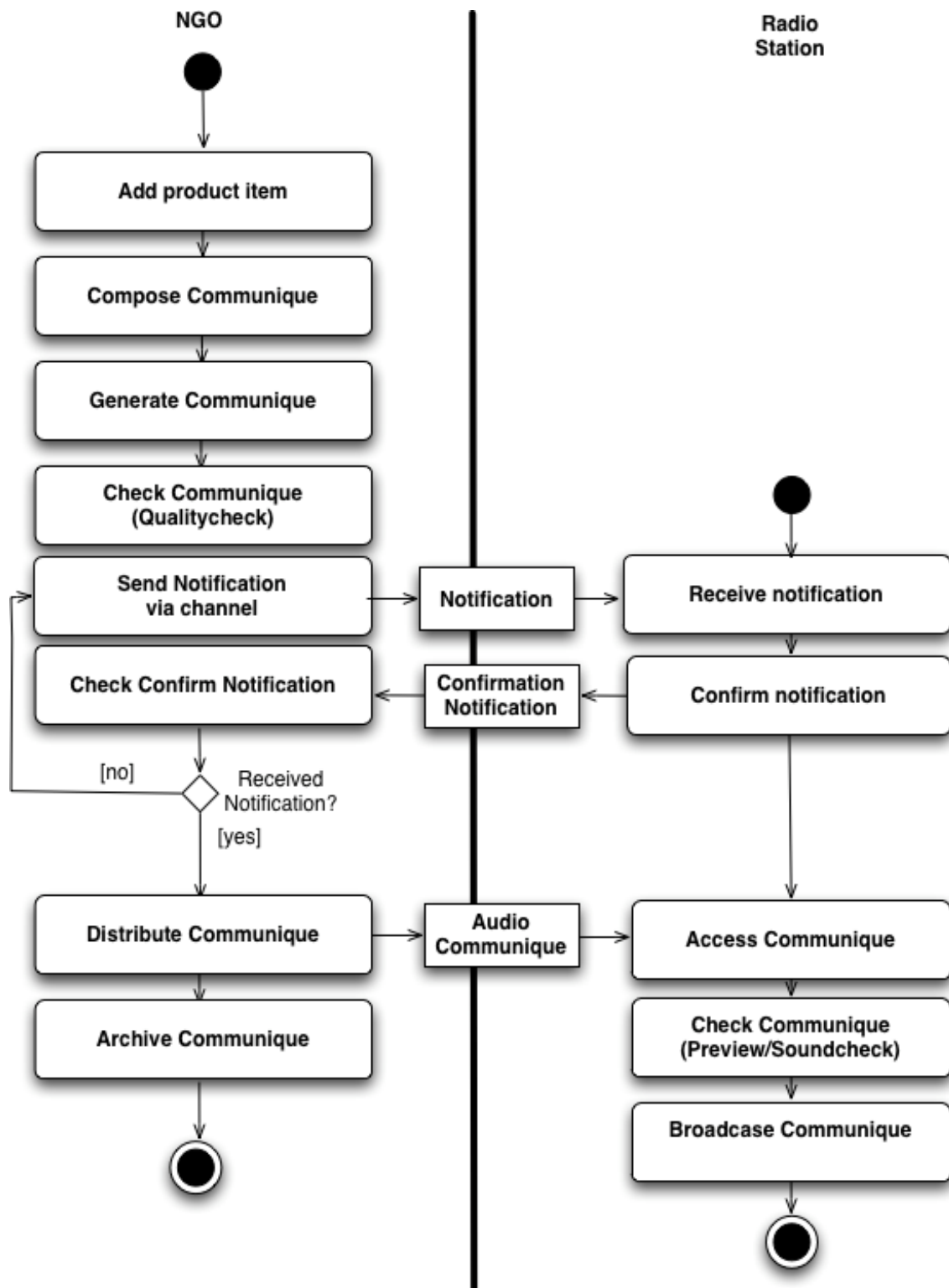


Where use case diagrams show *what* the system should do. Activity diagrams specify *how* the system will accomplish its goals. Activity diagrams show high-level actions chained together to represent a process occurring in a system.

The main actors in the actual system are:

- **NGO (operator):** The NGO has as steps:
  - Managing product data by **adding product items** (including price, quality quantity, region and contact data)
  - **Composing a communiqué** by selecting a number of product to be communicated.
  - **Generate 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 broadcast)
  - **Check the quality of a communiqué.** Both the quality of the content and audio will be assessed.
  - **Send notification** to radiostations that are relevant for this communiqué (based on region) via a channel (including SMS and email). The NGO will notify the radiostation in case of a new or adjusted communiqué
  - Wait for **confirmation** of a notification.
  - When a notification is not received the NGO will **resend the notification** Otherwise proceed to the next step
  - The actual communiqué will be **distributed**, either via text or audio
  - Finally the communiqué will be **archived**
- **Radio station (operator):**
  - **Receive notification** of the system: a new communiqué relevant for this radio station is pending to be broadcast
  - **Confirm notification:** via sms or email the radio station confirm receiving the notification
  - After download, **the quality of the communiqué** will be checked
  - The communiqué will be broadcast.

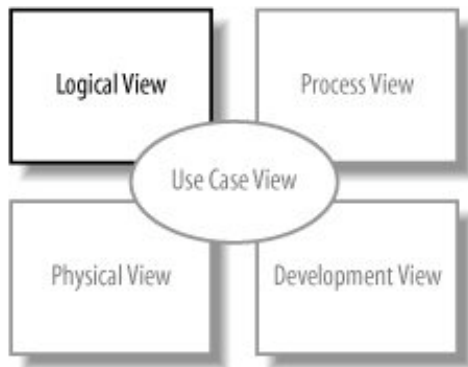
The Radio Marché overall activity diagram then reads:



Radio Marché summary activity diagram

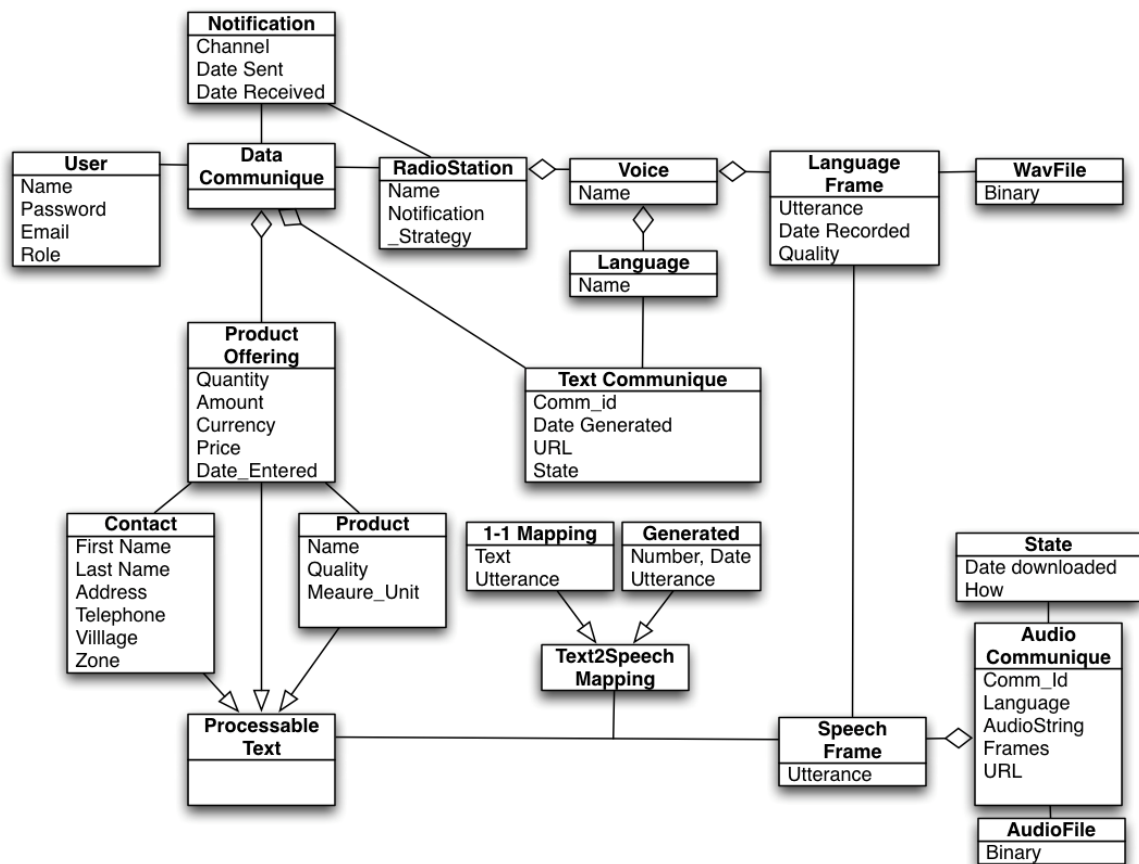
## Logical View (System Structure)

Describes the abstract descriptions of the system's parts, and is used to model what a system is made up of and how the parts interact with each other.



**Information model.** For Radio Marché, the information model, which is used for the design of the databases within the system is composed of five parts:

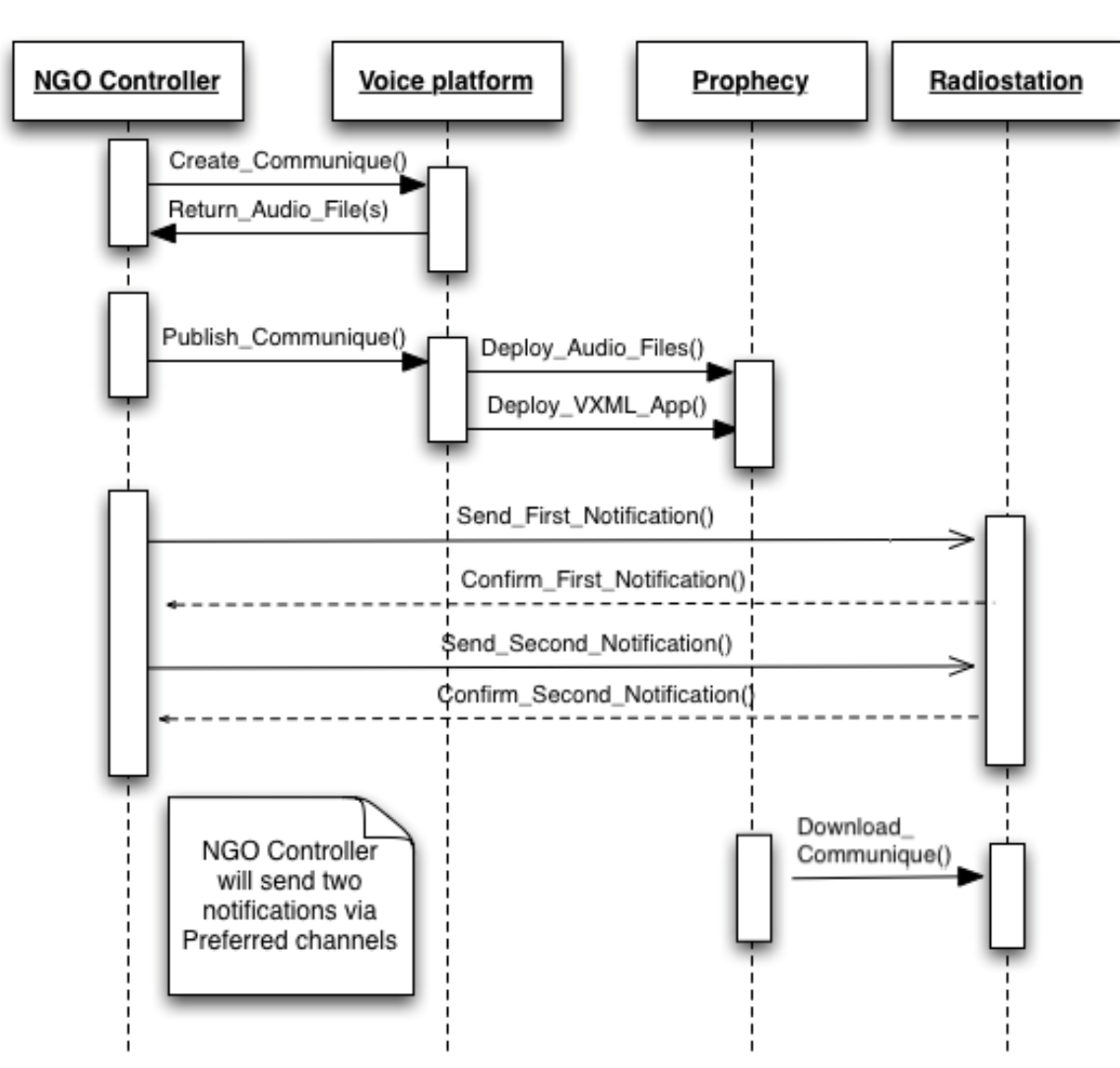
- Product offering: the actual market information, represented by the objects: **Product Offering, Contact, Product**
- Text Communiqués: textual representation of the market information, represented by the object: **Text Communiqués**
- Voices: fragments/frame samples of human voices, represented by the objects: **Voice, Language, Language Frame, Wavfile**
- Audio communiqués: audio representation of text communiqués, including mapping rules, represented by the objects: **Text2Speech, 1-1 Mapping, Generated, Speech Frame, Audio Communiqué and Audio File.**
- Workflow data in the form of the objects: **users, radiostations and notifications**



*Radio Marché information model as given by a UML class diagram*

**Operation.** The main workflow in the system is composed of the following participants (or active objects):

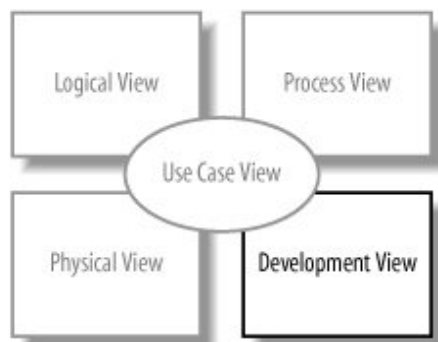
- **NGO Controller**, with as main tasks:
  - Delegates the task of generating a communiqué to the voice platform. The voice platform receives a text communiqué represented in JSON. The JSON is made up of mainly the ids of the various voice parts to be concatenated into words or sentences. The voice 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.
  - Manages notifications with the radio station
- **Voice Platform**, with as main task: composes the actual audio communiqué based on the JSON input. It also consists of a voice browser (e.g. 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.
- **Radio Station**, with as main tasks:
  - Acknowledge notification
  - Download notification (the actual broadcast is out of scope of the Radio Marche system)



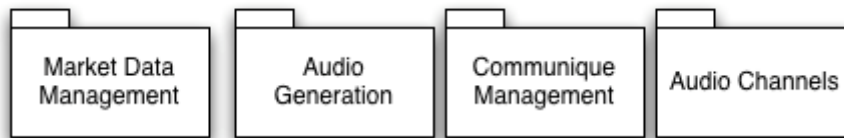
*Radio Marché system workflow as given by a UML sequence diagram*

## Development View (Software Implementation)

Describes how the system's parts are organized into modules and components. It is very useful to manage layers within your system's architecture. This view typically contains package and component diagrams.



**Radio Marché Packages.** The Radio Marché system is composed of the following packages:



**Market Data management** is responsible for the following tasks:

- Manage product information in the form of text communiqués
- Manage workflow flow with the radio station
- Delegate audio generation to the Audio generation package
- Delegate audio transport to the communiqué management

**Audio generation** is responsible for the following tasks:

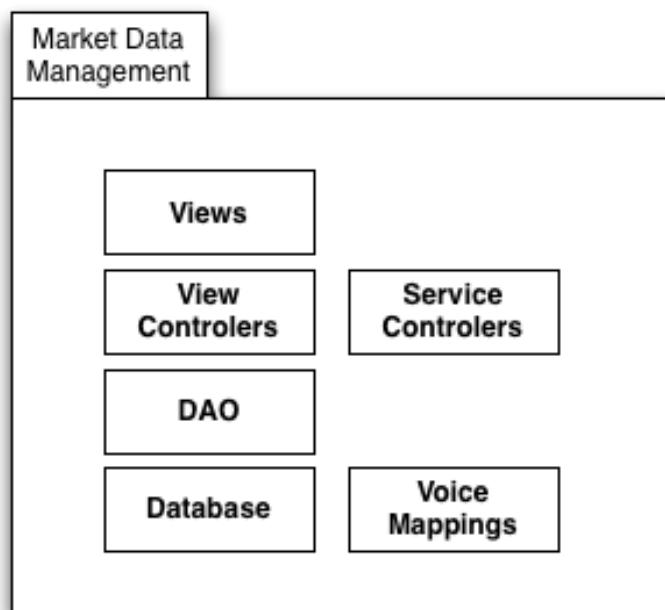
- Manage fragments/ sample audio frames of various voices in various languages
- Generate audio files based on textual input

**Communiqué management** has as main tasks:

- Distribute audio communiqué via on the available audio channels
- Archive audio communiqués

**Audio channels manage audio channels, such as:**

- Emerginov: This option has both the web interface and voice platform and communiqué platform running on servers (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 of covered under the project (Mali in this instance).
- 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 SIP channel to communicate with running Voice browser (prophecy) on a local laptop.
- Website: Website provides another means for generated audio communiqué to be downloaded and played live on air by the radio station.
- FTP: FTP channels would also be provided when the need arises to augment means of getting audio generated communiqué from the platform.

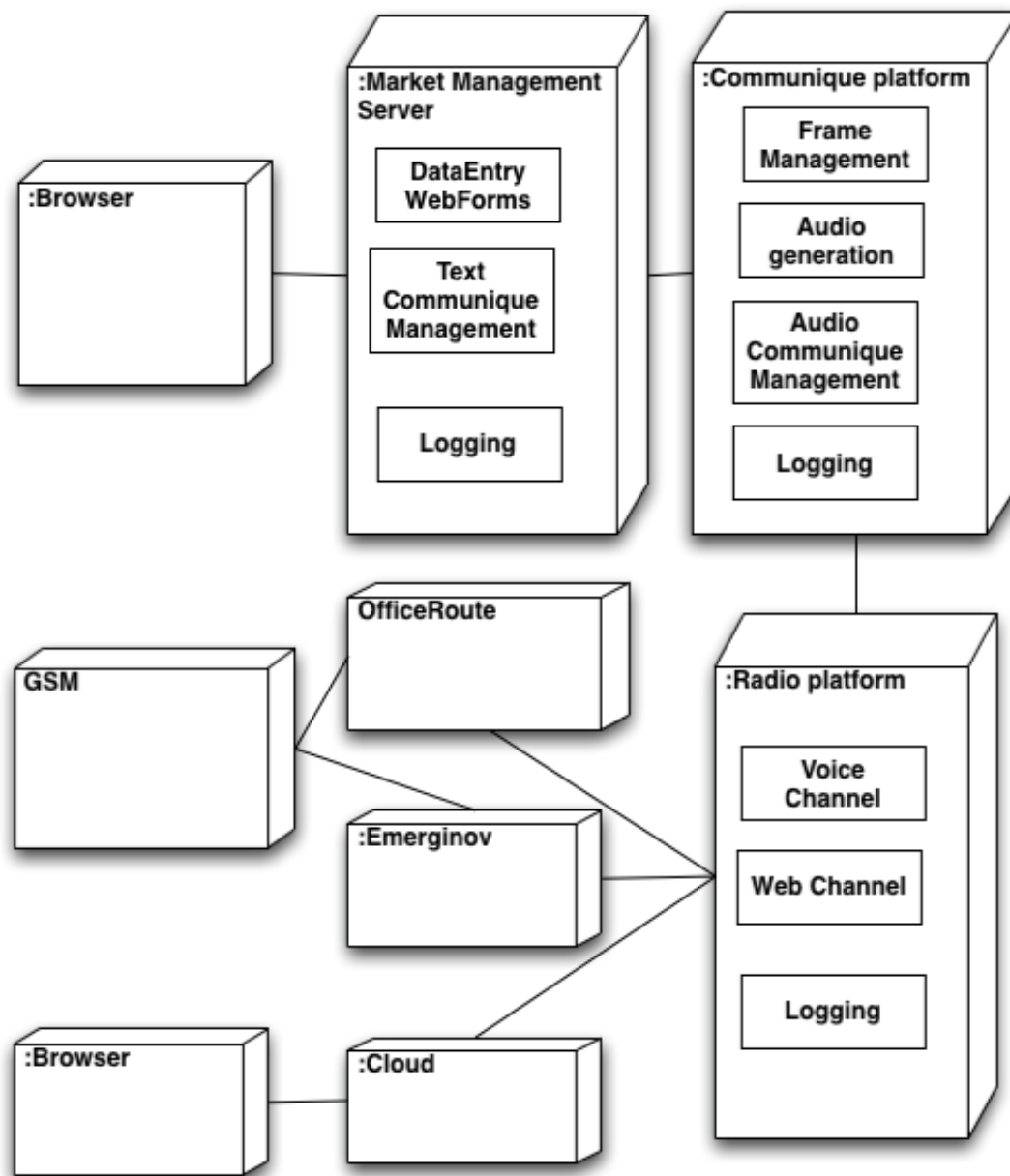


**Market Data Management.** The technical architecture of the Market Data system is composed of 4-tier architectural layers:

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

### Physical view (Deployment)

Describes how the system's design, as described in the three previous views, is then brought to life as a set of real-world entities. The diagrams in this view show how the abstract parts map into the final deployed system.

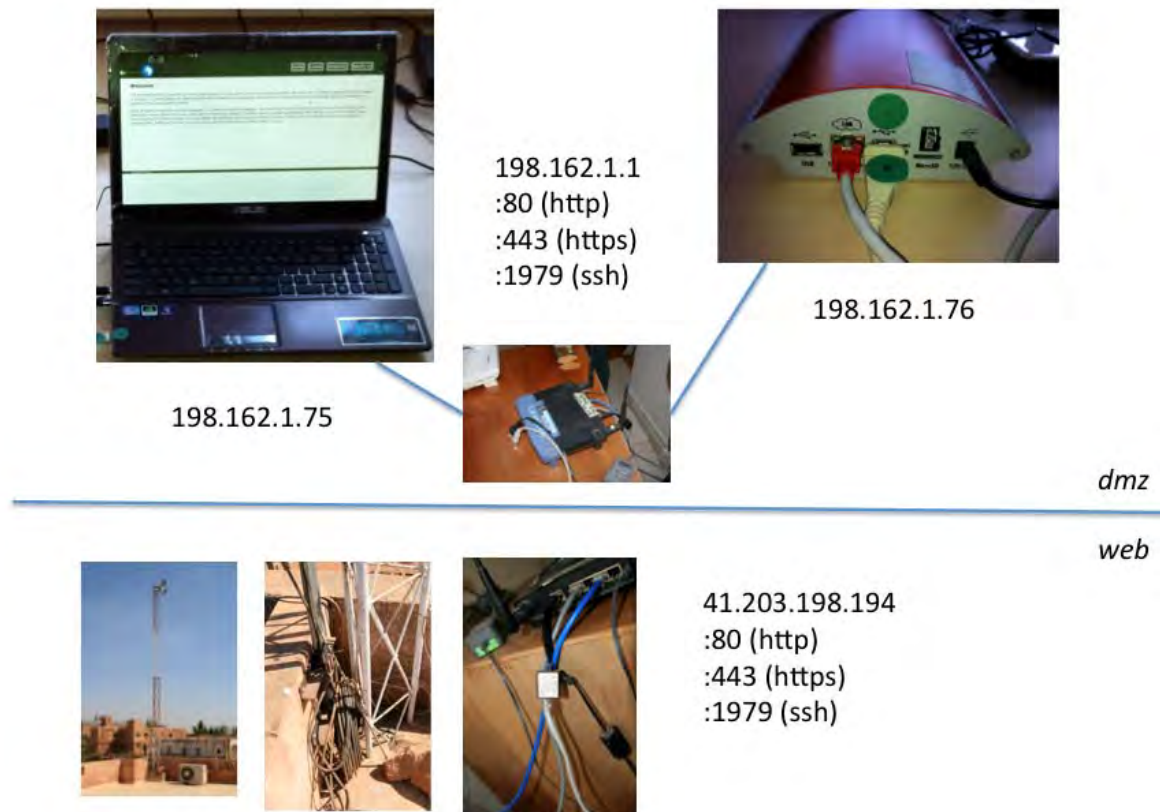


*Radio Marché system: deployment diagram*

The deployed system consists of a web browser of choice, voice platform and communique platform and the web interface which is deployed either locally on a machine, on the Emerginov platform, or in the cloud.

Each deployment method operates as described above in the section on the Radio Marche workflow (Process View: sequence diagram).





*Physical view of pilot cycle 1 deployment (as of Nov. 2011)*

The Radio Marché pilot system was realized using two separate technical implementations. In one version, we use cloud-based services to host the web form and database. The local telephone company provides the system with voice-based access by linking a number of local telephone numbers to this system. This is done using France Telecom Orange's Emerginov platform (from VOICES WP2).

The second version of the system is entirely local. This version has the web form and database running on a dedicated laptop. Radio stations that have internet connection can access this network directly via the web. The voice channel is provided by a voice browser (currently using the prophecy VXML browser by Voxeo) and a GSM gateway (2N OfficeRoute) device that allows phone calls to be handled by the Radio Marché system on the laptop. The OfficeRoute is connected to the laptop.

The local version has the advantage that the system can be updated and is accessible through the voice channel *even* in the absence of an internet connection. The fact that the system is completely localized might also improve local ownership and makes the setup less dependent on external service providers. Its disadvantage of such a "Do-It-Yourself" approach is that it needs additional equipment and development, and is more difficult to replicate elsewhere.

The cloud-based version on the other hand has the advantage that it comes with extensive support, robustness and scalability. But it does require a well-working internet connection.

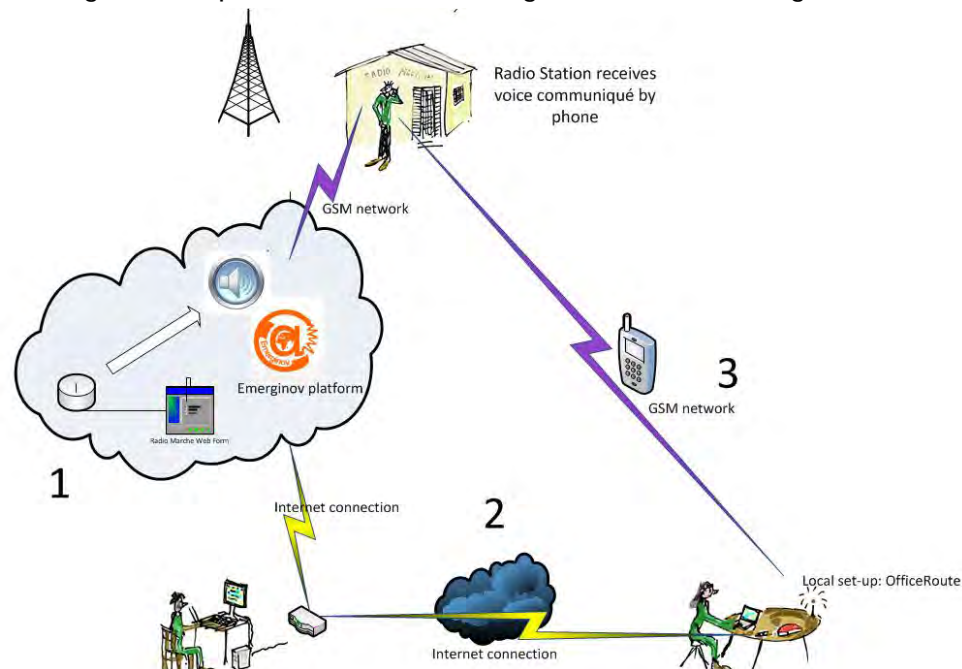
The two versions of the system are currently both being tested in the field. Also in combination: one version can act as a backup to the other in a redundancy-based setting, increasing robustness of the system.

In summary, the network diagram below shows how the Radio Marché voice pilot system is deployed using two different platforms, and in three different setups:

1. RM runs "on the cloud" and uses Emerginov, the voice open source platform by Orange (see VOICES WP2). This setup can be accessed via the internet. Emerginov provides connection to phone line, so the voice communiqué is accessible through GSM. This is the preferred solution within VOICES. It is scalable. Technically, a large number of phone lines can be used if needed.
2. The RM server is connected to OfficeRoute, a device connecting the RM server locally to the phone network. RM is installed and hosted on a server in Mali, in our case, hosted at Sahel Eco in Bamako. All RM software is installed on this server. It can be accessed remotely since the RM server allows web access (it has a small internet connection).

The disadvantage of this setup is lack of scalability. It supports only one phone line at the time. The internet connection in Mali can also be a problem for the accessibility. The quality of the audio of the voice communiqué is not constant. Sometimes it is poor.

3. RM runs stand-alone. In this setup RM is accessed directly on the server (in this case the RM-server is a laptop connected to OfficeRoute) hosted at Sahel Eco. In principle this setup would require no internet connection to enter data and create, send and/or retrieve the voice communiqué using GSM. However, an internet connection will be needed using this setup, for remote monitoring and troubleshooting.



*Network diagram of three different setups that are currently being tested: (1) using RM with Emerginov "on the cloud" (2) accessing remotely RM server, phone connection through OfficeRoute. (3) standalone RM, phone connection using OfficeRoute.*

## Conceptual Design Next Step

To date, the focus of the Radio Marché system development has first of all been on realizing the *specific instance* of use case A as described in Chapter 1.

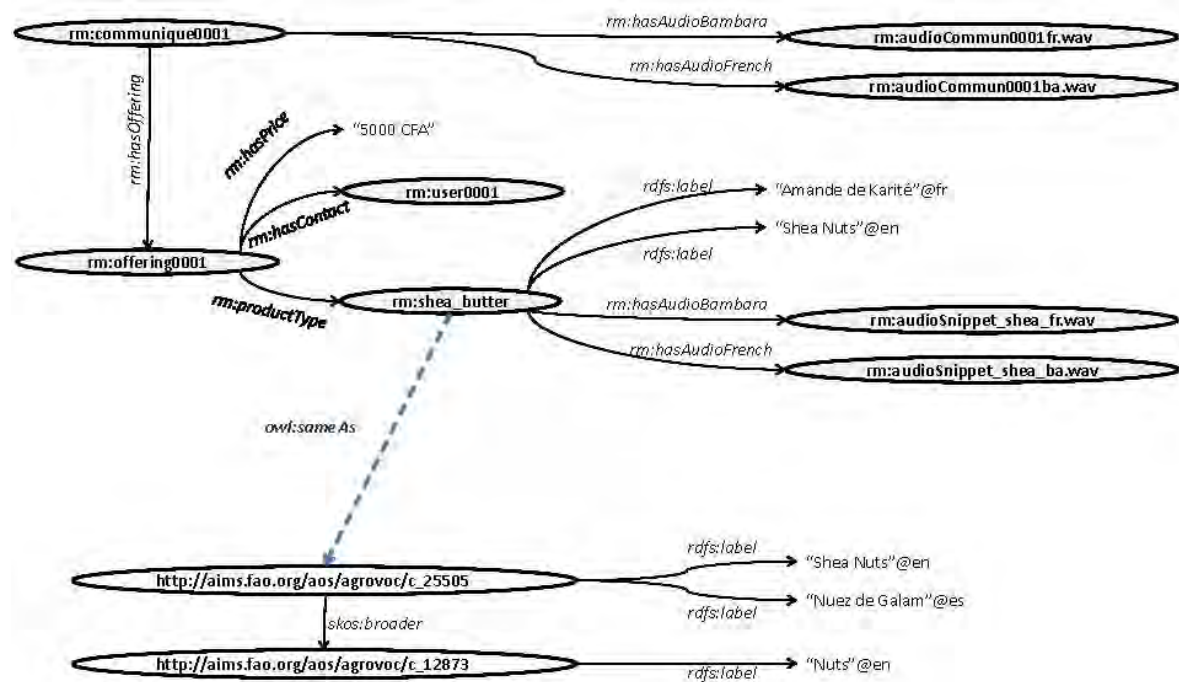
A future design step that is envisaged considers the further generalizability, by making it possible to have many instances of the same or similar systems, for example in different regions/countries and/or different domains (also other than m-agro), and then link these systems together to enable further applications related to the emerged umbrella system.

This can be done by employing the **Linked Open Data** concept and approach. In this section we outline how this generalization of the current pilot system may be achieved

**Data.** A local instance of Radio Marché has one data store with rudimentary market information such as product offerings (including product type, quality, quantity, location and logistical issues) and contact details from sellers and buyers. To maximize the reusability across different domains and regions and allow for automatic machine processing, we adopt Linked Data standards to represent the data.

More specifically, we follow the Linked Data guidelines and provide HTTP URIs for the resources (persons, places, products etc.) and describe the relations between them using RDF. The data is stored in an RDF database, also known as a *triple store*. Linked Data approaches provide a particularly light-weight way to share, re-use and integrate various data sets using Web standards such as URIs and RDF. It does not require the definition of a specific database schema for a dataset. Our implementation methodology assumes that we start from a legacy system. Although the specifics of the locally produced data will differ from region to region, Linked Data provides us with a standard way of integrating the parts of the data that different regions have in common. Also, because we do not impose a single overarching schema on the data, data reuse for new services is easier, both within a region and across regions.

An additional advantage is that Linked Data is well-suited to deal with multiple languages as its core concepts are resources rather than textual terms. A single resource, identified by a URI (ie. [http://example.org/shea\\_nuts](http://example.org/shea_nuts)) can have multiple labels (eg. "Shea Nuts"@en and "Amande de Karité"@fr). Other than textual labels, for our voice-services we add audio to the resources with language-specific voice snippets, also identified through URIs. The following Figure shows an example of how a very small part of the data would be represented using RDF.



Example of a snippet of RDF market information data in the RadioMarche triple store. Resources have URIs and are represented using ellipses, typed relations between resources and to literal labels are represented using arrows. "rm" is a shorthand for the namespace <http://radiomarche.com/>. The figure shows how multilingual audio resources are related to the communiqués. These are built up from audio snippets related to the content of the offerings making up the communiqué. The bottom part of the figure shows how the local market data can be linked to the Linked Data version of the Agrovoc thesaurus, opening up the possibility for mutual re-use and reasoning. Note that only a small part of the market data relating to offerings and product types are shown.

**Application layers.** The raw Linked Data is handled and aggregated into communiqués by the data/communiqué layer which interfaces with the RDF triple store using standard Linked-Data querying and data-posting APIs (for example using the SPARQL query language). This is where the market information is aggregated and it is decided what information is accessible to which user. In the interface handler layer, this information is represented in multiple views. It is here that the audio versions of communiqués are constructed. The interface handler layer is also used to process user input such as that of the NGO agent entering new market data through a web form or local producers doing the same through voice menus.

**Interfaces.** The interface layer is the technical layer consisting of the actual interfaces channels: each with its own limitations to user interface design. The Radio Marché design foresees multiple interfaces for producing and consuming market information.

1. The voices-based interface allows non-intrusive market information access for all users having a first-generation mobile phone. The voice-based interface allows farmers to navigate a voice-based menu and enter product offerings using a call-in service at a local telephone number. The voice service is available in the local languages relevant to the specific region. For the voice-based interface, we adopt the industry standard VoiceXML. Since we cannot assume that text-to-speech (TTS) libraries are available for the local languages, we currently design the possibility to use pre-recorded phrases in the local languages for the voice menus.

2. The SMS-based interface provides for literate users a more effective way of adding and consuming market data.
3. Through the traditional Web channels or via e-mail, users can get weekly digests of the latest offerings or add their own using a predetermined and machine-readable mail format. Standard Web access naturally allows for users to access market data using web browsers.

By offering multiple interfaces to Radio Marché, the system is open to contributions from a wider audience of users with less capabilities, both in terms of hardware as well as literacy; hence extending its generality. The multi-interface approach also ensures that when local development causes new hardware and connectivity to become available to the users, they can access the same system in these new ways.

**Radio.** Although users can directly interface with Radio Marché using any of the interfaces described above, local radio stations provide an interface to potential market information consumers such as buyers. Every week, the market information is sent to local radio stations, that broadcast them to their listeners. Community radio is an important communication channel in rural agricultural areas with a recognized potential for change and development. By integrating community radios explicitly in our system design, we aim to expand the range of potential buyers to users that have no access to mobile phones or web. The radio stations themselves access the system using each of the communication channels. Some radio stations have computer hardware and connections that allow them to receive the market data via the web. Radio stations that lack this infrastructure can use the voice channel, where they call in to the system and play the market information in audio form live on the radio.

These layers make up the market information system service on top of the data store. This system provides the ability to contribute market information by relevant actors, for example by producers wishing to add their offering to the system. The service also dispatches the relevant market information to potential buyers.

## **PART III: m-Agro Pilot User/Stakeholder Content**

This part discusses the (user/stakeholder-oriented) content and context background related to cycle 1 of the m-agro knowledge sharing pilot: the Radio Marché use case and Market Information System (MIS/SIM) voice system.

It is based on a field trip in Mali in November 2011 that included the onsite preparations to start the m-agro pilot (Chapter 4). Furthermore, discussions and explanations with users on pilot system use and test took place, on market information collection and processing (Chapter 5) as well as with radio stations on the voice communiqué mobile pickup and broadcast (Chapter 6). Finally, focus group discussions with local farmers, the intended beneficiaries of the Market Information System, were held (Chapter 7).



#### 4. FIELD PREPARATION OF PILOT

The first cycle of the WP5 m-Agro Pilot, planned for the first half of 2012, focuses on the Use Case A - nicknamed Radio Marché - as described above in Chapter 1. Use Case B, the m-event organizer, described in Chapter 2, will be part of cycle 2 of the m-agro pilot.

As part of the preparation of the pilot's first cycle, a second field trip to Mali took place from 12 to 19 November 2011, organized by Sahel Eco, VUA, and World Wide Web Foundation, in which also VOICES partners TNO and CSIR participated. This field trip followed on the first one in January 2011 that elicited and analyzed the use cases and requirements (reported in D1.1). From February to November 2011 a voice-based system was designed and built: the "Radio Marché" Voice System. It was developed in close collaboration between VUA and WF. Sahel Eco provided feedback and additional information during the whole period. During November 2011 in Mali, the first version of the Radio Marché Voice System was installed and shown to end-users.



*The logo for Radio Marché. The name of this little fellow is M. Mouriba Bonmarché*

The objectives of the field trip were partly technical and partly content/user oriented:

- Install Radio Marche Voice System in Mali
- Test and validate the system under field conditions
- Show and teach the local end-users how the system works
- Get as much feedback as possible on usability and new requirements
- Deploy it in Mali during six months until May 2012
- Collect as much information as possible from stakeholders to ensure sustainable business models beyond the lifespan of the VOICES project.

The end-users of Radio Marché are:

- Staff members from Sahel Eco who enter the market information they receive from the farmers, into the RM system using the web interface (web form). They also maintain the ongoing communication with the radio stations about the broadcasts.
- Radio journalists from Radio Segou and Radio Moutian, who are involved in the pilot. They receive the voice communiqué by phone or as an audio file by email. This voice communiqué contains the information that was entered by Sahel Eco staff. The voice communiqué can be broadcast directly on the radio.

Staff members from Sahel Eco, should be able to technically maintain the system after the W4RA-team departs from Mali, and do troubleshooting while contacting the staff at VUA, for technical support.

As an additional task, voice samples were recorded in audio, from two radio journalists, to develop more and better voice communiqués.

Participants of the trip in Mali were:

Mary Allen, Amadou Tangara (Sahel Eco);

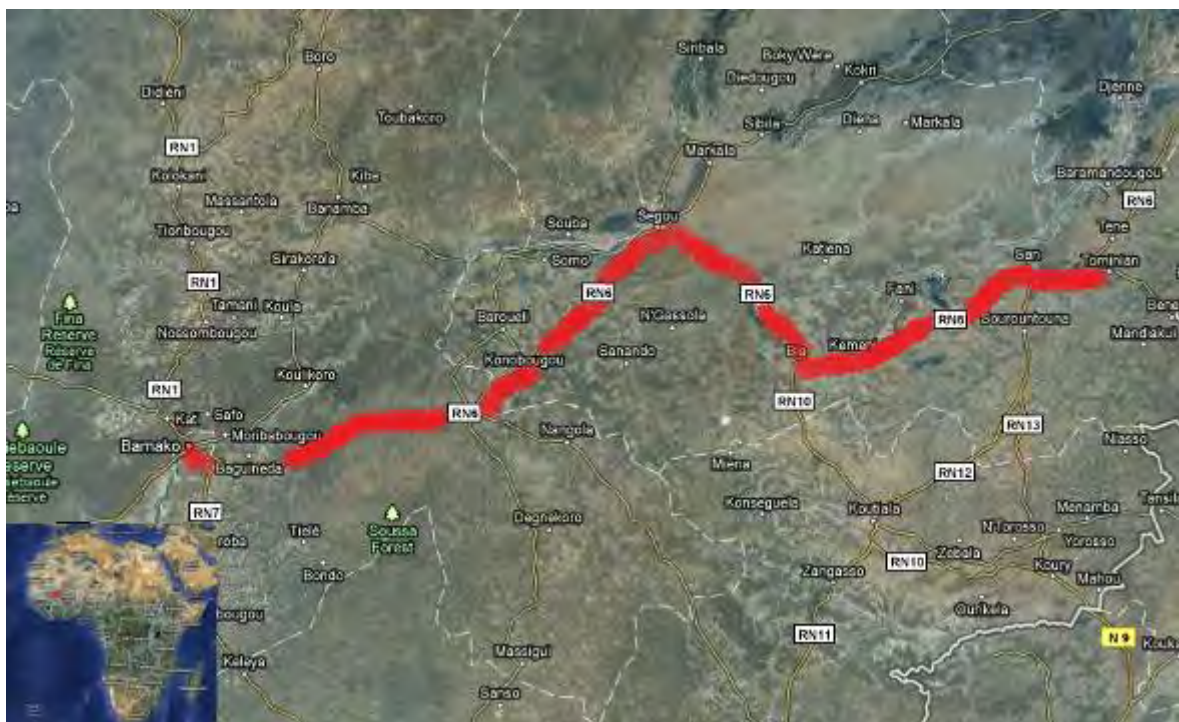
Stephane Boyera, Aman Grewal (Web Foundation);

Hans Akkermans, Anna Bon, Wendelien Tuyp, Nana Baah Gyan, Chris van Aart, Victor de Boer, Pieter de Leenheer (VUA);

Bruno van Moerkerken (independent filmmaker),

Pieter Verhagen (TNO)

Karen Calteaux, Aditi Sharma (CSIR).



*Itinerary of field trip 12-19 November 2011: Bamako – Segou – San - Tominian – San- Bamako.*

The various results of this field trip for the m-agro knowledge sharing pilot are discussed in the following Chapters:

- Chapters 5 discusses the market information user interface and the local installation of the pilot system as well as initial user-side comments.
- Chapter 6 discusses the first results of the voice technology tests carried out with the radio stations.
- Chapter 7 provides the user/stakeholder oriented content and context aspects of the pilot, cycle 1, as based on the farmer focus group discussions held.



## 5. SAHELECO: MARKET INFORMATION SYSTEM USER INTERFACE

As discussed in Chapters 1 and 3, the Radio Marché VOICES pilot system augments the current Market Information System (MIS/SIM) in a number of ways. First, we designed and deployed a web form, which allows registered users (SahelEco staff) to add and edit market information to a database. The pilot system stores all communiqués allowing for aggregating and analysing historical market information.

*Radio Marché Web form screenshot*



*Amadou Tangara from Sahel Eco, one of the end-users of RM, will enter the market data from the farmers into the RM web form*

The Sahel Eco staff member can generate a new communiqué from the current market information. At that moment, the communiqué is available for the radio stations that have web connection in text form. Alternatively, this text version can be sent via email or printed on paper. At the same time, an audio version of the communiqué is automatically generated from pre-recorded voice fragments.

In a technical discussion with SahelEco user Tangara during the November 2011 field trip, he made the following remarks related to the draft Radio Marché implementation:

- Tangara is quite enthusiastic to start with the RM system, and he sees it as work in progress and joint experimentation.
- One of the advantages that he already sees: RM gives me more control, because the end product, the voice message is directly broadcast by the radio. Before the radio staff had to read out the written message, this can create mistakes more easily. Now Tangara is in control of the broadcast message.
- The data in the Excel system doesn't necessarily show information on actual purchases, he would like to have that info.
- In the current RM system Tangara needs to fill in all phone numbers per person, he would like to have the numbers connected with the names.

The pre-recorded voice fragments have been obtained during local recording sessions. The audio communiqué is created using local Malian voices. Two of the local radio stations journalists' voices have been recorded and are used for the audio communiqués. By using local voices, we intend to increase recognisability and trust.

During separate sessions the quality of the automatically generated communiqués was evaluated by local radio presenters and producers. This is reported in detail below in Chapter 6.

Currently, this audio communiqué can only be produced in the Malian dialect of French, but in a later stage of the pilot we will develop these services also for local languages such as Bambara (work to be done in cycle 2 of the pilot in collaboration with VOICES WP3).

The audio communiqué is also accessible to the radio stations from the web as well as through a voice channel. As soon as a new communiqué is generated, the radio station employees can call a local telephone number. After identifying the radio-station through a voice-menu, the latest audio communiqué specifically created for that radio station is played. The audio can be played directly on the radio, or recorded using local equipment for later broadcasting.



*The local installation of the Radio Marché voice pilot system at the SahelEco offices in Bamako (November 2011, photos: Nana Baah Gyan).*

The photos here show the GSM gateway as well as the ethernet switch used to connect it to a local laptop as it is currently installed on location.

## 6. RADIO STATIONS: VOICE TECHNOLOGY INITIAL ONSITE TESTS

This chapter describes the voice technology tests that have been planned for and were carried out during the visits to Malian radio stations as part of the VOICES field trip in November 2011. The test program, the first results of the tests as obtained during the field trip and of the discussions with radio staff as future users are given in subsequent sections.

### Voice technology test program

#### Recording audio samples from the radio speaker

- Synopsis: asking the radio speaker to sit down in a quiet room and record some audio samples. It is about reading a couple of pages. See details at [http://www.mvoices.eu/radio\\_mali/references/french\\_numbers\\_record\\_procedure.txt](http://www.mvoices.eu/radio_mali/references/french_numbers_record_procedure.txt)
- Required Participants: Stephane, Radio speaker
- Material:
  - Audio recorder
  - Good quality microphone
  - Pages to be read by the speaker

#### Testing phone connection quality

- Synopsis: Testing the quality of phone signal and quality of the audio sent and received from a mobile phone
- Test:
  - Listing the recorded communiqué and asking opinion by radio people
  - Recording a short message and listening it
- Required participants: anybody able to drive the voice application, radio people (at least 2 to get different opinion)
- Material
  - Phone+simcard with credits+speaker for the phone

#### Testing broadcast quality

- Synopsis: Asking the radio people to record a broadcast they were ready to do live through a mobile phone, and then ask them to broadcast it live through the phone
- Procedure:
  - Record through phone interface the broadcast
  - Listen it to check quality
  - Broadcast it
  - Query radio people and some listeners for feedback
- Contingency plan: in case radio people feel uncomfortable to do that, download on their computer the recorded audio file (step 1 of the procedure) and have them broadcasting it from their computer (radio Segou option only)
- Required participants: anybody able to drive the voice application, radio people
- Material

- Phone+simcard with credits+speaker for the phone
- All possible cable adaptators to plug phone to radio
- For contingency plan: GPRS dongle or usb key

### **Testing authentication interface**

- Synopsis: Testing 4 different authentication procedures for the radio
  - Providing an authentication code (user id)
  - Selecting a radio in a menu
  - Detecting caller\_id
  - Using different phone numbers per radio (less scalable, most costly)
- Test:
  - Show the 4 interfaces and show pro and cons, and get feedback
- Required participants: anybody able to drive the voice application, radio people
- Material
  - Phone+simcard with credits+speaker for the phone

### **Testing broadcasting interface**

- Synopsis: Testing 2 broadcasting interface
  - One with a count down
  - One with the broadcast starting on a key press
- Test:
  - Show the 2 interfaces and get feedback,
  - Observe in practice what is the live broadcasting procedure taking place at the radio
- Required participants: anybody able to drive the voice application, radio people
- Material
  - Phone+simcard with credits+speaker for the phone

### **Testing the communiqué quality**

- Synopsis: Testing the quality of the generated communiqué
  - Generate one or two communiqués and have radio people listening them and providing feedback
- Required participants: anybody able to drive web form to generate a communiqué, radio people
- Material
  - Laptop with the communiqué generation script+speaker

### **Testing notification procedure for new communiqué**

- Synopsis: Testing 2 notification options
  - One through flashing (with number recorded in phone book)
  - One through sms with a message containing the phone number to call
- Test:



- Send manually from a remote place a sms
  - Send manually from a remote place a flashing signal
  - Get feedback
- Required participants: 2 people from the team (1 to talk to the radio people, 1 to send the sms/flashing), radio people
- Material
  - Phone+simcard with credits

### Misc

- Testing GPRS availability and bandwidth
  - Test:
    - Detection gprs signal and strenght
    - downloading 3 times a 1MB file to be put on the Web and measuring time
  - Required participant: anybody in the team (no need for radio people)
  - Material:
    - a GPRS dongle (to check with Mary)
  - Testing download time of a 1MB file (3 times)

### Radio Segou (FM 96.8)



*Meeting at Radio ORTM Segou on Tuesday 15 November 2011*

We started with a plenary meeting on 15 November 2011 of the VOICES-W4RA team with the radio journalists. Here we met Mr. Fousseyni Diarra again after 10 months. Fousseyni is a journalist and program maker at Radio Segou. We met last time in January 2011. Fousseyni knows our project well, and is a contact person for Sahel Eco, especially Tangara.

Radio Segou is part of the national radio broadcasting company ORTM (Office Radio Télévision du Mali), which provides part of the funding for this radio. There are few computers at this radio station, and since a month there is an internet connection (DSL). This radio has a coverage radius of 150 km. The listeners of this radio are young and old,

men and women. Basically everyone listens to radio every day. Every household in the region owns a radio (powered on battery when there is no electricity).

After the plenary meeting, a smaller group: Stephane Boyera, Aman Grewal, Anna Bon and Bruno van Moerkerken stayed at the radio. The working of the Radio Marché system was explained and tested. The voice of M. Fousseyni Diarra was recorded again to extend the functionality of the voice generating module of Radio Marché.

### **User questions posed to Fousseyni Diarra at radio Segou**

*Is the new procedure to receive the communiqué using voice and phone a good option and an improvement for you work?*

Answer: yes.

*Is the quality of the audio good enough for broadcast?*

Answer: yes.

*Does the auto-generated voice of the communiqué sound human and natural?*

Answer: yes.

*Is it important that we use your own voice (Fousseyni's voice is used now) or could it be anyone's voice?*

Answer: Definitely Fousseyni's voice. Especially Tangara from Sahel Eco is keen to have the communiqué in Fousseyni's voice because it is well-known by the listeners.

*Can we have a recording of the first broadcast of the new communiqué you will receive using the voice system?*

Answer: we can give it a try (this is not a usual procedure here).

*We would like to have your remarks on the functioning of the RM system, on a regular basis. Can we phone you or mail you with questions, let's say, every month?*

Answer: yes. Fousseyni will also communicate to Tangara.

Fousseyni's opinion is asked on several pre-recorded automatically generated voices. He recognizes that the voices are not Malian. (Burkinabé, Cameroun?)

Fousseyni looks forward to receive the communiqué in Bambara, next year.

Stephane Boyera presents a few voice-based demos. The voice of the radio journalist is recorded, as he reads out a number of words, numbers and sentences. The voice fragments will be processed and used to improve and extend the future communiqués.

## Radio Moutian in Tominian (FM 105.3)



*Radio Moutian, visited on Thursday 17 November 2011*

A similar visit was brought to Radio Moutian on 17 November 2011: A small group went to the radio: Stephane Boyera, Chris van Aart, Nana Gyan, Anna Bon, Bruno van Moerkerken. We here met Gustave Dakovo and Bakary Dembélé, both radio journalists. We met them before in January 2011. They know VOICES very well.

This radio was founded in 2008. Investments were provided by a European development agency (LuxDevelopment). The coverage of Radio Moutian is large, even in Burkina Faso people can receive this radio station. For licence reasons they cannot tell us the real coverage area of the radio. Electricity is often a problem for this radio (goes down frequently). Radio Moutian has a computer now since October 2011, but still no internet connection. (They now use Audacity to make their radio programs).



*Stephane Boyera recording the voice of  
Gustave Dakara at Radio Moutian (photo: B. Van Moerkerken)*



**User questions posed to radio journalists Gustave Dakovo and Bakary Dembélé.**

*Is the new procedure to receive the communiqué using voice and phone a good option?*

Answer: yes. We think it is very cool to be the first radio in the region to use these innovative voice technologies.

*Is the quality of the audio good enough for broadcast? Even holding the phone next to microphone?*

Answer: yes, excellent.

*Does the auto-generated voice sound human and natural?*

Answer: yes.

*Is it important that we use your own voice or could it be any voice?*

Answer: yes, we want to have it in our own voice.

*Can we have a recording of the first broadcast of the new communiqué you will receive using the voice system?*

Answer: that will be difficult. We cannot record anything here.

*We would like your remarks on the system on a regular basis. Can we phone you with questions, let's say, every month?*

Answer: yes. Gustave will also communicate to Tangara on a weekly basis.

Gustave's opinion is asked on several pre-recorded automatically generated voices. He recognizes that the voices are not Malian.

Gustave and Bakary are very keen on using Radio Marché. They think it is exciting to use this innovative system. They look forward to receive the communiqué in Bambara, next year. Bomu would be better in this region.

Gustave and Bakery tell us how the radio works. A broadcast message costs about 1000 fCFA per minute on the radio. People send many messages. Especially invitations for weddings at this time of year. They can be 15-20 minutes long.

People often contact the radio to ask about the honey trading. (Not about shea butter). Gustave redirects the customers to Amadou Tangara of Sahel Eco.

The radio would like to be able to store audio messages on the computer and retrieve them later. At this moment audio files are deleted after broadcasting. Paper messages are always filed in hardcopy.



*Radio Moutian's office in Tominian*

## 7. RESULTS OF FOCUS GROUP DISCUSSIONS WITH STAKEHOLDERS

### Focus Group Discussion with farmers of the Segou area



*Focus group discussion VOICES team with farmers from Segou, 15 November 2011, Tree Aid Office*



*Farmers from the Segou area during the focus group discussion*

At the focus group discussion in the Tree Aid Office garden in Segou on Tuesday 15 November, we met eight farmers from the Segou area, of which three women. The farmers are part of a small trading cooperative structured around groups of ten people. They are all members local farming communities in the Segou district. These communities do not participate in the Village Tree Enterprise radio marketing pilot of Sahel Eco that is

the basis for the use case for Radio Marché. The products of this group are mainly honey, shea nuts, shea butter, tamarind, and saban (a fruit).

Within a project supported by NGO Tree Aid, these farmers have been trained to improve the quality of their produce, including shea butter, shea soap and honey. This project has been running for two-three years. As a consequence of the project they have now formed a new organizational structure (called Benba) which consists of 6 groups of 10 farmers to improve negotiating and trading with their customers, setting better prices and improving communication channels. [People are organised into groups of 10, by product. All the groups trading the same product form a village level Benba and elect people to represent them at the commune level Benba. People at the meeting were mainly group, village or commune level Benba leaders for a particular product.] Formerly they all did their farming and trading separately, without success. Group organization has brought benefits to the group in terms of access to new customers and knowledge and fixing of prices on the local markets. Their negotiating position has also improved. Earlier, women easily got tricked by buyers due to the inability to read/write but the formation of the group has helped this improve significantly.

We asked them about the use of mobile phones. Almost every farmer is said to have access to somebody who owns a mobile phone. Phones are personal – not shared by a group - but are often borrowed. Some women don't have phones but use their husband's. This is difficult when the men take their phones when they travel and the women stay at home. About mobile phone use: most of the farmers spend 2000-3000 fCFA per month on phone calls, mainly to contact customers. The three women present use their phones for trading e.g. phoning buyers and NGO representatives. "Beeping" to potential customers is not used. (Beeping is ringing and quickly hanging up to avoid having costs). The phone seems an important business instrument for the farmers. Typical usage was described as keeping in touch with family and friends through phone calls, using the calculator, using the in-built phone clock (for time). SMS was not found to be very popular with this group with youngsters being asked for help with SMS (though the farmer group's leaders know how to SMS) with a female participant mentioning, "SMS is for people who can read/write".

In terms of mobile network coverage, some of the villages e.g. Sibila, do not have network coverage but closer to the main road coverage can be found and reception is better during the evenings. Farmers also mentioned that bad network coverage wastes their airtime/top-up balance since they have to make many retries. Farmers typically use USSD for adding their airtime/top-up balance and if they struggle they ask the shopkeeper who sold them the airtime to assist.

There is no electricity in the villages and they use 12 volt batteries and solar panels. A mobile phone can be recharged at local shop for 100 CFA.

The farmers here are interested to hear about the pilot in Tominian. They have already heard communiqués from the Tominian area broadcast on the radio (through the Sahel Eco pilot). These farmers still have difficulty in finding customers. Still, they don't know if they would be prepared to pay for the use of a system that broadcasts their own product offerings on the radio.

Their production can be increased. Human labour is not the restricting factor. The problem is access to customers and how to transport goods. Their individual production is too small for “big” customers, such as international companies. The local market is a more appropriate for them place to sell.



*Woman farmer from the Segou area during the focus group discussion (photo: B. Van Moerkerken)*

The list of names of the representatives at this focus group, from the Segou area:

Name	Place	Producer/role
Yah Louré	Nierela	Karité
Marianna Faré	Sibila	Karité, saban syrup
Djenuba Djarra	Dona	Karité, saban syrup Secretary of the farmer group
Brahima Famanté	Dona	Treasurer of farmer group
Bencé Tounkara	Sibila	Shea nuts, shea butter, shea trees, President of farmer group
Badé Carelibaly	Sibila	Secretary of a farmer group
Mahamadou Koita	Barakabougara	Secr of the Tamarinde group
Maurice Koné		National representative Tree Aid



## Focus group discussion with farmers from the Tominian area

Seven farmers from the villages (of which one woman: Naomi carrying 1-year old little son Joël) that participate in the “Village Tree Enterprises” pilot were invited for a focus group discussion with the VOICES-W4RA team at the SahelEco office in Tominian on 17 November 2011. The Village Tree Enterprise pilot, financed by Tree Aid and supported by Sahel Eco, uses the Market Information System (SIM) and the radio broadcasts, and provides the key use case for the Radio Marché system.

The farmers explain and show us their produce and tell us about the way they sell their goods. SahelEco works with Tree Aid in the promotion of Non-Timber Forest Products, in 19 villages in this area.



*Focus group with farmers of the Tominian area on 17 November 2011 at the SahelEco office  
(photo: B. Van Moerkerken)*

Honey is a product bought in a large number of small quantities, while shea butter has only few customers. The shea butter production exceeds the sales at this moment. Especially the high quality shea butter is difficult to sell.

About mobile phones: the coverage is not good at every place. Especially women, who have to stay at home with small children, are disadvantaged because they cannot move to a place with better coverage to make a call.

5 products

Shea nuts (women)

Shea butter (women)

Honey (men)

Néré seeds (women)

Tamarind (women)

About 63% of the producers are women.

Shea trees need about 600 mm rain per year and the area where they grow well seems to shifted to the south since the end of the 1960's. In northern Tominian we didn't spot new young shea trees in the fields. Mali is reported to have the most shea trees, but the processing of the nuts is higher in Burkina and Ghana.

The radio broadcast system was especially beneficial to the honey producers. One of them had 100 hives before, but now has 1000.

Néré seeds are used in cooking. Fermented they make soubala, a condiment that contains a lot of iron and vitamin C.

Tamarind is also used in cooking and used as a drink. It contains vitamin C too, and is used as a replacement for lemon, and to treat constipation.

**List of names:** 6 men (honey producers) and one woman (shea producer), unfortunately there were no producers of Nere and Tamarind.

Name	Cooperative	Product	Role
Naomie Dembélé	Hirosin	Shea	Treasurer of the cooperative
Fidele Koné	Hirosin	Honey	President of cooperative, 23 villages
Zakary Diarra	Hirosin	Honey	President NRM committee CP SE
Phylipe Diarra	Hirosin	Honey	Pépineriste tree nursery CP SE
Sabéré Diarra	Farakunna	Honey	President of Forest Surveillance Group (FSC)
Gérard Traoré	Farakunna	Honey	Contact Person SE (CP SE)
Andia Kalakodio	Farakunna	Honey	FSC
Farabé Mounkoro	Sahel Eco	Animateur	

### *Honey*

Traditional hives (woven from wood/bark, with clay inside) are hung in the trees, a bit hidden. People used to burn the trees to get the honey, now they smoke the bees out. They cut the honey/comb out of the hive, leaving some of it behind, which will facilitate

the new production. They received training on how to extract the honey by hand, without using fire. Wax and bee food is separated from the honey, which is filtered then 3 times. People from other villages copy this method but the result is not as clean. February - April is the production period of most honey.

Honey gives 3 products: honey, wax, and honey drink (alcohol).

In Hirosin the honey is only sold in this quality, in Dwa (Farakunna) also raw honey is sold.

*Who are the buyers:*

People who contact them through the MIS, by phone and at local markets. Until now no big buyers.

*How much honey is produced by one producer?*

One of them produces about 200 litres by himself and he also buys raw honey from other producers that he processes to clean honey.

The largest purchase was 80 litres, by a Fulani trader from Sévaré.

One of the other producers produced 255 litres with a few big buyers.

Another man produced 42 litres.

*What do they do to get new clients:*

Go to events, meetings, fairs and workshops to sell their products. (observation: there is still a lot of potential that is not taken into account at the moment, e.g. local hotels)

*Prices:* filtered honey: CFA 2000 – 2500, raw honey: CFA 1250. They don't take work time into account, when they calculate the profit.

The rest that remains after the filtering is mixed with water and sold as drink (alcohol). The wax is sold too, but clients are rare.

*How they decided to come with these prices?*

Once they visited the Ségou market to see the prices and they fixed their prices accordingly. In 2010 the price in Bamako was CFA 2500.

*Do they still use the MIS?*

At the moment they don't have a lot of stock so they are prudent with announcements.

For shea butter the women face similar challenges as the women in Segou to sell the improved quality. There are not many buyers. Non-improved butter is more popular (CFA 500) because people know this type better and are not willing to buy butter for more than CFA 500. The women ask CFA 1000 for 1 kilo of improved butter, because of the higher quality. The price is fixed in relation to the prices around. Business wise it is more interesting for the women to sell the butter than the nuts. Last year Naomie produced 350 kilos of butter that she used in her restaurant.

The boiled nuts have several advantages:

- The processing consumes less wood than the traditional burying and smoking.
- After boiling, the nuts produce more oil, and higher quality (fewer odours).
- The boiled, dried nuts can be stored much longer.





*Shea butter and nuts producer Naomi Dembélé from the Tominian area (photo: B. Van Moerkerken)*

Producing the improved quality butter was stimulated by the project, women received training. At the moment it is hard to sell the higher quality because of the price difference. When they can't sell the higher quality the women use it for their own consumption, for cooking oil. Interestingly, even women who didn't receive training start to boil the nuts and use that for their own consumption. So maybe it is just a matter of time that the improved quality butter will become dominant. But it remains to be seen if the higher price will be easily paid in the (near) future, the price might also drop.

*Has the MIS system brought any benefits?*

- Because of the MIS other people/villages would like to join the system (they hear the broadcasts on the radio and want them too).
- Last year the demand for honey was bigger than before, they link this directly to the MIS
- Before it was the buyer to fix the price, now it is the seller (observation: though for shea produce the women hardly sell the improved quality for their fixed price).
- In 2007 a buyer was surprised to see good quality nuts in Mali (this was before the system was in place though). For the honey, in 2010 someone tested their local honey with another village's honey in the sun and found that their honey was of far superior quality (did not discolour at all).

*Could we open up the system for any producer?*

Yes, most participants are positive, but they insist that participants should get training before entering the system to ensure that the quality of products is maintained.

Naomie: unity = strength

For shea butter it would be better to have the higher quality all over.

*What if SahelEco stopped to finance the system, would they be willing to pay for the system?*

One says yes, another says he would like to have a central store/shop with the cooperative, so transport will be easier to organise. Now sometimes potential clients will not show up because of the distances.

Naomie: the best would be a combination of a shop that is easily reached by road and the MIS.

#### *Mobile phones*

Top-ups are between CFA 4,000 – 6,000. Most people are able to add the top-ups themselves, if not they ask the local shopkeeper where they bought the top –up.

#### *SMS*

The sms training for the village contact persons was an eye opener, useful for messaging to the radio, other producers to fulfil large orders, and SE, friends: rarely.

Other users are mainly young people. Naomi says she asks her son to SMS for her. Also SMSes do not always go through easily, and they don't always know if the SMS has been delivered or not.

#### *Flashing/beeping*

Some buyers will beep them; they use it sometimes to beep Tangara (SE), but never for clients. They will call them.

Most of the men have a phone. Women have little ownership of phones, they mostly rely on their husband's phone. Recently one or two people in the area have set up small cabins to sell mobile phone services e.g. making calls and recharging batteries.

Another challenge, especially for women: the network coverage is not good everywhere. People know which specific areas they can go to for coverage, but this is an extra constraint for women, who are usually busy around the house and cannot easily leave just to make a phone call elsewhere.

## **8. CONCLUSION**

This deliverable provides the use cases and the system design specifications and content for the VOICES WP5 m-agro knowledge sharing pilot.

The first version of the pilot system has been built, installed onsite in Mali as well as made available online, and the first usage testing of the pilot system is commencing as of December 2011.

## APPENDICES

## APPENDIX A: REFERENCE AND RESOURCE NOTES

Website VOICES project <http://www.mvoices.eu>

### Chapters 1 and 2:

For further background on the m-agro requirements and use case analysis see VOICES WP1 deliverable D1.1 (available on the VOICES project website).

### Chapter 3:

The "4+1 architectural views" approach as used in this deliverable is discussed in:  
Philippe Kruchten: *The Rational Unified Process: An Introduction*, Addison-Wesley, 1999

For the Web-hosted platform implementation, see VOICES WP2 and its deliverables, and  
<http://www.emerginov.org>

For the local solution version, cf. <http://www.voxeo.com>

For the Linked Data approach, see <http://linkeddata.org>

### Chapters 4-6

For local language issues, see VOICES WP3 and its deliverables

See also e.g.

[http://en.wikipedia.org/wiki/Bambara\\_language](http://en.wikipedia.org/wiki/Bambara_language)

[http://www.ethnologue.com/show\\_language.asp?code=bmq](http://www.ethnologue.com/show_language.asp?code=bmq) (Bomu)

For the various pilot system users in Mali, short *user manuals* in .ppt form have been produced and discussed with prospective users. They are available in the WP5 folder of the internal workspace of the VOICES website.

### Chapter 7:

Farmers in the Tominian area selling non-timber products:

<http://ictupdate.cta.int/en/content/view/full/5808>

See also:

Website W4RA project <http://www.w4ra.org>

Website Regreening: <http://www.reverdirlesahel.org>

## APPENDIX B: PRELIMINARY NOTES ON SUSTAINABILITY

The field work done in WP5 has delivered a number of important insights into the issues of sustainability and future business models in a rural African setting for the technology that is developed and field-piloted in the VOICES project.

During the WP5 field trip of November 2011 in Mali, these issues were part of the discussions with farmer focus groups.

From these focus group meetings, qualitative data and usability feedback was collected. This will be used for further development, fine-tuning and adjustment of the Radio Marché system and other future voice-based systems within the W4RA-VOICES project.

Three participants in the field trip: Karen Calteaux and Aditi Sharma from CSIR and Pieter Verhagen from TNO, joined the trip especially to attend the focus group discussions. CSIR is especially interested in the Living Labs concept, which is followed in the WP5 approach and is also involved in deliverables within WP3 around the user experience and acceptance studies. TNO is especially interested in collecting information on the business case of the trading activities by the farmers in Tominian and Segou. This is used as input to VOICES WP1.

The farmer focus group discussions also touched on the issues of sustainability and future business models. Although not strictly part of the central topic of this deliverable (pilot content and specification), sustainability is a sufficiently central issue for the project as a whole to warrant inclusion of relevant field notes related to it.

Chapter 7 of the present deliverable D5.1 therefore also includes useful remarks on sustainability stemming from by the farmer focus group discussions. Also VOICES deliverable D1.1, in particular in its report of the field trip in January 2011 (Mali, Burkina Faso, Ghana) contains relevant information.

Based on this, the following contains a preliminary analysis by Pieter Verhagen, TNO, of some business case aspects of the Radio Marché pilot use case and voice system.

### Stakeholders, roles and goals m-agro pilot

For the m-Agro Pilot, the service delivered already exists without the use of voice services, and is called Radio Marché. Basically, it is a service where local farmers can advertise their non-forest timber products on local radio, so that buyers will be able to find them. In order to advertise their products, they have been trained in improved production processes to have higher quality products. In the VOICES project, voice services are added to this system.

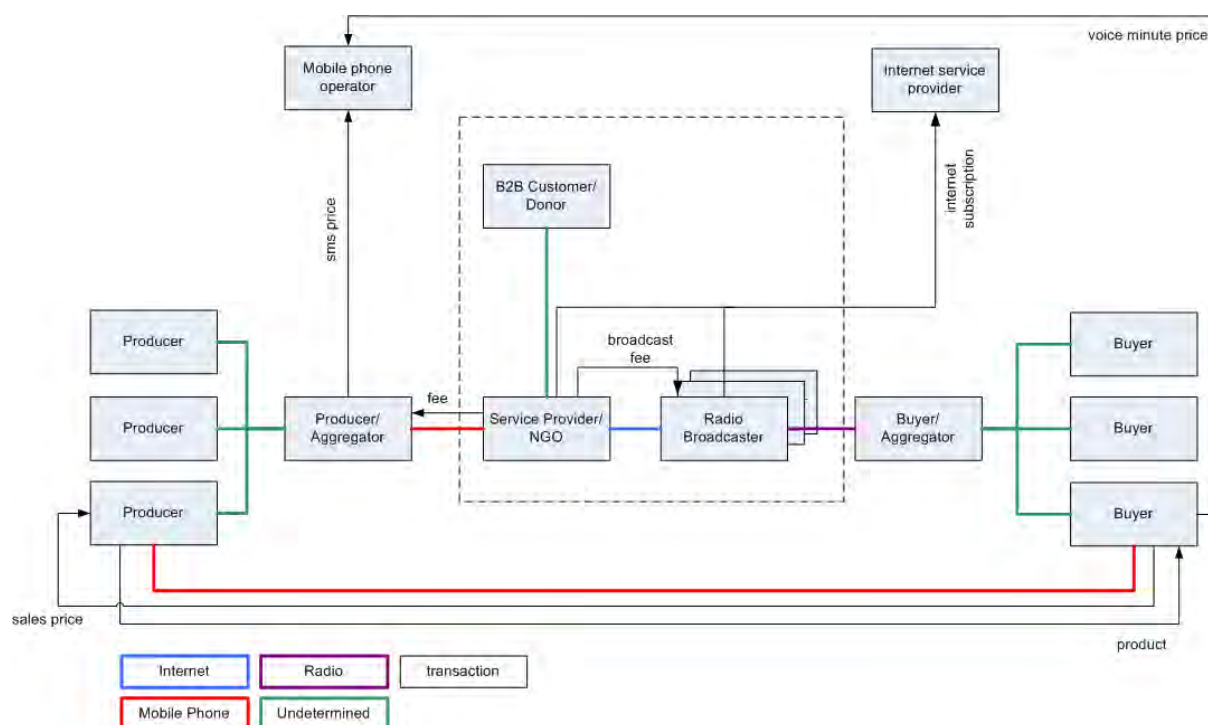
The stakeholders involved in this pilot are given below, as well as their role and goals.

Actor	Role(s)	Goal(s)
Local farmers producing non-timber forest products	Producer	Find new customers for their products
Local farmers commune representative	Aggregator	Bring together local

	(producer side)	supply
Buyer commune representative	Aggregator (buyer side)	Bring together (local) demand
(Local) buyers of non-timber forest products	Service Provider	Buy products for the best price/quality ratio
Sahel Eco	Service Provider	Regreening the Sahel by providing market development and production training
Radio Segou, Radio Moutian, etc.	Radio Broadcaster	Reach as many people as possible, make return on investment
Tree Aid	Investor / donor	Promote sustainable use of the forest
Mobile Phone Operator	Supplier	Sell mobile services (voice, sms)
Internet Service Provider	Supplier	Sell internet services

### Current use case of the Radio Marché function

The value network for the Radio Marché service in its current form can be graphically depicted as below.



*Value Network Radio Marché current situation*

Starting from the bottom left: A producer verbally (or in any other form s/he chooses) informs a village aggregator that s/he has a certain product available for sale. He mentions

quality and quantity. The aggregator receives several such product messages, which s/he bundles and transmits via an SMS to the Service Provider, in this case SahelEco. The Mobile Phone Operator is paid by the Aggregator for sending the SMS. The Aggregator is compensated for the expenses by the Service Provider.

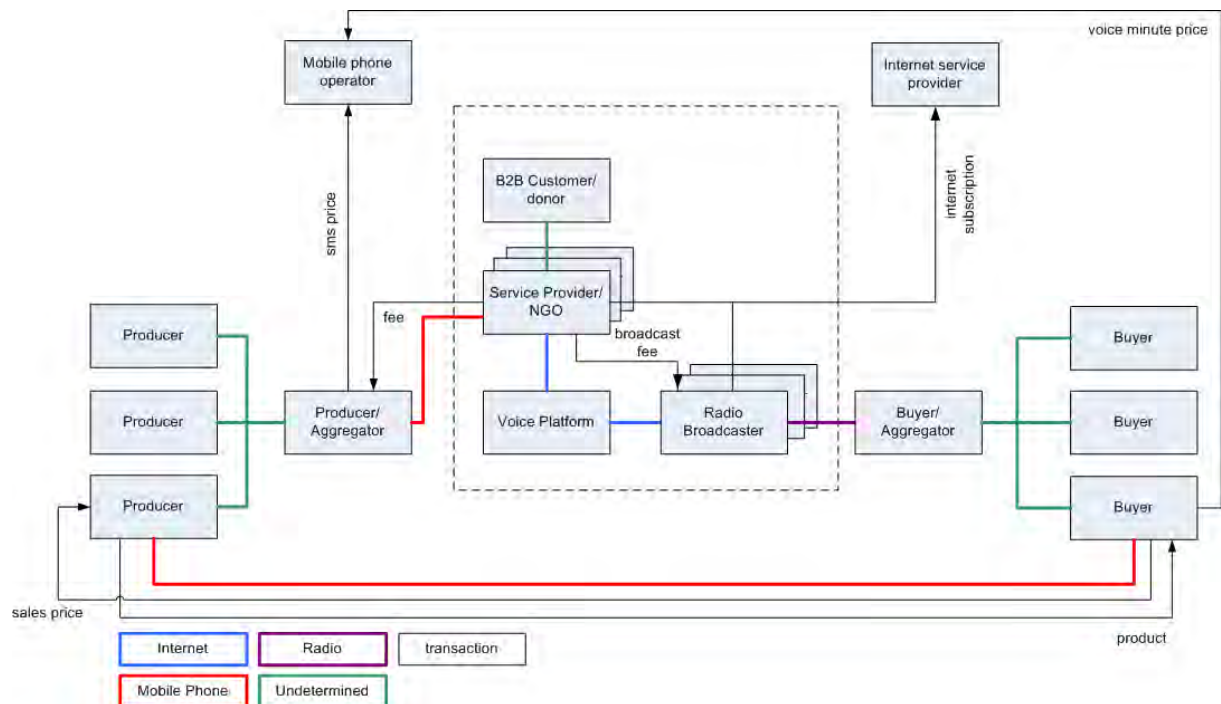
The service provider collects SMS messages from several aggregators, bundles those, and sends them as a radio communiqué to a number of radio stations. With each radio station, the Service Provider has made financial agreements to pay for broadcasting this communiqué. The Radio Broadcaster receives the messages (via email, or in one case via a letter send by a courier), reads it out aloud and broadcasts this communiqué on the radio. Both Service Provider and Radio Broadcaster pay a subscription fee to an Internet Service Provider for their internet connection. The Service Provider is paid for its services by a B2B customer, in this case a donor such as Tree Aid.

A Buyer listens to the radio, and picks up a message from the communiqué that has captured its interest. In some cases the message is picked up by an Aggregator, who informs another buyer. The buyer contacts the Producer through his mobile phone, which he pays for on a per minute basis to the Mobile Phone Operator. The Producer and Buyer agree on a purchase, and the product is exchanged in return the agreed sales price.

The dotted box in the middle shows the area of the value network on which the Voice Platform has a direct impact in the current system design.

### Prospective use case of the Radio Marché function

The value network for the Radio Marché service in its proposed form can be graphically depicted as below.



*Value Network Radio Marché prospective situation*



The role and transactions of the Producers, Aggregators, Buyers, Mobile Phone Operator and Internet Service Provider remains unchanged. Starting from the bottom left, an Aggregator sends it SMS message to the Service Provider similar to the current situation.

The service provider however enters these inputs into the Voice Platform back-end. The Voice Platform transforms the text input into speech output. This speech communiqué is sent directly to the Radio Broadcaster as an audio file. The Radio Broadcaster plays this audiofile directly on the radio, reaching potential Buyers.

From there on, the Buyers have similar roles and do similar transactions as in the current situation.

### **Advantages of the proposed use case**

The proposed situation has several advantages for several actors within the value web.

Service Provider:

- Less time spent by Service Provider staff on administrating incoming inputs.
- Better administration (used for impact assessment)
- Easier to scale up: service more producers, involve more radiostations, involve more buyers
- No mistakes in communiqués

Radio Broadcaster:

- Less time spent on reading out communiqués
- No mistakes in communiqués (less important for Radio Broadcaster than for Service Provider)
- For Radio Broadcasters without Internet connections, no time spent going to internet cafés to download and print communiqués, they can be broadcast directly from a mobile phone.

Investor / donor:

- Increased efficiency at the Service Provider side means greater impact per dollar invested
- Better usage statistics for impact assessment
- Monitoring of market development: prices, quantities, products types

Producers:

No change from current system

Buyers:

No change from current system

### **Initial observations on sustainability of the pilot**

One of the goals of the VOICES project is to come up with sustainable business models for voice-based services.

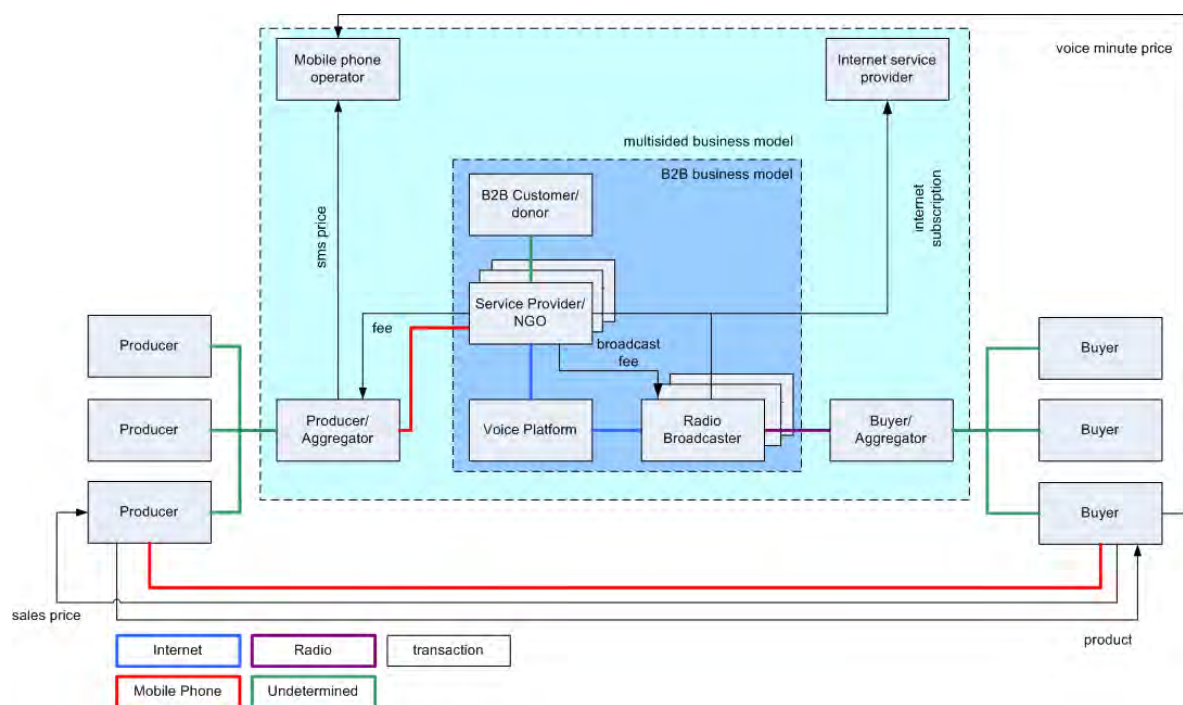
The current use case is set up as a typical NGO system:

- None of the end-users of the services is specifically mentioned or targeted to be the (paying) customer
- Most users of the system are paid for their expenses by the NGO Sahel Eco (the Service Provider) using Tree Aid's (the Investor's) funds

The proposed use case involves a technically different system, but from a business model perspective, the roles and activities of the actors involved stay virtually the same. The perspective from the future entrepreneur running the service is underdeveloped, because at this stage Sahel Eco is now in effect playing both the role of start-up (B2B) customer as well as the role of the entrepreneur.

## Two possible approaches towards sustainability

From the discussions during and after the Mali field visit in November 2011, it became clear that two possible approaches towards commercialization and sustainability of the business model can be identified. In this paragraph, these approaches are briefly sketched. This is a first draft, and will be a topic of further discussion and investigation in the next iteration (WP1).



*The boundaries of the two approaches visualized in the value network*

## B2B Business Model

The first possible approach takes the system as a B2B system. It is the simplest model, but also lacks some revenue generating potential. It looks at the Voice Platform replacing parts of the current Radio Marché system. The above Figure shows this by the darker blue section. The Voice Platform is the center of the business model, and most focus is on the direct connections between the Voice Platform and the Service Provider and Radio Broadcaster. The value added by the system is seen in terms of lowering cost for an already ongoing process.

**Multi-sided business model**

The second possible approach focuses on the use of the system as a B2C as well as a B2B system. It looks at the Radio Marché system including the Voice Platform as a whole, rather than at the Voice Platform as a part of the Radio Marché system. This opens up new revenue possibilities, but also increases complexity. The value added by the system as a whole is seen in terms of increasing value by offering a new service (to a set of new customers). This view is depicted in the above Figure as the lighter blue section.

In the first viewpoint, the Voice Platform may have its own sustainable business model within a Radio Marché system (that may not be sustainable seen in itself), while in the second viewpoint, the Voice Platform needs to contribute to the overall sustainability of the Radio Marché system as a whole.