

# Feasibility study to enable Freedom Fone with voice-based Emergency Data Exchange (FF4EDXL)

## Introduction

Natural disasters in the past caused by floods, war, volcanic eruptions, landslides, tsunamis, and cyclones, time and time again, have shown the complexities of coordinating large-scale national crises. In addition, a broken bridge connecting a village with the rest of society or a school inundated with water during the heavy rain cycles are more frequent and require emergency response. Crisis information organized in electronic form has proven to be efficient and effective in coordinating any scale of disasters. These procedures include activating emergency first-responders prior to the hazard impact to evacuate people and gather damage reports following the impact for rescue and restoration operations.

Freedom Fone<sup>1</sup> (FF) Interactive Voice Response (IVR) system can be a valuable tool for communicating emergency information during a crisis. Therefore, we are keen in enabling voice-based platforms for gathering and sharing crisis information in electronic form for efficient and effective communication of vital information to aid emergency managers.

Sahana disaster management system was developed for managing chaos during disasters with capabilities to integrate with external systems through data exchange standards. The long term goal of this initiative is to integrate FF with the Sahana disaster management system for voice-based emergency information collection and share.

The objective of the this phase of the research is to study whether voice-based data would comply with globally accepted emergency data standards. Thereafter, device a strategy to integrate FF with Sahana. For this research, we have chosen the Emergency Data Exchange Language<sup>2</sup> (EDXL) Common Alerting Protocol (CAP) and Situational Reporting (SITREP) as emergency information exchange standards for assessing the feasibility of FF integration with Sahana.

To assess feasibility of integrating FF with Sahana through global standards: EDXL-CAP and EDXL-SITREP, this research will subjectively assess the information needs in aiding a community-based disaster management environment, namely the Lanka Jathika Sarovodaya Shramadan Sangamaya (Sarvodaya). Then map those needs to EDXL-CAP and EDXL-SITREP and try to implement in FF in order to provide voice-based alerting and situational reporting. The research will conduct usability, utility, and reliability tests with selected resources persons at Sarvodaya. The objective-based, decision facilitation, and controlled-test evaluation schemes will provide insight and recommendations for positioning FF as a voice-based interface for exchanging standardized emergency information communication.

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1 Freedom Fone - <http://www.freedomfone.org/>

2 Literature on EDXL found here - <http://www.oasis-open.org/standards>

## Research Problem

*Research question - “What are the design strategies for facilitating an interoperable emergency data exchange platform for voice enabled alerting and situational reporting?”*

Evidence points to people in developing countries, like Sri Lanka, to be accustomed to voice-based telephony services opposed to text-based applications<sup>3</sup>. Hence, positioning the FF interface for aiding in communicating emergency information will benefit the disaster management communities in those developing countries. Absence of interactive voice applications for recording information, forces them to revert to paper-based systems. In many cases there is duplicate data entry at the incidence management centers where the information recorded on paper is reentered in to computers to produce aggregate reports. An end-to-end electronic system with data digitized at the frontlines will eliminate duplicate entries and will improve the efficiencies.

Disaster management is a multi-agency and multi-systems activity that can lead to complexities and even chaos. Access to the right information at the right time for emergency organizations and systems to function is vital for stabilizing the operations. In this regard, system interoperability is important for sharing the information across all platforms and entities.

Prior to the disaster striking an important aspect is alerting the first-responders and warning the public. Sahana Alerting Broker (SABRO) was developed as a Sahana module for publishing and subscribing to hazard events. SABRO was proven to work with Email, SMS, RSS, and HTTP posts. In this research we will investigate the design requirements for enhancing the SABRO module to deliver voice-based CAP messages.

A challenge faced in Sri Lanka is getting the message out to targeted first-responders in the local languages: Sinhala and Tamil. While SMS is efficient it is constrained by the number of characters a message can carry. Not all have access to email and the world wide web. Therefore, pushing the messages in the form of a phone call is perceived effective; especially, with localization.

During an emergency, many organizations produce a Situation Report (SITREP) that provides an overview of the event from that organizations perspective based on information gathered to date. It is a summary report that outlines not only the events to date, but also resources deployed, actions taken etc. Situational reports are traditionally provided in paper format, but are increasingly being delivered via electronic documents - particularly in pdf and/or doc formats. Depending on the nature of the event, SITREPs can be updated multiple times a day. Smart phones can provide the necessary functionality to manage situational reports with text, audio, and images. However, such high end hand held devices are not common and are not integrated in to the daily lives of common citizens in developing countries. Moreover, such applications are not self-intuitive compared with that of a simple voice call. Therefore, FF voice-based applications can be far more effective in receiving these situation reports in a timely manner for providing necessary response operations.

A research and development challenge would be voice-to-text and text-to-voice transformations; especially in the local languages. CAP profile for Sri Lanka requires messages to be delivered in

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3 Teleuse at the Bottom of the pyramid - <http://lirneasia.net/projects/icts-the-bottom-of-the-pyramid/>

Sinhala, Tamil, and English. Upstream communication of SITREP messages would also be in the same three languages. Natural language translation<sup>4</sup> (or machine translation) for voice-text transformations, both ways, for local languages, are still unstable and are in the working among the research community. One aspect of this research would be to identify the applicability of existing techniques or determine a workaround with strategies like crowd sourcing techniques with a more robust implementation of FF with provision to select values from a list or proposing a standard vocabulary to minimize free-speech inputs.

## Objectives

The ultimate goal is to integrate FF with the comprehensive disaster management system like Sahana. Thereby, enabling Sahana to exchange emergency information over the voice platform. This would strengthen the capabilities for deploying such a system to be used by those first-responders in developing countries who are more comfortable with voice messaging opposed to text-based messaging.

Figure 1 shows the intended architecture of the integration of FF with Sahana. The primary objective of this research is to study the feasibility of implementing FF for voice-based emergency information exchange using EDXL-CAP and EDXL-SITREP as data interchange standards. The study will specifically focus on community-based disaster management with the need for multilingual capabilities.

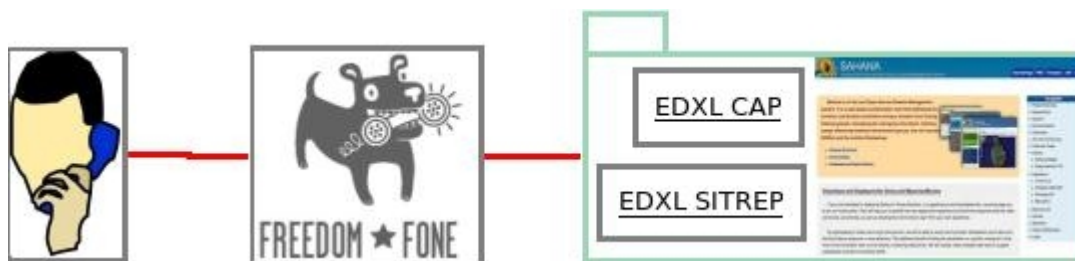


Figure 1: Integration of commercial telecommunication, Freedom Fone, EDXL-CAP/SITREP, and Sahana systems

At this stage of the research, the actual integration of FF with Sahana will not be implemented. Instead, the outcomes of this research will be to better understand the system requirements that will lead to design recommendations for a complete integration of FF with Sahana for standardized emergency information interchange. Based on those findings, apply for other funding opportunities to solve the prevailing gaps. We will also attempt to utilize Google Summer of Code and Google Code In initiatives to attract open source community members to contribute to future software developments.

As a result, the project will seek to achieve the following specific objectives -

1. Study the risk information communication needs for disaster coordination between “Samana Thetha” (also known as the Sarvodaya Community Disaster Management Center -SCDMC) and

4 UCSC Natural Language Research Lab - <http://www.ucsc.cmb.ac.lk/trl/>

- the Sarvodaya District/Divisional Coordinators
- 2. Map those requirements to EDXL-CAP and EDXL-SITREP as well as FF
- 3. Implement the FF IVR system that addresses the requirements for exchanging standardized messages between SCDMC and the District and Divisional Coordinators
- 4. Assess the challenges and design changes required for FF to comply with Sarvodaya needs, EDXL-CAP and EDXL-SITREP standards for exchanging multilingual emergency information

## Research Design

### Description of technology components

Figure 2 describes the use cases for sending and receiving EDXL-CAP and EDXL-SITREP compliant emergency information between the SCDMC and Sarvodaya Villages. This is a higher level use case diagram, which includes the Sahana system. In this phase of the research Sahana CAP and SITREP modules will be used purely as a guide to study the attribute requirements.

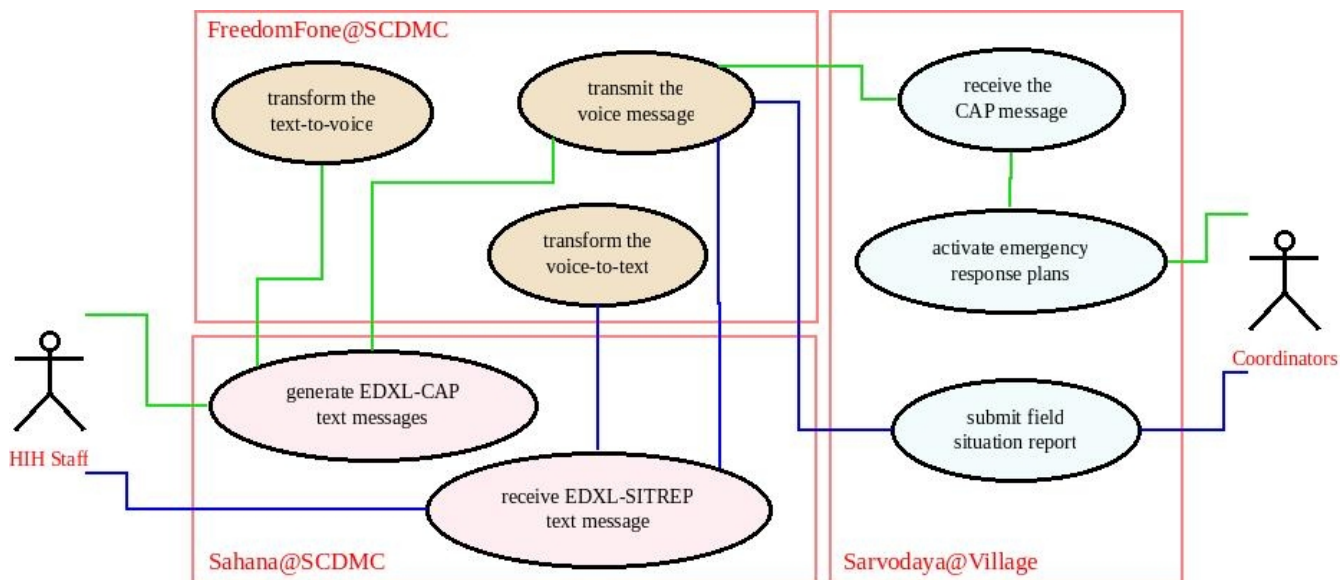


Figure 2: Use cases for sending and receiving standardized emergency information

Sahana is a Free and Open Source Software (FOSS) system designed for managing disasters<sup>5</sup>. The messaging/alerting module and the situational-reporting module are two key components in place for disseminating and gathering information during a crisis. Sahana system will be hosted at the SCDMC ([Sahana@SCDMC](http://www.sahanafoundation.org/)).

EDXL is a collection of emergency data exchange language standards, intended to facilitate information sharing between emergency-related organizations. This project is particularly interested in the two protocols: EDXL-CAP and EDXL-SITREP designed specifically for pushing and pulling crisis information. EDXL-CAP and EDXL-SITREP are based on eXtensible Markup Language (XML),

5 Sahana Disaster Management System – <http://www.sahanafoundation.org/>

which allows for system interoperability.

Freedom Fone is a FOSS system that when coupled with a GSM modem, such as Mobigater or OfficeRoute, can interactively send and receive voice-based content. The FF application server will be hosted at the SCDMC for exchanging CAP-based alerts and SITREP-based situational reports between the SCDMC and Emergency Coordinators working in the respective villages.

### ***Alerting and Situational Reporting process***

To issue an alert, authorized Hazard Information Hub staff (*HIH staff*) will *generate a CAP text message* using the existing Sahana Alerting Broker (SABRO). Typically, we would require FF to *transform the text-to-voice* before FF can *transmit the voice message* to the Sarvodaya district and divisional emergency coordinators (these actors are termed as *Coordinators*). For the sake of this research the transformation will be manual, where the HIH staff would bridge the output from Sahana into FF manually. Once the Coordinators *receive the CAP message*, they will decide whether or not to *activate emergency response plans* based on previously established protocols.

To report an incident, following a disaster or other times, Coordinators will *submit a field situation report*. The report will be a telephone voice message. The FF system will transmit the voice message to the HIH. The FF system will, typically *transform the voice-to-text*, but for the sake of this project the audio recording will be manually transformed to text. The text will be mapped to EDXL-SITREP data elements. *EDXL-SITREP messages received* from the field through Coordinators will be manually interpreted and then mapped to the text fields of the Sahana SITREP module.

## **Methodology**

The end-users such as HIH staff and District/Divisional Coordinators will be exposed to the FF technology and given training to communicate alerts and situational reports through mobile or fixed voice telephony. The FF system, being an interactive voice system, will be systematically implemented for the users to follow a menu driven application for receiving or submitting voice-based emergency messages.

The participating users will engage in a series of silent-tests and live-exercises to determine the usability, utility, and effectiveness of the implementation. Feedback on the usability, utility, and effectiveness indicators will be obtained for analyses through focus-group discussion, interviews, and observations.

Evaluation of the FF4EDXL will comprise objective-based, decision facilitation, and controlled-tests methods. Four districts will be selected on the basis of their historic exposure to a major disasters such as the 2004 Tsunami in the east and southern coastal belt, 2008 Ethnic War in the north and east, 2011 Floods in the east, and other events such as public health epidemics in the west. The requirements for implementing will be gathered through these four districts.

## ***Objective-based***

The design requirements for enabling FF with EDXL-CAP and EDXL-SITREP may change over time while progressing into the project. The design that is derived from the functional requirements, with the assistance of the Sarvodaya emergency coordinators, may anticipate a certain level of aptitude in users and would invest fewer resources in making the system substantially foolproof. However, testing the resource in the real setting may reveal that the interactive design process was underestimated.

The problem with any innovation is that developers and users might not imagine or anticipate to determine all of the functional requirements. It is only after a few iterations of development and hands-on experimenting that they realize the true potential. For a basis to gather evidence for establishing the requirements, the research will study Sarvodaya's involvement in past major disasters such as the 2004 tsunami, 2008 war, 2011 floods. Mapping the present way of upstream and downstream risk information sharing practices within the Sarvodaya community-based setting will provide the initial requirements.

## ***Decision Facilitation***

This method will seek to resolve issues important to developers and administrators for individuals to make decisions about the future of the resource; namely FF coupled with Sahana. Those who are interested in these issues are mostly the disaster related researchers and practitioner determining the policy implications for implementing FF for emergency communications. In addition, the technology partners (The Kubatana Trust of Zimbabwe<sup>6</sup>, LIRNEasia<sup>7</sup>, University of Alberta<sup>8</sup>, Sahana Software Foundation<sup>9</sup>) are keen in understanding the outcomes and to absorb the lessons towards improving their systems. The emergency managers deciding on the future of voice-based standards compliant information communication would be mostly interested in upstanding adaptability of such technologies.

Most of the decision facilitation will be done through individual and focus group discussions or interviews.

- Researchers in this project will engage with Sahana Software Foundation's community through discussions to determine the design requirements for adopting EDXL-CAP, EDXL-SITREP, and integrating FF with Sahana.
- Formally exercised interactions with Sarvodaya disaster managers will help justify some of the hypothesis derived, specifically in community-based disaster management.

## ***Controlled-tests***

Research will conduct controlled-tests in the form of a tabletop exercise or other formal adversary proceeding to judge the FF implementation intended for upstream and downstream standardized

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6 Kubatana website: <http://kubatana.net/>

7 LIRNEasia website: <http://www.lirneasia.net/>

8 University of Alberta, Faculty of Extensions website: <http://www.extension.ualberta.ca/research/faculty-members/gow/>

9 Sahana Software Foundation website: <http://www.sahanafoundation.org/>

emergency data exchange. This particular exercise will be confined to a single chosen district with selected Sarvodaya personnel. The study will look at the implemented system and the added benefits, which will be important in determining the shortcomings of implementation, especially, the robustness of the technologies, tainting requirements, perceived usefulness and the ease of use.

## Activities and Time-lines

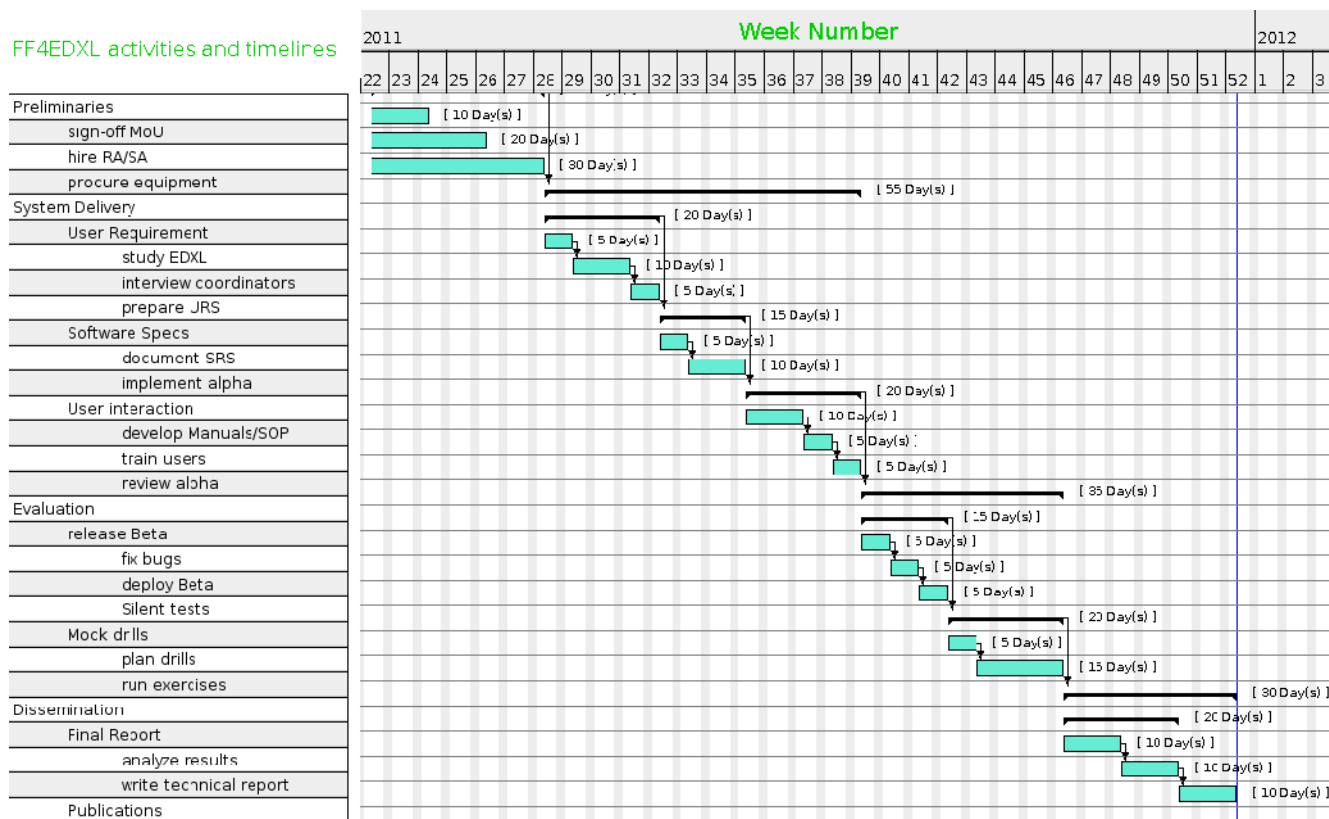


Figure 1: Project tasks and time-lines scheduled over six month period

Table 1: Description of the tasks in Figure 3 and the expected deliverables

Main activity	Description of subtasks	Deliverables
Preliminaries	<ul style="list-style-type: none"> <li>A Memorandum of Understanding (MOU) will be signed between LIRNEasia and Kubatana.</li> <li>Research Assistant cum Analyst Programmer (RA/AS) will be recruited to carry out the project tasks as defined in the Terms of Reference (TOR).</li> <li>A branded computer with power backup, External hard drive for system backup, and a GSM modem for connectivity will be purchased</li> </ul>	MOU 1.0 TOR 1.0 Receipts



<p>System Delivery</p>	<p>User requirements</p> <ul style="list-style-type: none"> <li>• RA/AS will study the EDXL-SITREP and EDXL-CAP specifications to understand the data requirements and document them in a User Requirements Specification (URS) document</li> <li>• Based on the EDXL study a questionnaire will be developed to conduct interviews with Sarvodaya emergency coordinators</li> <li>• Findings from the interviews will be documented in the URS, then signed off by the research team</li> <li>• Those findings will be mapped to the EDXL-CAP and EDXL-EDXL-SITREP specifications</li> </ul> <p>Software Specifications</p> <ul style="list-style-type: none"> <li>• A Software Requirements Specification (SRS) will be produced to transform the URS to technical specifications to define the EDXL based implementation</li> <li>• The RA/AS will implement the confirmed specifications to build the prototype release (Rel) of the requirements for alerting and situational reporting</li> </ul> <p>User Interactions</p> <ul style="list-style-type: none"> <li>• Research team and RA/SA will develop a set of training aid inclusive of quick guides and Standard Operating Procedures (SOP)</li> <li>• The HIH staff and Sarvodaya emergency coordinators will be given training on sending, receiving, interpreting, and mapping alerts and situational reports</li> <li>• The research team and other project involved persons will review the prototype implementation to validate. Thereafter, the prototype will be presented to the Sarvodaya coordinators for an initial assessment to ensure all requirements are captured</li> </ul>	<p>URS 0.x</p> <p>SRS 0.x / Rel 0.x</p> <p>Manual 1.0/ SOP 1.0</p>
<p>Evaluation</p>	<p>Release Beta</p> <ul style="list-style-type: none"> <li>• First the bugs and changes revealed through the review process of the prototype release by the research team and Sarvodaya coordinators will be applied</li> <li>• The final release of the implementation will be deployed with a complete entry of master (static) information and process flows</li> <li>• A series of silent-tests will be carried out with HIH staff and Sarvodaya emergency coordinators as a precursor to the mock-drills</li> </ul> <p>Controlled-tests</p> <ul style="list-style-type: none"> <li>• The tabletop exercises will be planned by the RA/AS at the convenience of the Sarvodaya emergency coordinators. Research team and RAAS will develop a set of guidelines,</li> </ul>	<p>URS 1.0 / SRS 1.0 / Rel 1.0</p> <p>Evaluation matrix 1.0/ guides 1.0</p>



