OPEN SOURCE SOFTWARE FOR DISASTER MANAGEMENT

Evaluating how the Sahana disaster information system coordinates disparate institutional and technical resources in the wake of the Indian Ocean tsunami.

BY PAUL CURRION, CHAMINDRA DE SILVA, AND BARTEL VAN DE WALLE

The Sumatra-Andaman earthquake of December 26, 2004 with an undersea epicenter off the west coast of Sumatra, Indonesia, triggered a series of devastating tsunamis that spread throughout the Indian Ocean killing approximately 230,000 people, including more than 168,000 in Indonesia and over 30,000 in Sri Lanka. Following the Indian Ocean tsunami, humanitarian assistance was desperately needed for the hundreds of thousands of people affected, and to recover from the widespread damage to the infrastructure of the affected countries, mostly Indonesia, Sri Lanka, Thailand, and India.

In major disasters such as the Indian Ocean tsunami, the need for accurate and timely information is as crucial as is a rapid and coherent coordination among the international

humanitarian community [1, 2, 5]. Effective information systems that provide timely access to comprehensive, relevant, and reliable information are critical to humanitarian operations. The faster the humanitarian community is able to collect, analyze, disseminate, and act on key information, the more effective will be the response, the better needs will be met and the greater the benefit to affected populations [3].

International and national disaster response organizations use a range of information tools and resources, depending on their institutional and technical capacity to develop and manage those tools. While some organizations field quite sophisticated technology, most humanitarian organizations struggle to keep up with new technology. This struggle is mainly caused by limitations of staff capacity, financial resources, connectivity, and security in the field. In light of these constraints, the humanitarian community has not been able to take full advantage of the tremendous potential the information revolution has unleashed in other areas. This is not to say the humanitarian sector is unique in terms of business processes; however, it is fair to say the environments in which these organizations work are substantially more challenging than those in most other areas [7].

Despite these challenges, the Tsunami Evaluation Commission (TEC) in its evaluation of the international response to the Indian Ocean tsunami stated that "the information technology revolution, the primary driving force in changes to disaster response, was well reflected in the overall response to the tsunami" [6]. One can justify this slightly optimistic view by focusing on the more visible aspects of this revolution such as remote sensing, yet there are still substantial gaps in the information systems for large-scale disaster response. One of the recommendations made by the TEC was that "significant effort and funding should be dedicated to organizing open source, easily shareable software and training tools to prepare for all stages of disaster response."

This article describes how Sahana, a free and open source disaster management information system developed in Sri Lanka in the immediate aftermath of the Indian Ocean tsunami, is addressing this recommendation and associated challenges.

The Significance of Open Source Software for Disaster Management

Very few countries and organizations commit sufficient resources to disaster management, regardless of past experience or future potential. Disaster management becomes a pressing concern only after the disaster has struck—a concern that may be short-lived, as other needs quickly resurface. While this is obviously true of poorer developing nations, it is also often the case in richer developed countries; there are always higher-priority projects that need funding, and investment in disaster preparedness remains low around the world.

As the issues addressed by disaster management systems are relevant for any country dealing with a disaster, ideally such systems should be shared, developed, and owned globally. The Free and Open Source Software (FOSS) development and community mechanisms have a proven track record in building such systems. In particular, we believe the FOSS principles and practice mesh well with the humanitarian sector on three important criteria:

- **Approach:** the FOSS approach—an open, transparent, and grassroots-shared movement—fits very well with the proclaimed principles of most humanitarian organizations.
- **Cost:** although there is an initial cost in setting up a FOSS disaster management system in terms of technical support, the system has no cost to procure and is low cost to maintain. This overcomes some of the basic resource constraints that affect many governmental and non-governmental organizations. This particularly addresses the problem of lack of funding before a disaster strikes or any administrative constraints that would require a long procurement process for a high-cost license. In addition, FOSS development leverages the goodwill and expertise of a global community of IT and non-IT actors at no cost.
- **Adaptability:** the approach and cost factors described here combine to make it possible for a FOSS disaster management system to be set up, adapted, and localized quickly, so that it can be more responsive to the specific situation. Since it is FOSS, the source code is available for anyone to adapt freely; as a Web-based system, it does not require end users to install additional software and updates can be managed centrally.

The Origins of Sahana

In the Sinhala language, "Sahana" means "relief," and the Sahana Disaster Management System development was initiated by considerable relief coordi-

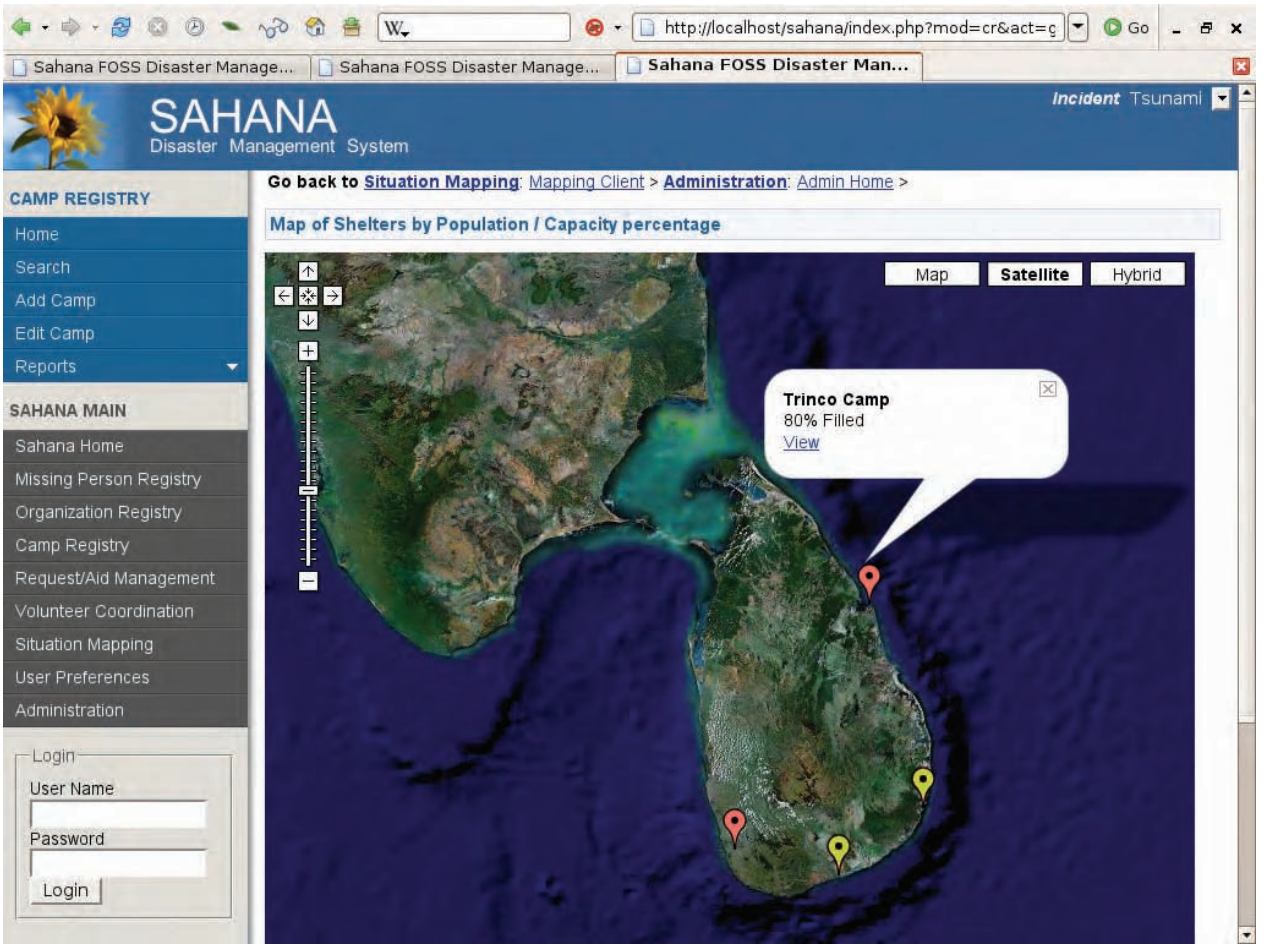

Figure 1. Sahana main interface.

nation needs in Sri Lanka following the tsunami. Spearheaded by the non-governmental organization (NGO) Lanka Software Foundation, Sahana was initially built by a group of volunteers from the Sri Lankan IT industry. Developing a disaster management solution immediately after a disaster is clearly not the best time to do it, but there was simply nothing else available to the Sri Lankan government. After three weeks of development the system was authorized as part of the official portal for the Center of National Operations, the main government body in Sri Lanka coordinating the relief effort. Over 40 volunteers from various groups and companies contributed to the development, and approximately 100 students were recruited to deploy the system and to collect and enter village population data [4]. By the time the Center was closed in early February 2006, the Sahana system contained data on over 26,000 families.

Component-based Design in Sahana

Figure 1 shows the main interface of Sahana providing access to a collection of interconnected yet independent components. These components interact with each other via a set of shared databases to provide a range of Web-based information services. Each component is designed to address a particular coordination problem

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Component	Description
Organization Registry	• To help self-distribute, monitor, and coordinate agencies and their geographic and sectoral coverage. • Provides a report of who is doing what where (W3), leading to gap analysis of relief efforts.
Missing People/ Disaster Victim Registry	• To trace individuals, whether injured, missing, displaced, dead, orphans, and so on. • Allows people to find family and friends through search and messaging facilities.
Camp Registry	• To report, track, and help manage shelters and their residents, whether temporary (schools, hospitals, residences) or semi-permanent (camps, new settlement). • Maps locations, capacities, and requirements of camps to facilitate effective management.
Request Management System	• To track supply and demand of aid, monitoring movement of aid supplies. • Matches requests for assistance with offers of support.

Table 1. Sahana components and descriptions.

Component	Description
Inventory Management System	• Provides basic inventory control for camps and warehouses, allow coordinators to review where supplies exist, when resupply must occur, and expiration dates.
Messaging Module	• For generating alert messages as a client to responders in the field. • Stores complex messages as templates for later use.
Situation Mapping Module	• Allows annotation of a map with text and images of the disaster.
Synchronization Module	• Allows the data from disconnected Sahana systems to be synchronized. • Enables exchange through USB flash drives or similar devices in disasters where Internet connectivity is a issue.

Table 2. Additional components added to the core set of solutions.

in disaster response, and can be dynamically included in any installation (see Table 1).

In Sri Lanka, the main components that were utilized were the Organization and People registries; the Camp Registry and Request Management System were used to a far lesser extent. Subsequently, additional components for inventory management, messaging, situation mapping, and synchronization have been added to the core set of solutions (see Table 2).

Sahana Deployment and Customization

Sahana has officially been deployed in response to the October 2005 Pakistan earthquake, the 2006 Philippines mudslides, and the 2006 Yogyakarta earthquake in Indonesia. In Pakistan and the Philippines, the project was deployed for the government with the support of IBM country teams. In Indonesia, Sahana was deployed independently by the civil society group Indonesia Relief Source and sponsored by the Australian Computer Society (ACS). Sahana is also pre-deployed with Sri Lanka's largest NGO Sarvodaya in preparation for future disasters, and a child protection module has been custom built for the international NGO Terre des Hommes.

The Sahana system can be scaled up or down from a single notebook computer (with or without a portable WLAN) to a fully distributed networked platform. The deployment diagram in Figure 2 illustrates what a large-scale deployment involving multiple organizations may look like. The disaster coordination and relief hub may be located away from the affected disaster region, and satellite communications or rapidly deployed mobile telephony could be required for network-based operations.

Sahana includes a synchronization framework that allows individuals to go to the field with a snapshot of existing Sahana data, and later synchronize with the central Sahana server when Internet connectivity is available. The data itself can be exported in XML format and stored on a USB removable memory device, allowing for data sharing and manual transmission at locations where there is no connectivity. Sahana has a role-based security system that can allocate permissions by any view or action performed on the system. The system is intended to create a secure WAN of trusted organizations—governmental or non-governmental, public or private, volunteer or paid, civil or military—that can share common data across organizational boundaries to respond more effectively to disasters. Clearly, as the data gathered is often sensitive in nature, measures must be in place to ensure its privacy and protect it from malicious individuals or organizations.

Community Recognition and Further Development

The Sahana project has been fortunate to receive considerable recognition within the FOSS Community. Sahana has received a Red Hat Award, has been nominated the SourceForge Project of the Month for June 2006, and has been included in the BBC documentary on FOSS "Code Breakers." The Free Software Foundation has recently created a new award for software designed for social benefit, directly inspired by Sahana. The private sector has shown great interest as well. Some of the Sahana deployments have been directly supported by the IBM crisis response team, and much interest is being shown by other large IT companies.

The core development team works with a wider "Sahana community" to support the requirements and needs of organizations responding to disasters, partnering with the government and NGOs working in the field. The Sahana community has grown to over 100 disaster management experts, emergency management practitioners, humanitarian consultants, NGOs, academics, and FOSS developers from around the world and mainly from Sri Lanka, U.K.,

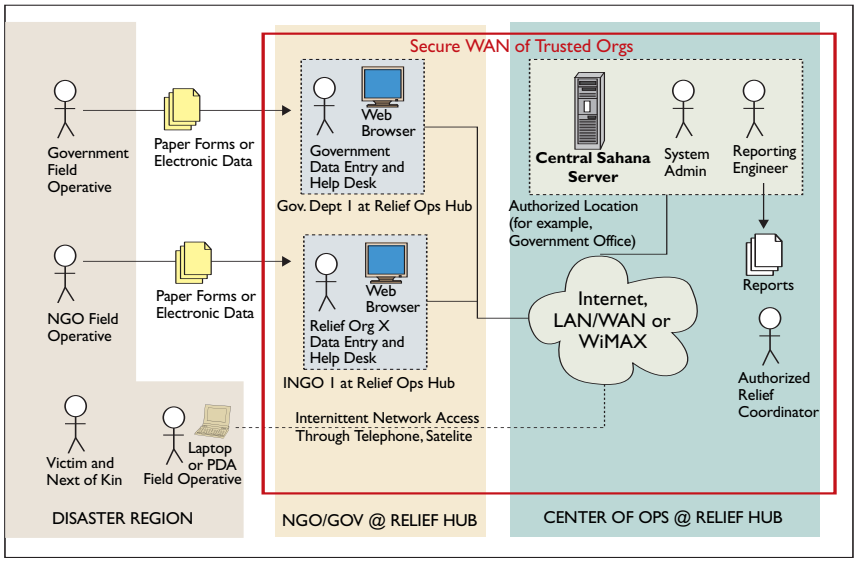

Figure 2. Sahana deployment overview.

U.S., New Zealand, Australia, and Thailand. As a result, the project benefits from access to a wide range of experience and expertise in both technical and non-technical domains when designing and developing components.

Conclusion

With the key characteristics of an open-access approach, low-cost deployment, and easy adaptability, FOSS disaster management systems will play an increasingly important role in the humanitarian sector. Our experiences in the field during the past two years with Sahana have shown that the FOSS approach has much to offer to the coordination of agencies's response to large-scale disasters. Development of Sahana will continue under the guidance of the Lanka Software Foundation, with a long-term objective to grow into a complete disaster management system capable of handling disaster mitigation and preparation, relief activities, recovery, and reconstruction.

There have not yet been any independent evaluations of Sahana deployments in the field, making it impossible to definitively judge whether the platform has played a significant role in any given response. Nevertheless, based on positive feedback from practitioners, governments, NGOs, and the continued level of interest in Sahana, it can be stated that this project has filled a need in the disaster response community—specifically for an extensible and usable platform for the basic coordination functions required in responding to disasters.

The most important challenge remains to prove the concept in the field as widely as possible, and to ensure the end-user community is brought into the process of application development. Only in this way will FOSS applications such as Sahana grow and mature to fulfil the real needs of humanitarian assistance, and live up to the expectations that Avelino J. Cruz, Jr., Secretary of National Defense in the Philippines, expressed when discussing the deployment of Sahana in response to the Leyte landslide disaster in early 2006: "There is no greater innovation that matters more than that which saves lives." C

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