RELIEF 10-03
After Action Report

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Background

The RELIEF 10-03 experiments was the first pause in operations for several of the key free-and-open-source software players in the Haiti response, as well as the first chance many had to work on issues discovered in the field, especially as it relates to the interoperation of their applications with large organizations like the DoD. The attendees included Sahana, OpenStreetMap, Walking Papers, GeoCommons, Synergy Strike Force, and the ESRI. Also attending were Dr. John Gage (Kleiner Perkins and former CTO of Sun Microsystems) and Dr. Linton Wells (Force Transformation Chair, National Defense University and former CIO of the DoD).

## Summary of Accomplishments

- **Walking Papers Atlas:** developed an extension of Walking Papers that enables any user to print out entire regions of OpenStreetMap into field atlases. Notably, handwritten notes made with these atlases can be scanned and uploaded back into OpenStreetMap.
- **ESRI OpenStreetMap Tools:** developed an alpha version of an ArcGIS plugin that can read and write to OpenStreetMap.
- **OpenStreetMap Job Tasking Server**: designed the basic framework for checking out grid squares from OpenStreetMap for editing, and then for auditing work submitted against that grid square.
- **Offline GeoCommons Browser**: developed an offline version of the GeoCommons platform, which enables average users to upload spreadsheets and automatically build thematic maps.
- **OpenAerialMap First Node**: designed the architecture for the first node of OpenAerialMap, which will be hosted at NPS. OAM will be the raster equivalent of OpenStreetMap, storing and distributing open-license imagery of disasters.
- **HFOSS Consortium**: designed the outlines for an organization that can function as a single point of contact between large agencies (DoD, UN, etc) and humanitarian free-and-open-source software communities.
- **HFOSS Maturity Model:** designed the first draft of a model for evaluating the readiness of humanitarian free-and-open-source software for deployment to disasters.

Walking Papers Atlas

When the Humanitarian OpenStreetMap Team (HOT) deployed Walking Papers (http://walking-papers.org) in Port au Prince, they found that paper-based maps of OpenStreetMap (OSM) were in heavy demand by field staff of the UN and many NGOS, most of whom have no GIS training and poor access to good maps of Haiti. In one case, a member of the EU Humanitarian Unit walked into the MapAction tent specifically asking for paper versions of OpenStreetMap's Haiti Map that he had loaded onto his iPhone and GPS unit.
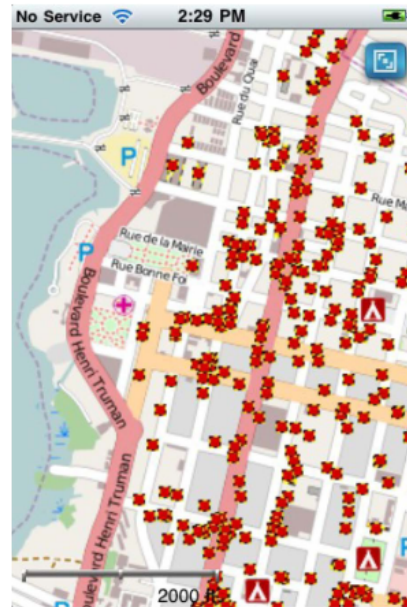
Because OpenStreetMap was designed for online use, the best method for printing a region in OpenStreetMap onto paper is via Walking Papers, which can overlay MGRS grids and underlay alternative base layers, including high-resolution aerial imagery, under

OSM's street data. Walking Papers can also embed data about the bounding box of the grid and its placement on the map, enabling it to function as a field notebook: anything written by hand on the printed paper can be scanned back into Walking Papers and traced; those tracings can also be added back to OpenStreetMap.
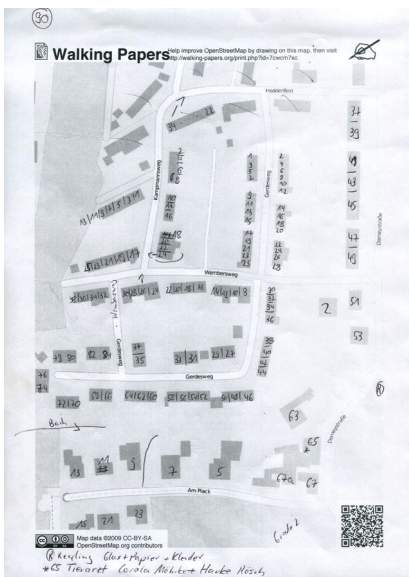
That said, Walking Papers was designed to print one grid-square at a time via PDF. When the field worker from the EU Humanitarian Unit asked for all of Haiti, that project turned into a long manual process of generating every PDF file for every grid square. This situation was not helped by the fast pace at which OSM was adding data to the map.

Solution

At the request of the HOT team members, the inventor of Walking Papers, Mike Migurski, joined the RELIEF 10-03 team to confront this problem. Mike created an "atlas" feature for Walking Papers. This capability enables a user to choose a bounding

box over a large area (like the city of Port au Prince) and divide it into 4, 16, 32, or 64 grids. Each of these grids is automatically turned into Walking Paper and appended to a single PDF "atlas" of the selected region. Each page in the atlas retains the ability to be scanned back into Walking Papers and traced into OpenStreetMap.

Next Steps

Walking Papers atlas was immediately deployed to Haiti at the end of RELIEF 10-03, where it is in use by UN agencies and NGOs. It is currently enabling teams to print out maps of ongoing relief and development activities onto large-format paper maps, which are being posted in information kiosks in Port au Prince. (see picture).

ESRI OpenStreetMap Tools

Like the early spreadsheets freed financial reports from a cabal in an enterprise's central computing facility, OpenStreetMap is liberating mapping from a small cadre of surveyors and GIS analysts. That said, OSM is not equipped to prepare high-end geospatial analysis; for that task, one requires a tool like ESRI's Arc series of products. To enable read/write input from OpenStreetMap, ESRI is building a plugin to ArcGIS which enables trained analysts to open data created from OpenStreetMap, add new data through ArcGIS, and then save the changes back to OpenStreetMap.

Solution

The ESRI team joined the RELIEF 10-03 experiments to work with OSM to develop an alpha version of a plugin for OSM. ESRI improved the "read-write-read" roundtrip , so that it works in basic format, but with remaining issues related to the different data models between OSM and ESRI. In specific, OSM uses a bottom-up tagging system to classify points of interest, which enables users to add new terms to the taxonomy. ESRI uses a well-characterized top-down taxonomy to classify POIs, so that its GIS analysis tools can manipulate data in predictable, controllable ways. The mesh between these two data models is the subject of the experiment on the Humanitarian Data Model (below).

Next Steps

1. Continue to develop the ESRI toolset for OpenStreetMap. OSM looks forward to continued work with ESRI on the OSM plugin.
2. Educate ESRI in the issues of community that are related to the introduction of the tool to the military and UN. ESRI is learning how to work with an open-source community, which is different from its normal mode of operation. OSM has no single points of contact and no decision-making body in the corporate sense. Decisions are more about building grassroots consensus in a large, distributed community than seeking the approval of a few decision makers.

OpenStreetMap Job Tasking Server

Crowdsourcing is not efficient when multiple people attempt to perform the same work—especially when they are unaware of each other's activities and lack a means to discover the duplication and coordinate a solution. Crowdsourcing also raises issues of validation, particularly when an individual is new to the project and has performed a task which needs to be audited by more experienced hands.

The OSM team discovered this problem firsthand during the Haiti operation. More than 1000 individuals tackled the work of mapping Haiti's roads, infrastructure, and buildings from sources as diverse as 8cm aerial photography to travel guides and tourist maps. Because Haiti was essentially a blank spot on OpenStreetMap, the twin tasks of 1) knowing who was tackling which part of Haiti and then 2) determining how to cross-check completed work were difficult to coordinate.

Solution

At *WhereCamp* in April, the OSM team proposed developing a job tasking server, whose purpose would be to provide a means to check out grid squares for mapping, and then to assign auditing tasks to completed work. At RELIEF 10-03, Kate Chapman led a team of programmers (mostly virtual) to build this job tasking server. The initial scope was simply to sketch out the initial architecture for the server. During this work, the team surfaced a number of issues:

1. *Prior Attempts:* several developers had been working on code for a similar purpose, but had only sketched out the basic outlines of the software. This code was deemed too hackish for the humanitarian realm. The team set forth to write a new architecture from scratch.
2. *Remote participation challenges:* The team learned an important RELIEF lessons: When designing new software architecture, it is desirable to have the whole team co-located. Further work can continue virtually, but efforts to resolve architectural conflicts and to brainstorm new ideas is best done through face-to-face contact.

After the initial survey of software and preliminary coding, the team decided that it should table the job tasking server until the OSM conference in May (State of the Map in Girona Spain, stateofthemap.org) and the next RELIEF experiments, when more

developers could contribute to building out the initial prototype. This is an important lesson-learned for RELIEF: *when starting new projects, expect teams to bring all necessary people to the field for architectural discussions.*

Next Steps
At the next RELIEF experiment, we need to recruit more developers to work on the job tasking server, enabling them to break out the code into constituent parts:

1. Tasking: tasking the initial mapping.
2. Validating: creating a system to designate the level of trust in newly completed work.
3. Auditing: displaying the level of auditing that has passed over work that has been completed in a given grid square.

Offline GeoCommons Browser

For most NGOs in the field, data exists as spreadsheets. When these data include GPS points, they tend to be displayed as dots on a map (georeferenced points of interest (POIs)). When staff wishes to turn dots on a map into thematic maps that display comparative analyses (such as the density of hospitals against the density of population), they generally have to send the data to a GIS analyst. GeoCommons begins to automate this process.

GeoCommons is a platform that enables anyone to upload spreadsheets with georeferenced POIs (such as worksheet with hospitals and a worksheet with population) and to automatically turn that spreadsheet into a thematic map that compares two more data sets (here, hospitals and populations). That said, GeoCommons has traditionally existed as an online service that requires public Internet access. While a prototype of the parent software (GeoIQ) has been deployed to Afghanistan for offline use, the free version, GeoCommons, had not yet been ported to offline use. The experiment focused on creating an offline GeoCommons for inclusion in a mapping stack for humanitarian operations.

Solution
Kate Chapman of FortiusOne worked with Todd Huffman of Synergy Strike Force to build an offline version of GeoCommons. She branched the software, stripped the libraries down for offline server, and worked on the user interface to remove calls to all external Javascript libraries. The resulting offline installation of GeoCommons performed the basic tasks for GIS and thematic mapping: it provided the ability to upload data from records in a spreadsheet and/or KML into a thematic map, and enabled comparisons between multiple uploaded datasets. It also allowed the user to transform data from one open format to another, so that Excel spreadsheets could be converted into KML and/or shape files, which could then be exchanged over SneakerNet.

Next Steps
The GeoCommons browser is customized to Afghanistan, with basemaps oriented towards this theatre. Kate would like to make a more generic version as well as a version customized to Hait, where OSM is continuing to deploy.

OpenAerialMap First Node

OpenStreetMap could not have traced so many roads in Haiti without good aerial imagery. That said, there exists no single clearinghouse for satellite and aerial imagery collected before, during, and after humanitarian emergencies. Also, there exists no licensing schema to handle the intellectual property rights around the use of such imagery. Instead, during the Haiti operations, efforts to aggregate all known sources of imagery were *ad hoc*, relying on the expertise and good will of a small handful of GIS experts from academia and industry.

OpenAerialMap (OAM) seeks to address this problem by establishing an imagery archive that is the raster equivalent to OpenStreetMap, providing both a technical platform for imagery aggregation, processing, and distribution, but also a licensing schema that will allow for use of that imagery during humanitarian emergencies.

Opportunity
With the generosity of a 10K grant from NPS, OAM received the funding necessary to purchase the hardware for its first node and the hosting environment where OAM can develop and test a software stack capable of processing, storing, and distributing tilesets and raw imagery for humanitarian emergencies. The experiment at RELIEF 10-03 dealt with assembling the community of OAM developers around core architectural and policy issues, including:

1. *Design of OAM's first node*. What hardware, operating system, and software should drive the first node of OAM? How much drive space would be needed for a proof of concept?
2. *Operating System*: Would OAM be willing to use the proprietary Solaris operating system to meet challenges with that no Linux filesystem currently supports?
3. *OAM's method of work over the summer*. What procedures would OAM follow to drive development of the software stack that will run on the first node?

Solution
The OAM team held a conference call, linking together core developers, NPS staff, and TIDES representatives. The hardware discussion quickly settled on using the architecture used for clients of OpenSGI, which offers 32TB of storage set up in a RAID configuration that leaves 24TB of storage plus 2TB of SSD failsafe storage. Several questions emerged during the debate over operating systems:

Like most open-source initiatives, the community around OAM has a strong bias to ensuring that all aspects of the architecture are open source. That said, no open source file system can handle billions of files without causing corruption issues; only ZFS from Solaris can handle that many files. Because OAM will be generating tile sets that will

easily reach into the billions or tens of billions of files, the team decided on a compromise: to use CENTOS Linux for the front end of the web service, and Solaris for the storage node. The NPS team facilitated this decision by adding a small Linux server for developing a front end, which it would connect to the storage server (the server that will be purchased with NPS funds and would run Solaris for an operating system).

Next Steps
1. The NPS team will procure the specified hardware and install Solaris on the server. It will also design a means to mount the Solaris storage node to the Linux server that NPS is re-allocating to this project.
2. The OAM team is responsible for developing software for processing, storing, and serving tile sets of imagery. The OAM team will provide this software stack to the NPS team for installation.
3. OAM will work with NPS to obtain the base imagery for the United States from government sources at a sub 1m resolution.

HFOSS Consortium

During the operation in Haiti, problems emerged around the interaction of small, nimble HFOSS organizations and the large institutions that were trying to make use of open source information. Because HFOSS communities tend to operate without corporate structures and with flat organizational structures, large institutions—including SOUTHCOM—found great difficulty with answering three questions:

1. Which organizations where doing what where?
2. Who the points of contact were for each HFOSS organization?
3. Which organizations could help SOUTHCOM meet which parts of its mission?

Similarly, large organizations found great difficulty funding and contracting of the open-source communities that build open-source software and foster the exchange of open-licensed data. Neither US Government institutions nor UN agencies currently possess the mechanisms or contracting vehicles that allow for them to send monies to consortia of grassroots communities that work together on common problems. As a result, the good work performed by open-source communities lacks resources to turn (albeit successful) *ad hoc* processes into reliable, scalable systems.

This interaction problem between HFOSS and DoD/UN agencies manifested itself around several initiatives that proved to be critical to the response, including:

1. **Kapab MedNet**. To identify the location and disposition of Haiti's health facilities, an *ad hoc* consortium of OpenStreetMap, Sahana, Ushahidi, Crisis Commons, GeoCommons, Crisis Mappers, Synergy Strike Force, and STAR-TIDES led a tiger team to SOUTHCOM and built an SMS-based tool to deploy to Haiti. This platform would have enabled physicians to text their location, patient throughput, and supply needs to a central call center (staffed by Haitians through Samasource), making the data available to all authorized response operations, including SOUTHCOM. There was no way to fund the initiative, not for lack of

funds, but because there were no means to ensure that this *ad hoc* consortium would create a sustainable platform that large institutions could rely upon. WHO/PAHO approval—the key to deployment under the UN cluster system—hinged upon this perception of reliability and sustainability.

2. **4636 emergency SMS services**: an *ad hoc* consortium of FrontlineSMS, InSTEDD.org, and Ushahidi created a mechanism for Haitian citizens to submit SMS reports to a central number (shortcode), while also creating a mechanism for response organizations to broadcast SMS messages back to Haitian citizens. That said, much of the effort was created on the fly, with funding and permissions coming deriving from personal relationships with individuals instead of systems and processes that are sustainable and can be expected to be operable during the next disaster.

The team at RELIEF 10-03 dove into a frank and deep conversation on the constellation of issues related to operations in Haiti. Stemming from this discussion, the team came to the realization that the best way to bridge federal ad UN agencies and with the HFOSS community would be to form a consortium—a new NGO that would function as an intermediary. This organization would have the minimum structures necessary to meet the following missions:

o   To be the single point of contact to the HFOSS community.
o   To route requests for HFOSS assistance between large agencies and small HFOSS communities.
o   To route funding to HFOSS organizations that need funding for deployments and development.
o   To credential members of the HFOSS community so that they can be certified for deployment into HADR zones.
o   To set professional and ethical standards for its members.
o   To establish clear guide to the capabilities and maturity of the software platforms that its members are developing.
o   To develop and recommend standards for interoperability, including data schema, data model patterns, and classification of concepts (ontologies).

The HFOSS consortium would also serve practical purposes between catastrophes.

o   To focus members on common (shared) problems and to avoid duplicative solutions. This work would also require industry relationships, to ensure that HFOSS is focusing on areas where it adds the greatest public value.
o   To develop relationships within the humanitarian community and to learn how to best integrate with response plans of other organizations.
o   To run demonstrations and "shadow operations" that show little bits of functionality and build trust within skeptical organizations, especially with potential champions.
o   To develop safety protocols around the use of applications and the deployment of HFOSS personnel to HADR zones.

Governance of the consortium would be focused on creating decision-making structures congruent with HFOSS methods and dispute resolution mechanisms that foster collaborative solutions over competitive ones. Governance would also focus on ensuring sustainability of any application that is deployed to the field, as well as adherence to humanitarian values.

Next Steps
The creation of an HFOSS consortium will require building support for the idea in multiple forums. The group seeded the idea in Geneva at the ICT for Peace meeting, and will continue the discussion through conference calls over the summer.

HFOSS Maturity Model

Over the past several disasters, new technologies have been introduced into practice during the crisis. While these tools may meet immediate needs of unique circumstances, the underlying systems are often still under active development or have never been tested. As a result, the participants of RELIEF 10-03 created a side conversation to discuss what kind of metric might be used to evaluate open-source software's readiness for deployment. The following maturity model is a sketch for a larger set of conversations that an HFOSS (humanitarian free and open source software) working group will tackle over the summer of 2010.

Brainstorm of Areas in which to explore metrics:

- Internal and External Training
- Licenses
- Community
- Readiness to Respond
- Experience
- Transitional Capability
- Availability of Support
- Sustainability
- Professionalism and Training
- Security
- Usability and accessibility
- Localization and internationalization
- Standards and interoperability
- Fault-tolerance
- Reliability
- Scalability
- Values/mission/vision
- Governance: Decision support/conflict resolution mechanisms
- Social acceptance
- 'Collaborativity': the capability, desire, and reputation to collaborate
- Support diversity
- Burden/footsprint (power, staff, time)
- Transparency/accountability

o   Non-profit status (a hotly contested issue)
o   All-hazards analysis

Next Steps
The Sahana team will convene a series of conference calls to discuss the maturity model, and will publish a proto-model for review.

Humanitarian Data Model: OpenStreetMap-Sahana-ESRI

The interface between traditional bureaucracy and crowdsourcing presents many challenges. One of the most pressing is the differing methods for building data schema. Large organizations (and many large open-source projects) tend to establish fixed data schema that can be coded into scalable architectures. Many crowdsourcing applications take the opposite approach: those with wiki models leave the data structure up to the community, letting the collective actions of trusted actors determine the data schema from the bottom up via a flexible system of tagging. OpenStreetMap is one of these bottom-up tagging applications.

Each approach has strengths and weaknesses. Fixed (top-down) schema optimize for interoperability and software scalability, but make that optimization available at the expense of flexibility to changing circumstances. Wiki (bottom-up) schema optimize for flexibility and scalability of the *contributor community* (i.e., the number of humans who can contribute), but at the expense of interoperability.

Problem
During the Haiti operation, OpenStreetMap's flexible tagging system enabled about 1000 contributors to quickly categorize points of interest (POIs). That said, these tags were difficult to match with the taxonomy features found in ESRI's Arc products, which were used by many of the UN and US military organizations.

The Humanitarian Data Model emerged as a possible solution. It enables a person performing tagging in OpenStreetMap to follow a basic classification schema for describing POIs, called the HDM. The HDM is in turn supported by Sahana, which enables a flow between OSM <-> Sahana <-> other fixed schema applications. That said, the flexibility in the HDM is still an issue for many well-used software applications, including ESRI.

Solution
The OSM, Sahana, and ESRI teams explored possible mappings between the HDM and both the ESRI data model and other open-source data models used during disasters. This initial mapping was put into prototype in ESRI ArcGIS by Martin Hogeweg of ESRI and into Sahana by the Sahana team. The Sahana RELIEF 10-03 report contains additional details on the HDM.

Next Steps
The HDM will require additional technical development with ESRI, OSM, and Sahana, and will need to integrate additional application support. Adoption of the HDM will also

require policy changes within humanitarian organizations. These issues will be scoped out during discussions at RELIEF 10-04.

Appendix

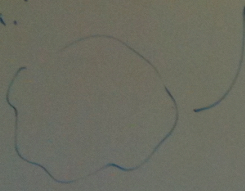Structural
ctural

Media   · Authoritative Sources
3   · Survey
ra.   · Field Data Collection

· Who are you going under?

· Sustainability

· Professionalism

· Trust
· Predictabiln
· Credentialing
· Official Ties

· Shadow OPS · off critical path,
  wide bits of help of champions

· Related Tasks
  from earlier work
  repurposed for
  Crisis

m
s

⎰ Ethics
⎱ Legalities

_____ (Policy) ─

· Financial
        └ on ground
          └ reachback 2
· Consortium fund

1. Crowd sourcing - Ushahidi

2. Data Integration — Health

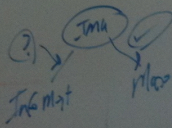3. Mapping.

4. Infrastructure

5. Imagery
   - Distro w/ low bw. 64 bit
   - TF₁ · 2004/5yr. acquisition cycle through FDNY
   - Reachback — Parallel tracks of info gathering
     - field -
     - offshore analysis

   Pool of 4 + Credentialed People

7. Data - Open + Available — on all Software, open + closed source

Unstructured
- SMS
- Social Media
- Reports
- Diaspora.

Structured
- Authoritative Sources
- Survey
- Field Data Collection

Verification
Validation
↓
Actionable — Ethics, Legalities
Tools —— (Policy) —

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+ FOSS's MATURITY MODEL

Wireless passcode

- LICENCE
- COMMUNITY
- READINESS TO RESPOND
- EXPERIENCE
- TRANSITION CAPABILITY
- AVAILIBITY SUPPORT
- SUSTAINABILITY
- PROFESSIONALISM + TRAINING
- SECURITY
- USABILITY & ACCESSIBILITY
- L10N ~ I18N
-       STANDARDS & INTEROPERABILITY
- FAULT-TOLERANCE
- RELIABILITY.
- SCALABILITY

RCCC
iMCDA
- VALUES - MISSION - VISION
- GOVERNANCE - Decision support / Conflict Res.
- SOCIAL ACCEPTANCE
- COLLABORATIVITY
- SUPPORT DIVERSITY
- BURDEN + FOOTPRINT
  POWER / STAFF / TIME
- TRANSPARENCY - Accountability
- NON-PROFIT?
- ALL-HAZARDS