

Camp Roberts RELIEF 09-04 After Action Report

STAR-TIDES¹ “Nangarhar PEAK²” Information Sharing and
Geospatial Information System (GIS) Activities at Camp Roberts
during RELIEF³ 09-04 Events

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¹ Sustainable Technologies Advanced Research, Transportable Infrastructures for Development and
Emergency Support

² Prepositioned Expeditionary Assistance Kits. PEAK is a pending Joint Concept Technology
Demonstration (JCTD) that is sponsored by US Southern Command (US SOUTHCOM)

³ Research and Experimentation for Local & International Emergency & First Responders

Overview

New Capabilities for Pakistan-Afghanistan (PAKAF) (CENTCOM)⁴ and PEAK JCTD (SOUTHCOM)⁵.

EXPERIMENTATION

STAR-TIDES (ST) gathered engineers and innovation leaders from industry, academia, and the non-profit sector, focusing on individuals with direct knowledge of open-source geospatial information system (GIS) applications, unmanned autonomous systems (UAS), and disaster management systems (DMS) and social system networking. Scenarios included stabilization operations in Afghanistan and disaster response situations in Central America.

Entities at CP Roberts included Google's Enterprise and Crisis Response Team, the Development Seed's experts who created Drupal's leading GIS and short message system (SMS) frameworks, core developers of OpenStreetMap and Walking Papers, InSTEDD's GeoChat and National Crisis Response team, the Center for Technology and National Security Policy (CTNSP) at National Defense University (NDU) and Mapping Human Terrain (MAP HT) Social System Engineering Team (SSET) for social networking observation and framework development.

GOALS

1. **Processing NGA⁶ Imagery.** Explore the necessary technical steps to enhance the ability of civilians to participate in US and coalition operations by exploring innovative ways to comply with new (July 2009) NGA NextView licensing procedures. (See Appendix 9 for information about the NextView license).
2. **Processing UAS Imagery.** Explore the technical steps for orthorectifying georeferenced UAS imagery by civilian partners to US operations.
3. **Proving Concept of Operations for Crisis Mapping.** Creating necessary interoperability between the mapping applications and messaging frameworks most commonly used by Non-Governmental Organizations NGOs,⁷ including Google Earth/Maps, SMS/text-messages, OpenStreetMap, Sahana, GeoChat, and Drupal.
4. **Developing Capacity for Building Civilian-Military Partnerships.** Building technical capabilities, collaborative skills and trust among core developers of the most common platforms used by NGOs and other civilian partners and between this developer community and Department of Defense (DoD)/US government (USG) officials.

⁴ US Central Command

⁵ US Southern Command

⁶ National Geospatial Intelligence Agency

⁷ In addition to NGOs, Private Volunteer Organizations (PVOs) (such as Rotary), and International Organizations (IOs) (such as the UN), often participate in civil-military activities. For the purposes of this report, NGO will be treated as shorthand for NGO/PVO/IO and related organizations.

NEW TECHNICAL CAPACITIES CREATED

NGA Imagery Processing

Created proof-of-concept process for receiving broad area one meter (1m) NGA imagery and baking them into small area “Tiles” for use in open-source applications.⁸ Created methods for building NGA-imagery base maps in several GIS applications that are common among NGOs. Created methods for integrating NGA imagery with SRTM⁹ 90m elevation data for 3D fly-throughs of sites where NGOs are operating.

UAS Imagery Processing

Created proof-of-concept scripts for ingesting KML files created by four UAS platforms (Rascal, Scan Eagle, RP Flight Systems, and TerraPan), and proof-of-concept methods for overlaying the imagery into layers in open-sourced mapping applications. Note: Making this capability operational will require significant work and partnership between the DoD, open-source GIS developers, and private-sector UAS partners; recommendations for this work will be listed in future proposed plans for November RELIEF programming. STAR-TIDES strongly recommends further exploration of UAS imagery for areas like Central America, where cloud cover will frequently thwart the ability of satellites to provide daily imagery takes or post-disaster assessments.

Proof-of-concept Crisis Mapping Applications

Developed the glue code necessary for many common NGO platforms—including Google Earth, Sahana, Drupal, OpenStreetMap, and GeoChat—to integrate shared GIS visualizations and a shared SMS messaging framework for crowd-sourced crisis mapping. Integrated multiple base maps into crisis mapping visualizations. Integrated vector-based georeferenced datasets into the visualizations.

Interoperability of Common Open-source Disaster Management Systems

Developed glue code to make major open-source disaster management systems and GIS applications interoperable, including GeoChat, Sahana, OpenStreetMap, Drupal, and Google Earth.

Building Collaborative, Trusted Relationships: DoD, NGO, Industry

Created “quantum leaps” forward for several widely used GIS applications for fielded civilian partners. This concentrated work has created the potential for new collaborative relationships among DoD, industrial, NGO, and open-source communities. Future collaborative research into crisis mapping and geospatially based situational awareness can extend those relationships.. The collaborative work needs to be extended into building and sustaining trust, not only among the development teams, but also in forward areas. Particularly exciting are the opportunities for engagement with local populations

⁸ Tiles are method for handling large imagery data sets. A tile divides a larger area into discrete smaller areas that can be more easily manipulated, displayed, and stored. Web tiles carry this method further, subdividing large areas into thousands or even millions of tiny files that are more easily transferred and displayed in web-enabled geospatial browsers.

⁹ Shuttle Radar Topography Mission. These world-wide elevation data were collected by a specially modified radar flown aboard the Space Shuttle Endeavor during a mission in February 2000.

and others working on the ground in Afghanistan and disaster relief areas through NGA's forward-leaning positions on the NextView license.¹⁰

LESSONS LEARNED

Imagery Processing and Analysis

1. **NGA's revised release process enables NGOs to have far greater resolution and provides far more utility than ever before.** The release of sub-1m imagery for eastern Afghanistan lets NGOs and others view many more farms and features than had been previously visible at 15m. NGA is to be applauded for making these data available. Figure 1 shows an examples of the difference between the previously (left) and currently (right) available NGA imagery :

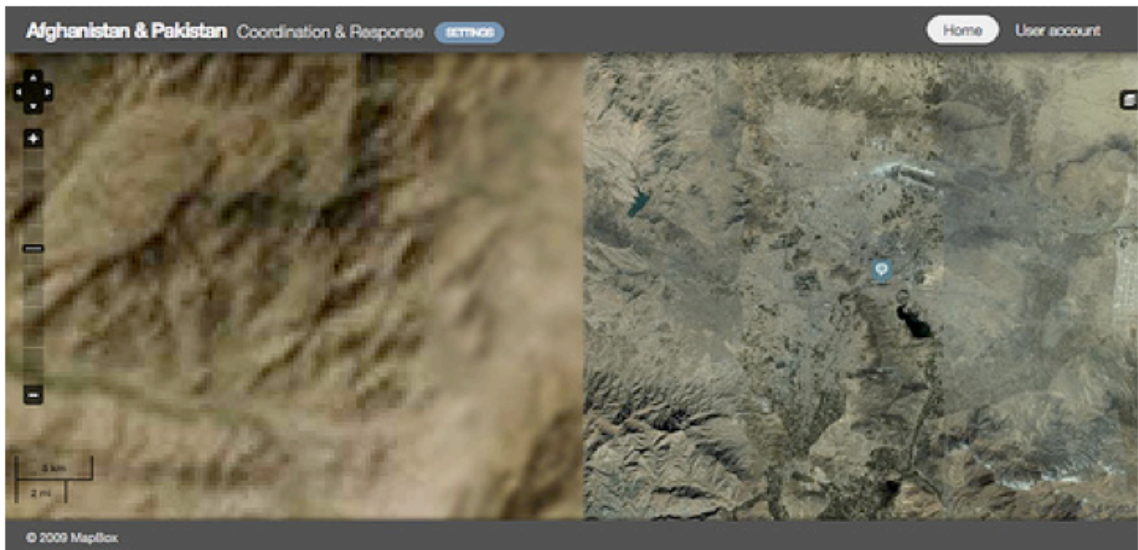


Figure 1

The second example reinforces the detail now available to civilian participants, compared to the fuzziness on the left above:

¹⁰ Less than two weeks after the start of these experiments, geospatial products derived from them were being used in Nangarhar Province, Afghanistan to help with election monitoring and other activities. See http://www.usaid.gov/about_usaid/gdc/

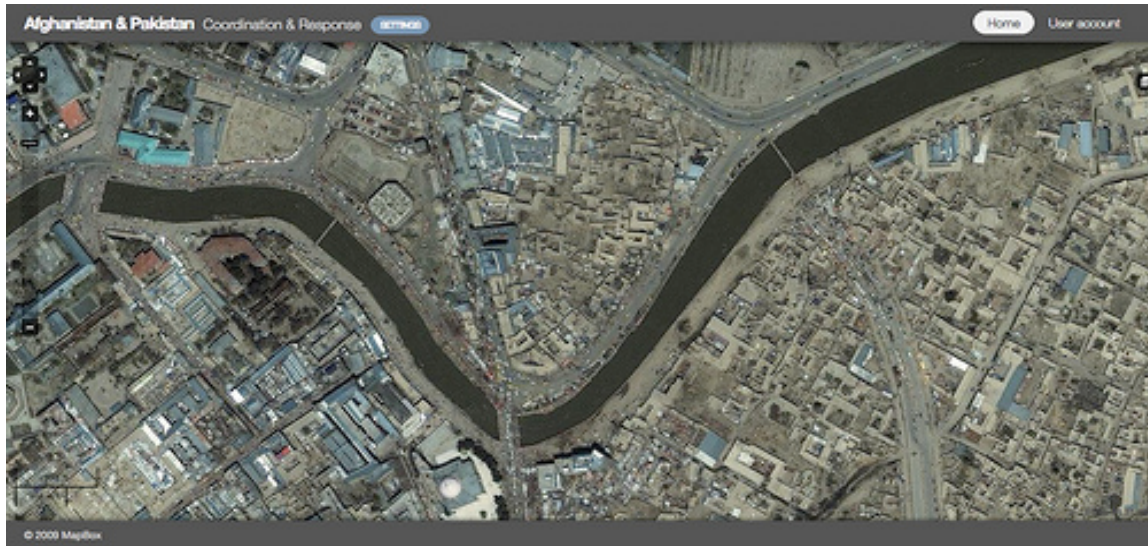


Figure 2

2. **Interoperable maps require standards for projections and data formats.** NGA released imagery in the exact formats requested for the experiments: GeoTiff and SIB. Based on the results, the importance of different data formats for use by less technologically sophisticated players, such as some NGOs, became evident. In particular, recommend that NGA release imagery as spherical Mercator projections since this can be easily shaped into tiles that are far smaller and more usable by workers in the field, who will likely not have access to large GIS servers.
3. **UASs will be required for areas of high-cloud cover, like Central America.** In the aftermath of a disaster or other event requiring time-sensitive coverage, daily overhead imagery takes will likely be insufficient for certain regions. UAS flights at lower altitudes or different hours for satellite passes (often early morning) may become a requirement.
4. **The NGO community needs a central library for imagery that follows open standards.** The integration of aerial and UAS imagery into a common basemap accessible by NGOs will require a common, shared library like OpenAerialMaps.
5. **Effective integration of daily imagery “take” will require more work than a simple web services platform focused on dissemination.** NGA has contracted with a vendor to provide web-services-based downloads of daily takes from certain regions of the world. This functionality will be tested in the November RELIEF tests. There will be a need to build a set of Tactics, Techniques and Procedures (TTPs) for integrating daily take data into the imagery processing tools for NGOs. Critical to this effort will be tools that automatically analyze differences between successive daily takes.

Crisis Mapping

1. **Paper is an advanced technology.** The simplicity of Walking Papers—which places a section of a map or image onto a bar-coded A4 sheet of paper—proved to be a usable tool for field workers. Under NGA licensing, these pieces of paper could be released to farmers and other partners, and any notations can be scanned back into the GIS tools and made available as a layer to analysts.

2. **Support for multiple grid systems is important.** There are grid systems for multiple purposes. Some are meant to be simple for civilian use; others must conform to military protocols. A common software library or service must be built that can convert any kind of grid coordinates into Lat/Log coordinates.

Interoperability

1. **Common microsyntax formats are critical elements of messaging protocols.** For communication of georeferenced messages via SMS, NGOs will require a shared set of microsyntaxes for various purposes (e.g., public health, supply chain, etc).
2. **OpenLayers enabled easy sharing of GIS information.** The shared library called OpenLayers made interoperable between Sahana, OpenStreetMap, Google, and Drupal a matter of building a quick mashup, rather than an issue of long software development. We recommend further study of this library.

Experimentation Design

1. **The size of the conversation matters.** The STAR-TIDES team had no more than 15 people on site at any time. Developers were just barely able to track what everyone else was coding at this team size. Larger events should keep groups smaller than 20 and probably close to 15.
2. **Loose structure works.** This community was brought together without detailed project implementation plans or test scripts. As a result, they were able to work iteratively, building code in parallel to their own learning process about each other. The team needed more slack in the schedule to facilitate more mashups between organizations. As the size of STAR-TIDES' work under the RELIEF program grows, it may prove necessary to form a loose advisory board to advise in the design of each RELIEF experimentation cycle, but not something with formalized membership.
3. **Orienting Scenario.** It may be wise to explore use of a scenario that can orient the team towards a specific problem domain. The scenario should not be the whole event, but should focus some period of the experiments towards an end. Preparation for the upcoming Afghanistan elections performed this role in the August RELIEF events.
4. **Build Wiki of Procedures and Methods.** Future activities may include an informal advisory board to advise in the design of each RELIEF event, but not necessarily something with formalized membership. A wiki could contribute in these circumstances.
5. **Include more NGO participants with field experience.** The presence of NGO personnel with deep field experience would give engineers better access to ground truth and clear articulation of problems that solutions need to address before being field worthy. The August experiment included staff who had been in Afghanistan, Palestine, and the Sudan. STAR-TIDES will include more NGO participants in the future.
6. **Include participants with skills in Human-Social-Cultural-Behavioral (HSCB) research.** Based on the results of the RELIEF 09-04, the Naval Postgraduate School (NPS) and NDU will collaborate on HSCB-related research in the future.

Experimentation Resources

1. **Networking.** The networking resources available on site are limited to a shared DSL line, more commonly used to check email and other light tasks that require public

Internet access. The experiments severely tested the limited bandwidth and low-end wireless router that were onsite. Continued presence of civilian organizations with powerful GIS servers and imagery sharing tools will require a more robust connection and commercial grade civilian networking hardware.

2. **On Site Working Area.** The 15-members of the STAR-TIDES team were located in one of the rooms in the Tactical Operation Center (TOC) supplied by NPS. The SSET was in an adjacent room. The orientation of the tables towards a large bank of monitors was *not* ideal for Agile collaboration, though the structure mimics the way a traditional Command and Control environment might be structured. STAR-TIDES recommends renting trailers with tables and whiteboard where engineers can engage in Agile development. STAR-TIDES also recommends researching optimal office configurations for methods like Agile development.
1. **Off Site Working Area.** Due to safety concerns, security issues, and fatigue and driving distance between the airfield and the front gate, research operations at the TOC ended at 7PM. To keep the momentum going, participating engineers sought out makeshift work areas in Starbucks and hotel lobbies from 7PM until midnight (and later). Recommend that future experimentation plans include renting a hotel conference room or suite for use during these late hours. It might be possible to rent a house with a large common room, where many members of the team might be able to share in the costs of housing, thus providing an environment for continuing development work beyond 7pm.
2. **Intranet.** Preparations for Camp Roberts took place through a mix of phone calls, emails, and a free/open-source intranet application called OpenAtrium (built by Development Seed, one of the participants). The participants still are searching for a common platform that works across the civilian/military boundary. Recommend that there be substantive future conversations about developing an intranet platform that will enable more effective preparations for the event and allow participants to blog/tweet the event for their constituencies (internal to the event and outside the event).

Building Partner Capacity

1. **Small investments lead to disproportionate returns when pursued with trust.** NGA's new process catalyzed a substantial investment of time by resource-constrained NGOs, PVOs, and companies. Based on trust developed in various other environments (and strengthened during RELIEF 09-04) and the opportunities for collaboration, individuals paid their own way to CP Roberts just to make this new imagery useful for fielded staff, and then proceeded to develop software code of significant value. One team member estimated from past work on government contracts that the cost could have been in millions of dollars if acquired in traditional ways.

Follow-ups for November 2009 and February 2010 RELIEF Activities

UNMANNED AUTONOMOUS SYSTEMS (UASs)

1. **Large area scan followed by high resolution analysis of POIs.** A study of the use of high-endurance UAV platforms to survey large areas with real-time video feeds, followed up by microUAVs which will take high-resolution still images. Proposed use of a Scan Eagle plus an RP UAV and TerraPan UAV.
2. **Imagery processing work process and distribution system.** Develop a process for managing the collection, analysis, and distribution of both real-time and sortie-based (SD-card) imagery from UAVs.
3. **UAV-enabled Networks.** Using networking nodes as payloads for multiple UAVs, prove that civilian networking systems can distribute imagery and data to forward operating bases. May involve dirigibles as well as UAVs.
4. **Remote Delivery of Humanitarian Gear by UAV.** Using the parafoil technology created by UC Berkeley, prove that small payloads can be delivered to forward operating bases as well as affected populations.
5. **Georeferenced Video Handing.** Develop tools to input and analyze georeferenced video feeds for Google Fusion or similar services.
6. **Terrestrial Robots.** Explore the use of low-cost terrestrial robots for survey missions to remote areas.

AERIAL IMAGERY

4. **Build Partner Capacity (BPC) for NGOs on GIS application.** Explore means to build partner capacity for processing NGA imagery within a clarified NextView license, which may include excluding vendors from the processing phase.
5. **OpenAerialMap.** Revive the OpenAerialMap archive and develop a work flow to deliver and retrieve imagery from the field to/from the archive.
6. **Pakistan Imagery.** Recreate the Afghanistan imagery work flow for imagery from Pakistan's Swat Valley.
7. **Synchronization Tools.** Develop tools to synchronize small-file-size basemaps at forward operating bases with daily-take aerial imagery and near-real-time UAV imagery.

SUPPORT FOR CRISIS MAPPING

1. **Multiple Gradicule/Grid System Support.** Develop tools to handle multiple grids (e.g., MGRS, USNG) across Walking Papers, OSM, the various SMS-frameworks (GeoChat, SlingshotSMS, etc), and Sahana.
2. **Map on a Stick.** Explore the concept of providing low-bandwidth maps to first responders via USB sticks.
3. **Authentication/Authorization Protocols.** Add security protocols and procedures to the distribution of imagery and related web services developed at RELIEF.

EXPERIMENTATION ON EXTREME COLLABORATION

1. **Social Network Development/Partnerships.** Explore tactics for quickly building trust and collaborating under extreme conditions at RELIEF events. Observe effective Agile development techniques for Camp Roberts/RELIEF experiments.

2. In addition to examining how to build trust more quickly and effectively among the members of the team at Camp Roberts and related activities, there also should be a focus on how to build trust in the field among likely participants. See also Appendix 10.

SMS/SOCIAL MEDIA

1. **Support all major SMS frameworks.** Explore support for five disaster SMS systems: Ushahidi, FrontlineSMS, GeoChat, SlingshotSMS, and Twitter.
2. **Microsyntax Development.** Develop a microsyntax analogous to radio protocols for the communication of HA/DR/SSTR activities.
3. **Public communications plan for microsyntax.** Explore tools for educating the general public about the microsyntax for SMS.

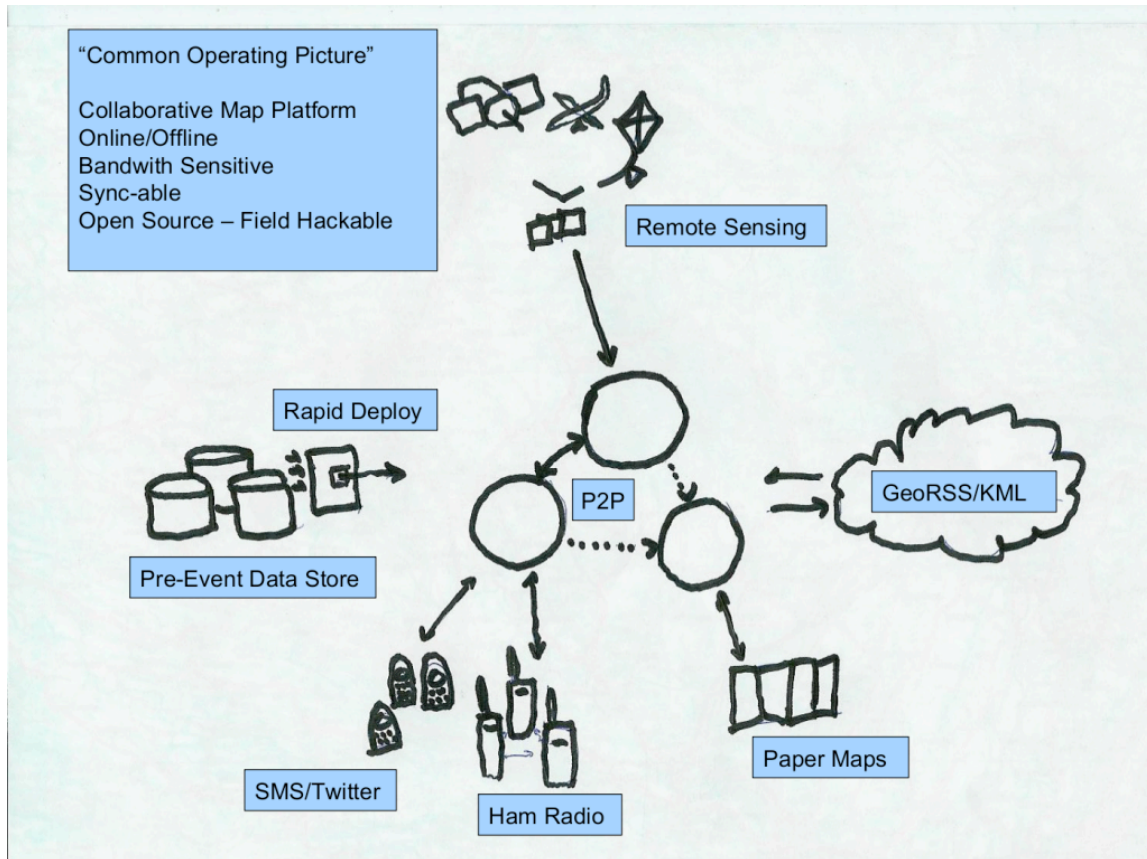
Appendices for Individual Technologies

Participants submitted quicklook reports in a variety of formats, including public blog posts. Where possible, these QLRs have been reformatted as experimentation reports; in this version, some remain as blog posts.

1. OpenStreetMap
2. Sahana Disaster Management System
3. Development Seed
4. FortiusOne GeoCommons
5. InSTEDD GeoChat
6. TerraPan Labs UAV
7. Google Crisis Response Team
8. Crisis Mapping Recommendations
9. NGA NextView License
10. Social System Networking Analysis

Appendix 1: OpenStreetMap

Through work at Camp Roberts, OpenStreetMap realized a vision first articulated two years ago at State of the Map conference. This back of the napkin sketch envisioned the use of OpenStreetMap (OSM) for disasters:



1. **Basemaps:** Vector and raster data are collected and prepared for use prior to deployment.
2. **Imagery Collection:** Remote sensors, aerial imagery, and UAVs collect new imagery, which is fed into OSM and integrated into the basemap.
3. **Field Report Collection and Visualization.** Reports from people in the field are collected via SMS and Radio, then visualized on the map for the world to see.
4. **Paper-based Reports.** Paper-based maps distributed to field workers can be scanned back into the map with annotations and made available for public use. (Note: the original intention of the diagram only include broadcast of maps outward, not import of data from paper back into the map. This conception changed with the advent of Walking Papers, a tool to print georeferenced small grids from OSM onto paper with bar codes that enable scanning of annotations back into OSM).
5. **Georeferenced News Feeds.** GeoRSS enables news reports and other feeds to display on the OSM map.

Camp Roberts offered OSM the first opportunity to turn this concept into a reality. OSM assembled a team of three—Mikel Maron, Josh Livni, and Mike Migurski—to engage in iterative Agile development with other geographers and developers on site. We were able to text and extend the capabilities of OSM and Walking Papers in important ways:

OpenStreetMap Basemaps

2. **Created the first OSM Local Server:** Until Camp Roberts, OSM had operated a centralized web site, with servers based in London. Work before and during Camp Roberts enabled the team to build a version of OSM that would work on a local server. This code proved able to produce tiles, shapefiles, KML, and Garmin Maps for use on the Camp Roberts site. It also was able to link with the Google Fusion server on site.
3. **Created ability to serve transparency layers from local OSM Server.** The developers were able to turn vector data (include street names) into transparency layers that could be served from the new local OSM server.

Imagery Collection/Distribution

NGA Imagery Ingestion. The NGA imagery arrived on an external hard drive and was processed by a Google Fusion server into spherical Mercator tiles. OSM was able to create a link with the Google Enterprise server that hosted the processed imagery and was able to ingest those data for use as new OSM base maps.

Field Report Collection and Visualization

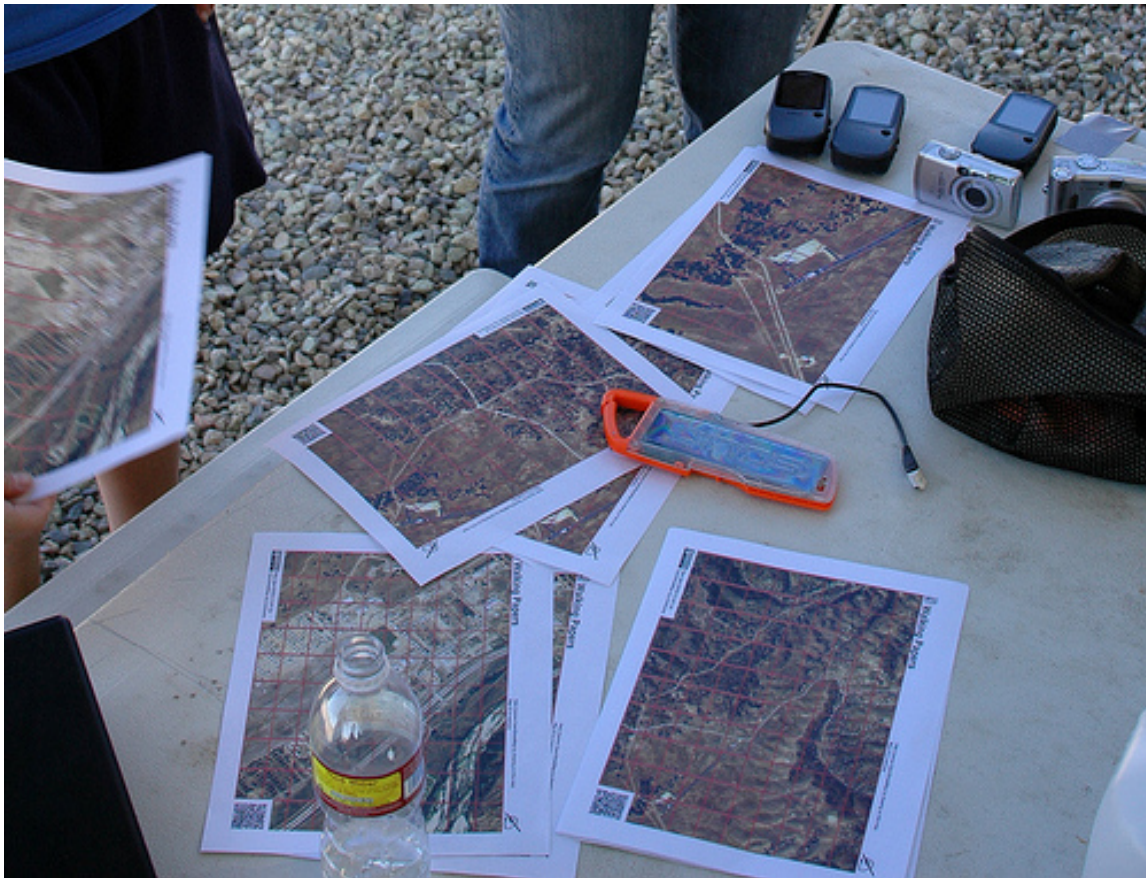
SMS/GeoChat Integration: Prior to Camp Roberts, OSM had no mechanism for incorporating data submitted by SMS into its maps. Through partnership with InSTEDD, the OSM team was able to plot georeferenced SMS messages on OSM maps.

Paper-based Reports with Walking Papers

1. **Test use of Walking Papers in the field.** Walking Papers is a new concept which enables a user to select a grid from OpenStreetMap at nine zoom levels for printing via PDF. This channel enables users to annotate maps on paper, then scan them back into OpenStreetMap as raster images that can be overlaid on top of the OSM basemap. The scanning is made possible by a barcode printed on the lower right of the map (see figure):



2. **Developed a Local Walking Papers Server:** To make Walking Papers useful in the disconnected environments often found within HA/DR operations, the OSM team decoupled Walking Papers from its original Web services design (which is reliant on public Internet access) and built a local Walking Papers server. This new local WP server is capable of printing maps from OSM basemaps that have (in turn) been baked from tiles taken from NGA aerial imagery or other sources.
3. **Grid/gradicule integration.** To make Walking Papers useful in contexts where street names, street signs, and other landmarks are either destroyed or were never present, the OSM team added a simple gradicule to the printed Maps (see above).



Georeferenced News Feeds

Sahana Integration via OSM integration with GeoChat. By developing a GeoRSS feeds, the OSM team was able to feed georeferenced information that was imported from GeoChat into the Sahana Disaster Management System. Sahana was able to import OSM basemaps with SMS reports into its visualizations.

Future Development

1. **Sync Tools between Local OSM Servers and Primary OSM servers.** With the invention of local OSM servers, a need has arisen for creating a carefully controlled, version-controlled method for synchronizing data between multiple local instances of OSM and the primary OSM servers.
2. **More Advanced Grid/Graticule Support.** The grid overlay on Walking Papers needs tweaking, and probably migration to a real coordinate system. There are standard emergency iconography and schemas, and we need to get proper mapping in place, as we have for the UNSDI-t. My feeling is that OSM tags need a little bit of structured around them, but not explicitly in them, to provide better flow between the Map Features descriptions, tagging process, rendered icons, configuration options in editors, and mapping to other systems. OAuth and OpenID need fleshing out so that things like GeoChat can fully post updates on behalf of OSM mappers. In the long term, the tools for synchronizing OSM from multiple sources are needed, something approaching multimaster-sync, but based in better UI tools for sorting through geographic change and conflicts.

3. **Close loop with Google.** After Camp Roberts, OSM can read data from Google Enterprise servers. However, a method to export OSM data into Google is still in process. Part of this code is in proof-of-concept phase, but needs to be made into full prototype.
4. **Reviving OpenAerialMap.** With increased sources for imagery collection and processing, a central, the absence of public library for storing these imagery—which preserves licensing restrictions and provides access control—proved sobering. OSM recommends reviving the work which started on such as resource through the OpenAerialMap (OAM) project. There are lots of ideas on how to relaunch and scale up OAM, and there may be some efforts in the space in the near future.

Appendix 2: Sahana

The Sahana project completed a successful week (August 4-9, 2009) at [Camp Roberts](#) in California at an experiment called RELIEF (Research & Experimentation for Local & International Emergency & First responders) that is sponsored by the [Naval Postgraduate School \(NPS\)](#). RELIEF is a funded research project of NPS's Field Experimentation Program that looks at technologies and solutions to get information to government about how better to conduct humanitarian relief activities. Our team was composed of [Chamindra de Silva](#), [Mifan Careem](#), [David Bitner](#) and [Mark Prutsalis](#) and participation was supported by [National Defense University](#)'s participation in the [Star-Tides](#) Program, the [Lanka Software Foundation](#) and through board member [Louiqa Rashid](#) and the University of Maryland.

While the major focus of RELIEF was on imagery captured from satellite and UAV systems and processed by GIS systems, Sahana's role was to demonstrate its capabilities as an integrated platform for disaster response activities. We developed several exciting new capabilities in Sahana based on the trunk code.

SUMMARY OF ACCOMPLISHMENTS:

Sahana's major accomplishments included:

- We were able to integrate with a local [Google Enterprise Fusion Server](#) that was used to process imagery of the Camp Roberts area through [OpenLayers](#).
- We were able to integrate with a local [Open Street Maps tile server](#) that produced data collected through [Walking Papers](#) and was available to Sahana through OpenLayers again. See [Mikel Maron's blog post](#) on this.
- We were able to set up two-way integration with [InSTEDD's GeoChat](#) application through [GeoRSS feeds](#).
- We tested the ability of [OLPCs](#) and [Netbooks](#) to collect data in both networks and disconnected environments, connected by WIMAX and powered by a combination of solar and wind at a remote Forward Operating Base.
- We developed procedures for synchronizing and importing data collected through [portable applet](#) instances.

These are all things that Sahana could not do before a week of coding and experimentation at Camp Roberts.

DESCRIPTION OF EXPERIMENTS:

We organized our activities into three areas of experimentation, as described below:

Experiment 1: Remote Site Humanitarian Information Center

Goal: Create a repeatable model for deploying Sahana in austere environments to serve as an integration platform for disaster information and management.

Description of Experiment: Couple new and accessible technologies like Netbooks powered by solar or kinetics to create an open blueprint for a Sahana mobile unit for tactical collaboration around an incident (i.e. for a Humanitarian Information Center or HIC). A blueprint for a low-cost mobile HIC based on very accessible technologies and Sahana should be something like:

- Popular low-powered Netbook or OLPC (One Laptop Per Child)
- A secured wireless LAN using any of the popular wireless routers
- 3G, HSPDA or BGAN (more expensive) for connectivity (optional)
- Power for all the above from a Solar Panel or from a car battery
- Preconfigured LAMP/Sahana distribution

Objectives:

- Document required equipment, power and networking to create a Sahana mobile HIC
- Document performance and networking requirements for Netbooks and OLPCs

Outcomes: Sahana was tested on the [Asus Eee PC 701 4G](#), the [OLPC](#) and as a portable application for mobility in the field. The Eee PC was configured with a custom version of [Ubuntu](#) that booted rapidly and hosted a Sahana server instance. Once this was connected to the WIKI network at the forward operating base (FOB), it was able to operate as a mobile Sahana data collection web server. The other machines were able to access this machine simply using a web browser in the wireless local LAN in the FOB. Independent of this ability the Eee PC could also be used as a portable data collection device and is light weight enough to be held in one hand, whilst you enter data with the other. The Eee PC only consumed 10-22 watts of power and thus was able to run without issue on the integrated solar and wind power found on the FOB. A custom version of the OLPC operating system with Sahana was setup on a USB stick. The OLPCs would boot this custom OS from the USB stick, however for this to be possible the OLPCs had to be unlocked with a developer key which takes 24 hours to process.

The team did manage to setup a Sahana server on the OLPCs as well; however they were more useful as machines that would be mobile in the field to capture data, especially with their screen that was still very visible in bright sunlight and its rugged construction. Also the inbuilt handle made it easier to hold with one hand and walking by foot along a path while recording information. The only issue with the OLPC was the lack of sufficient

processing which made the Sahana application sluggish, however power consumption was the lowest with approximately 5-8 watts of power. A possible root cause for this might be the lack of sufficient memory and in the next experiment it might be worthwhile to consider cutting down the OLPC OS even further to make room for the Sahana and its processes.

The performance of the mesh network was also tested and we were able to access one Sahana OLPC server from another OLPC. However in an environment where people already have windows based laptops in the field the easiest to use would be the Sahana portable application, which is a self contained web server, database and Sahana application that can be shared on a USB stick. The portable application performed without issue on the 3 different windows laptops it was tested on and we worked out an approach to quickly replicate a configuration from the main Sahana web server on Linux, with all base configuration data being sent to the portable application running on windows. Added scripts and processes were created to import the GIS feature data recorded by the portable apps and the Eee PC into the main Sahana server (that was integrated with Google Enterprise Fusion and Open Street Maps). Thus we were able to take pin points captured in the field from the Netbooks, OLPC and portable apps in a disconnected mode and import these features into the central Sahana server such that it could be visualized in the context of the other GIS data. We were not however able to test the SMS properly since there were compatibility issues and the phone needed to support AT commands.

Key takeaways:

- Netbooks are a good fit for the field due to the low power consumption and ability to easily carry them about whilst recording data.
- Netbooks have to be rugged to work in dust conditions and must be visible in direct sunlight. The OLPC had the advantage here over the Eee PC as it was ruggedly built and the screen was designed to be seen clearly in direct sunlight.
- The Netbooks have low power consumption and can be easily deployed as local server at the site with a solar panel and wind power combination.
- The stylesheet for the Netbooks needs to change to accommodate the smaller screen and avoid horizontal scrolling when maps are used.
- Though maps render in on the OLPC as the maps are JavaScript heavy they become too slow to use on the OLPC (however the Eee PC has sufficient power for this).
- Integration of a mobile phone to have Sahana communicate with the other is heavily dependent on having a phone that supports AT commands.

Experiment 2: Sahana as Situational Awareness Platform

Goal: Demonstrate Sahana's capabilities to serve as a situational awareness and integration platform for disaster information and disaster management and response activities. Identify the capabilities that need to be added to Sahana on a permanent basis to be able to effectively integrate with other common providers of GIS data in disaster environments.

Description of Experiment: Establish Sahana as a situational awareness platform for general disaster response management. Determine extent that Sahana can consume GIS data (layers and imagery) produced by other GIS systems, including Google and OpenStreetMaps. Ideally processed through OpenLayers. This also involves the configuration of Sahana to share data (both a producer and consumer) through SMS and/or other messaging or web services with other producers and consumers of geo-referenced disaster data including InSTEDD's GeoChat, GeoCommons, and DevelopmentSeed's Drupal Mapping Stack.

Objectives:

- Provide GIS Mapping on Sahana using local map servers (Google & Open Street Maps) without requiring an internet connection.
- Exchange geo-referenced data with InSTEDD's GeoChat application

Outcomes: The current version of Sahana uses the OpenLayers base library. The Catalog system for GIS that we currently have in Sahana allows the configuration of various data sources that can in turn be viewed in the mapping client. Currently the GIS Catalog supports various Mapping APIs such as GoogleMaps, YahooMaps, MS Live, Multimap etc., collaborative mapping APIs such as OpenStreetMaps, feeds and files such GML, KML and GeorSS, and any data source that can serve files as WMS. This, amazingly, handles quite a lot in terms of data sources - see the following post for more information: [Sahana GIS Catalog](#)

The challenge at Camp Roberts was that the two GIS data sources were local servers.

The first was the Google Enterprise Fusion server, serving out the standard and custom tiles, including the newly incorporated hi-resolution aerial imagery of certain regions. Even though the Sahana GIS client works with GoogleMaps, the fusion server approach was significantly different. We initially created access to the fusion server in the older SahanaGIS GoogleMaps plugin and later the OpenLayers library was customized to access the Fusion Server - we anticipate that these changes can find its way back into the OpenLayers project itself, which of course would be a significant contribution.

Another 'exercise' we worked on was to access the local OpenStreetMaps (OSM) Tile server, which was setup by OSM team at Camp Roberts. The OSM Tile server was pulling in data from the [WalkingPapers](#) project, which is a paper-based solution to update/contribute to OSM - the OSM team customized WalkingPapers so that it could print out WalkingPapers with a grid and a GoogleMaps overlay coming off the Fusion Server. This initiative saw a lot of data gathered in the field finding its way back into the local OSM server - the highlight being a pointer saying "here be the Kit Fox." Sahana started pulling in these updated set of tiles from OSM, thus making this exercise a success as well - the local OSM integration was something we worked on during the [Myanmar deployment](#) as well, so it was nice to see it being completed here.

In an instance where local server versions of these mapping APIs are present, Sahana can seamlessly work with them instead of having to solely rely on the Internet versions - an

important concept in emergency situations where Internet-less environments may be commonplace.

The next integration came via InSTEDD's GeoChat SMS solution. After some attempts to get the SMS Gateway to support 2-way communications, we settled on pulling in and publishing GeoRSS feeds - which makes perfect sense from an integration point of view. Sahana pulled in a GeoRSS feed from GeoChat, consisting of the data collected in the field at the location. Sahana also published RSS and GeoRSS feeds of its own, which were pulled in by GeoChat. Thus in a situation where both GeoChat and Sahana co-exist side by side, both can work seamlessly together - either one can act as a Gateway to allow input, and either one can visually map out information from the other.

Key accomplishments:

- Completed configuration to pull tiles from local Google Enterprise Fusion Server working through OpenLayers.
- Completed configuration to pull tiles from local OpenStreetMaps Tile server - this allowed Sahana to access the most updated maps available.
- Both above made changes to the OpenLayers library, which will be contributed back upstream to the OpenLayers project
- Worked with InSTEDD to help them create a feed using GeoRSS that could be used to display GeoChat data in the Sahana Situation Awareness Module
- Completed GeoRSS feed from Sahana's Situation Awareness module to allow GeoChat and others to pull data from Sahana and display it in their own application.

EXPERIMENT 3: SAHANA AS DISASTER AND EMERGENCY MANAGEMENT SYSTEM

Goal: Demonstrate Sahana's capabilities to serve as a disaster and emergency management system by helping to manage the organization of the Camp Roberts experiment.

Description of Experiment: Sahana will also be used to help manage the exercise itself, including the use of the organization registry and the request/aid management module to track resource requests from exercise participants.

Objectives:

- Register all participants as organizations within shared Sahana server
- Manage participant resource requests through Sahana's request/aid management module

Outcomes:

The Sahana system successfully configured for use by exercise participants

Participation in and use of the system was limited from the perspective of other exercise participants, though a few individuals did use the system and provided valuable feedback to the Sahana team on usability and functionality issues. Exercise participants needed to be better engaged and given reason to use Sahana. We identified need to integrate use of Sahana with running of exercise - i.e. use Sahana to have people check in to Camp Roberts - get individuals and organizations and experiments registered as part of the

official experiment procedures. Sahana can even be used for participant situation reports - or a final check out report upon leaving. This will give participants reason to use Sahana and further the experimentation on Sahana itself – especially if the push to use Sahana comes from NPS.

Finally, we documented many important procedures – such as the required order of entry – and created replicable procedures for future deployments – focused on preconfiguration of Sahana instance to enable more immediate use of the system by end users.

KEY LESSONS LEARNED:

The “[Situation Awareness](#)” module needs to be a major focus of Sahana development going forward - simplifying data entry and ensuring that we are populating geo-coded data layers throughout whatever Sahana does. End-users are increasingly dependent on visualization of information - and being able to map all data is an important capability to demonstrate.

The usage of standards is inversely proportional to the complexity of integration. Since the GIS efforts in Sahana lean towards standards based development, making use of existing libraries, we found that we could accomplish complex integration with relative ease - OpenLayers and various feeds into it including WMS, TMS, GeoRSS etc. helped save the day. Another successful case study for the GIS capabilities of Sahana.

FUTURE PLANS:

Based on the positive results we achieved, Sahana plans to become regular participants at these quarterly events - the next will be in November and the RELIEF experiments may use Sahana to help administratively and to run the experiments scenario. We also hope to be able to extend the capabilities we demonstrated this past week at the next experiment to include the use of locally cached tiles to produce maps when no local or internet-accessible map or tile server is available, to be able to pull in data from other producers of geo-referenced datasets, and to publish - using an open standard for data exchange, such as GeoRSS, more information collected by Sahana. We are also looking at documenting and testing different hardware and platforms on which Sahana can operate including Netbooks, iPhones and Android phones, and extending portable applet and the synchronization capabilities of Sahana. Involvement in a regular experimentation cycle has incredible potential for Sahana, and matches well the open source development process.

Signed,

Mark Prutsalis on behalf of

Chamindra de Silva, Mifan Careem, David Bitner

Sahana Software Foundation

August 21, 2009

Appendix 3: Development Seed (Drupal)

DRUPAL AS A VISUALIZATION TOOL FOR NGA DATA

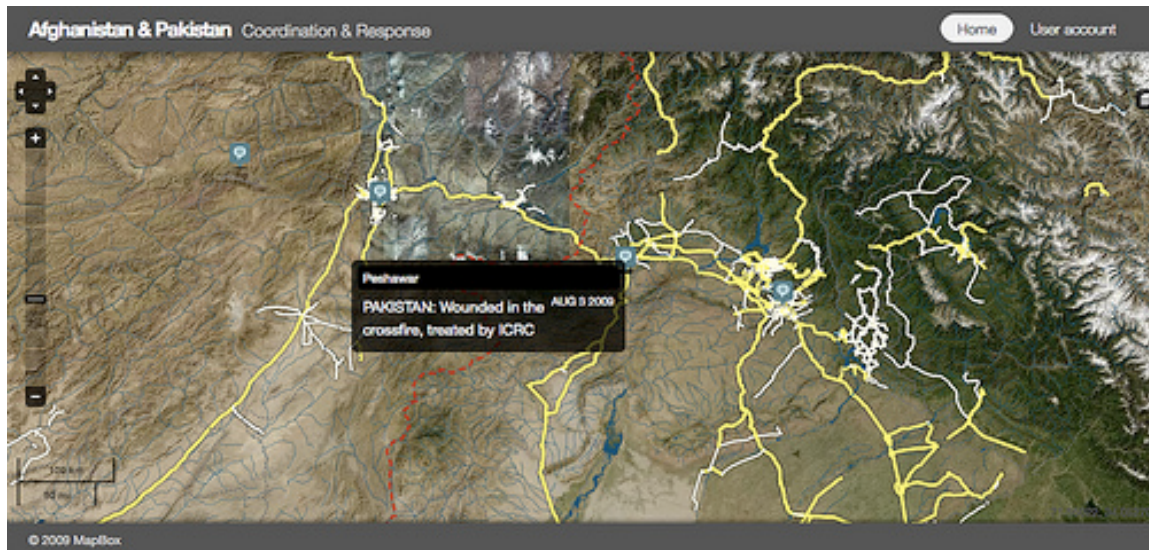
Experiments

- Modify open source tools to act as a glue layer for aggregating real time data from the field into a rich data browser.
- Test our rapid map tile generation tools and integration with our new open layers stack, deploying our SMS monitoring system (light GSM modem/python system) for both receiving data from the field and sending alerts, and using our aggregation tools to parse and map drone data - like pinpointing aerial photos from unmanned aerial vehicles (UAVs).

Observations from Visualizations

We built a lightweight Drupal aggregation hub sucking in Pakistan and Afghanistan incident reports coming in from both Relief Web and IRIN. The incidents were geo-tagged via a lightweight geo-coding tool that we have been investing in with the support of the Knight Foundation.

In addition to the NGA data, users can see a custom road overlay designed in QGIS using OSM data. This is the road from Kabul in the West through Jalalabad across the Durand Line (in red) to Peshawar and then on to Islamabad. Here you can see a new post from IRIN on civilians caught in the crossfire being treated in Peshawar.



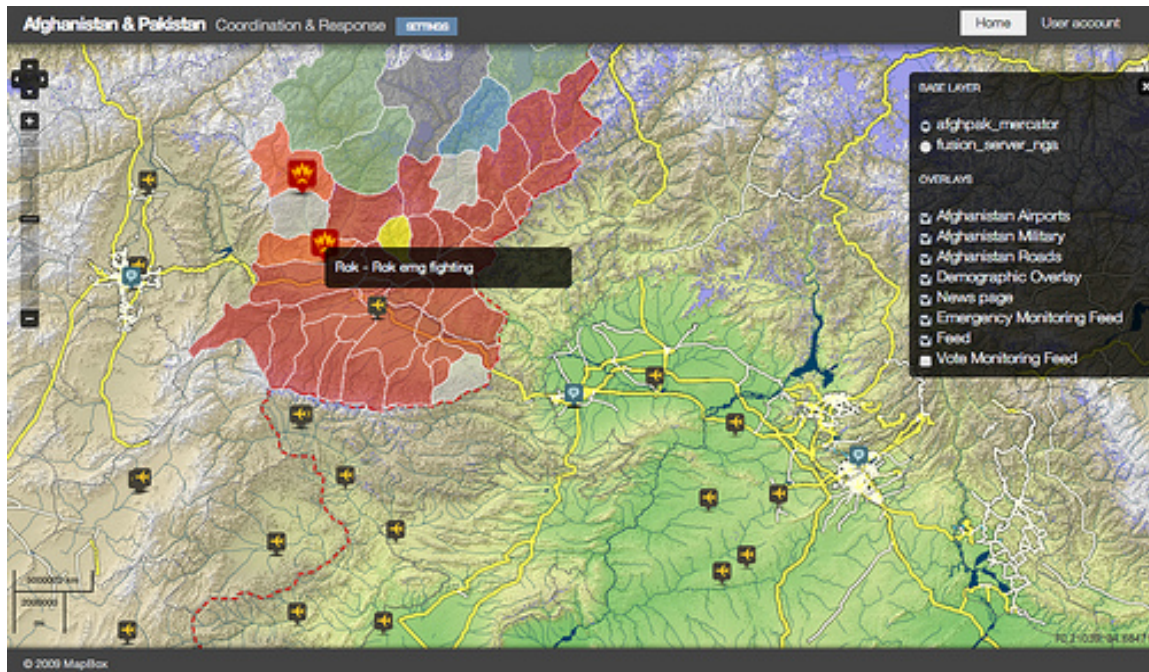
OBSERVATIONS FROM SLINGSHOTSMS

We tested SlingshotSMS, a lightweight SMS server written in Python that listens for incoming messages and provides an HTTP service for a RESTful interface that we were able to integrate with Drupal.

Here Tom has SlingshotSMS running on his computer and is able to receive SMS messages from folks out in the field. All he needs to be operational is an internet connection and cell reception, both of which we had at the forward operating base.

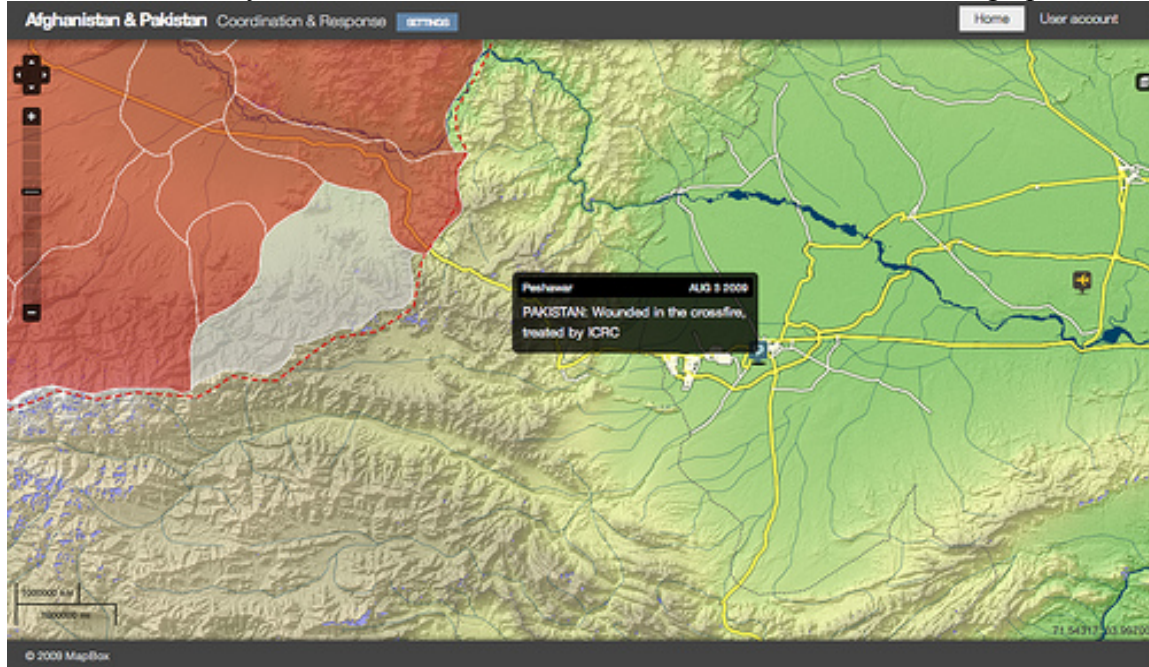


Once we got the messages in Drupal, we could rely on tools made available by the FeedAPI Module, OpenLayers, and all the other options that Drupal provides. We discovered that this architecture gave us a lot of flexibility in terms of routing alert messages back out to other members of the team, parsing text for location information and mapping them, and tallying vote counts in exit polling simulations.



Thanks to the flexibility of this approach to SMS relaying and parsing, data collectors in the field - with no immediate access to the internet - can send structured data to a secure site where folks back in headquarters or even spread around the world can see an aggregate view of the data.

We were also able to pull in KML overlays from the Beer for Data project as well as data from a custom data hub provided by GeoCommons that includes polling place locations, the number of likely voters at each, threat assessment information, and demographic data.



Future Experimentation

1. Lightweight Local GIS Tile Storage. Visualization of the OpenLayers via Drupal can also occur with a single lightweight HTML page plus Javascript SlippyMaps. This architecture offer a very lightweight means of choosing between multiple basemaps and adding various KML layers with user-selectable transparency. We would like to explore this architecture for use in the field.
2. USB Map on Stick. Using the lightweight HTML map from above, we would like to explore distribution of basemaps to field staff via USB sticks, with a web services architecture to support daily distribution of new KML layers for field assessments and other frequently modified data sets.

Appendix 4: Fortius One's GeoCommons

Blog Posts from Fortius One.

Camp Roberts Exercise and the Afghanistan Elections: Creating a Geo-Stack for Humanitarian Relief

August 10th, 2009 by Sean Gorman

This past spring Andrew ran into Todd Huffman at SXSW - where Todd was telling him about the beer-for-data program at the Taj Mahal guest house in Jalalabad, Afghanistan. In short MIT's Fablab had set up shop at the Taj where they installed a satellite up-link and wifi. The real bonus, though, was the Taj had a tiki bar from when it was part of the United Nations compound. Thus making it the only place in Eastern Afghanistan you can get a beer. Not surprisingly the combination of wifi and beer made the Taj a popular hang out for a variety of folks working in Afghanistan.

The result was lots of ad hoc data sharing between the disparate military, humanitarian, construction, and NGO communities visiting the Taj. This activity was semi-formalized when a hard drive was donated to reside on the bar to store shared data, and the beer for data program was born. Lots of the data ended up being geospatial in nature but mapping it was challenging. Most of the folks in the field did not know GIS, or even if they did were lacking access to desktop applications. Todd and company found GeoCommons and started using it to map data out. The downside was the satellite up-link powering the wifi was slow and connectivity could be sketchy.

Andrew told Todd we had appliances that had self hosted OpenStreetMap and Blue Marble tiles that could run completely locally. Traditionally we've done this with a rack mounted server, but that did not seem to make sense for Todd's purposes. So, we grabbed one of the GeoIQ Mac-Mini's we use for conferences, loaded it up with lots of Afghanistan data, and donated it to the program. (*GeoCommons is our free public site and GeoIQ is the tech we sell to pay the bills)

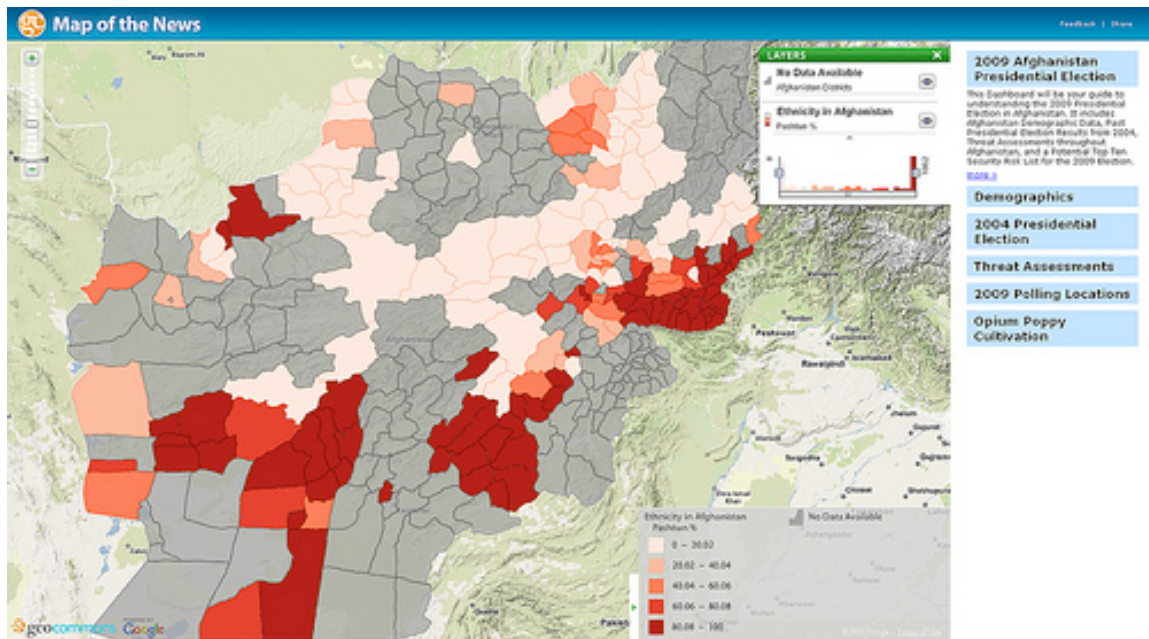
Shortly after this we attended CrisisCamp here in DC and met a bunch of folks interested in using tech to help with humanitarian relief projects. John Crowley invited several of us to participate in a STAR-TIDES sponsored exercise in Camp Roberts to simulate deploying technology for humanitarian relief in harsh climates (no power, no Internet etc.).

Unfortunately we were not able to make it out to Camp Roberts, but Todd was, and he had the GeoIQ appliance with him. In addition to the Afghanistan data we sent along, we also added an Afghanistan geocoder for georeferencing data from the field. Many thanks to Kate Chapman for extending our open source geocoder to pull that critical bit together. Sean Wohltman has a great video with highlights from the exercise and Mikel Maron has a nice two part (1 and 2) blog series as well. Also see Development Seeds involvement and take here.

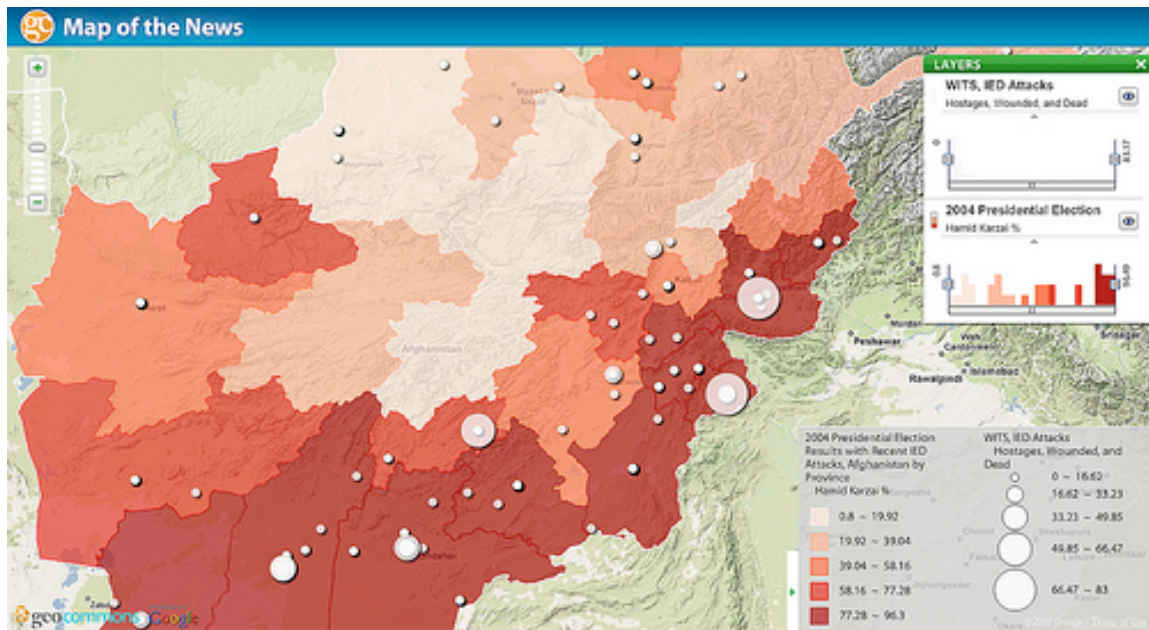
One of the great upsides to all this work is that Todd will have a lot more functionality to deploy in Afghanistan. For starters Google has graciously donated a mobile Google Fusion server and it is configured to serve tiles to the GeoIQ appliance and other apps as well. Also it looks like there is a lot of potential deploying Walking Papers and using them to dynamically update OSM tiles. An OSM tile generator is loaded on the appliance and now Walking Papers is as well. It will be fun to see what comes of the new combination. Both enhancements will really help create much better tiles for us and anyone else looking for detailed basemaps in Afghanistan.

Gearing up for the elections themselves we've already started ingesting data from Todd and folks on the ground in Afghanistan. Data will be geo-referenced and mapped with the Mac-Mini GeoIQ appliance for local use then federated up to public GeoCommons for wide spread dissemination. We'll be publishing the most pertinent maps to a dashboard throughout the elections. So far we've been georeferencing data from UNHCR district profiles, JICA security summaries, polling locations, tribal boundaries, etc.

Tribal/Ethnic data from the latest UNHCR district profiles



2004 Votes for Karzai and Recent Attacks



Interesting trends in tribal relations (Pashtun), support for Karzai (who is Pashtun), and recent attacks. Stay tuned as Todd and his team push up more data from the elections as they happen. It will be fascinating to see the variety of data coming in from new avenues like SMS geo-located polling and Walking Papers. We'll be posting all of it on GeoCommons and funneling the most interesting maps to the dashboard. If you are in Jalalabad drop by the Taj and check out the OSM/Walking Papers/Google/GeoIQ stack in action. Don't forget to drop off some data and have a frosty brew while you are at it.

Appendix 5: InSTEDD

Overview:

The RELIEF effort which InSTEDD participated in as a member of TIDES was our first step into the world of domestic and international crisis response through our integrated social and technical approaches. Our technical focus was on testing and gaining feedback for our group communication and coordination tool, GeoChat, but our social approach was set on integrating and adapting our software to work with the tools of all who were involved. InSTEDD was set on being able to push information to our partners, and then bringing the data pathway full circle by pulling the aggregated information back from our partners in the field.

Objectives/Requirements

InSTEDD came to RELIEF with the goal of being able to collect information from remote field positions by using GeoChat and making that information actionable within the GeoChat interface.

- Take the information within GeoChat and get it displayed in Open Street Maps, Sahana, and Development Seed.
- Pull cached Google imagery and include it into the map base layer of GeoChat, and pull Geo-referenced feeds from each of the participating organizations.
- Record feedback and requirements from responders (DHS, military, NGOs, corporate sector) and incorporate that feedback into InSTEDD's tools
- Apply all previously stated requirements to the real field scenario of election monitoring in Afghanistan. Based on that scenario, InSTEDD set an objective of integrating our tools with all involved TIDES organizations

Accomplishments

We developed basic integrations with almost every other system that was present at RELIEF.

Our first step was pulling imagery from the Google Earth Enterprise (GEE) server containing the detailed Afghanistan National Geospatial-Intelligence Agency (NGA) data and Camp Roberts Unmanned Aerial Vehicle (UAV) data, and then displaying it in GeoChat's website.

Our next step was to use Walking Paper's printed maps as an alternative geo referencing system with SMS integration. Users would not need to scan the maps to input data. They would also not need GPS to enter their position, because they could use a very simple grid referencing system that was built on top of a walking paper map. We developed a simple endpoint which was correlated with map data every time a new paper was printed so that we could translate map-specific grid coordinates into a global lat/long system.

Since walking papers was being used to input data into OpenStreetMaps by scanning annotations onto the map itself, we decided to use GeoChat as an alternate channel for map data. Therefore, on specifically tagged messages, we triggered an event that created

a node on OSM related to that message. The alert was sent through the system seamlessly, in real-time.

We also exposed a geocoded RSS with the messages streaming to be consumed by Sahana, who added all of the GeoChat messages as an additional map layer into their disaster management system.

We were able to take a geocoded RSS feed from GeoChat and expose it into Riff, another InSTEDD product.

Lessons Learned

- It is essential that InSTEDD strives to remain open and willing to play and cooperate with all organizations on the ground in both domestic and international crisis.
- Based on the role that InSTEDD plays in straddling the divide between public health, disaster, and policy realms, we are well-placed to help lead in bridging the gaps between these organizations.
- InSTEDD's tools can help fill a gap in the response community by bringing tools that were designed for emergency response, like GeoChat, to the public on a wide scale.
- InSTEDD's tools have much room to improve and grow, and much of this gap was not seen until we could test our tools with other platforms in such an open experimentation environment. Further experiments will yield much greater insight and room for improvement as our tools become more robust and deployable.

Moving Forward

InSTEDD needs to stay engaged with all parties in an open dialogue in how to build out on the partnerships built at RELIEF. We must work to build trust between organizations, and between types of organizations. InSTEDD hopes to bring in a larger social component to these experiments that will help with field applicability anywhere on the globe.

From a tech-based approach, future work should involve more seamless integration between different systems, as well as better authentication and authorization protocols to share data in an efficient, yet secure, way. The development of a rich API for GeoChat, taking into account a common standard on API formats for different types of event, is mandatory for the next set of experiments. Agreement on an extensible and intuitive microsyntax for SMS messages is key to the usability of GeoChat.

Appendix 6: TerraPan Labs

(verbatim report from TerraPan Labs)

TerraPan Labs, LLC attended RELIEF August 5-6 to work on integrating data from our Low-cost Unmanned Imaging System (LOUIS) into the situational awareness of NGOs operating in Afghanistan, and to get feedback from the group about how our UAS might be of use in the field. Seeing how imagery is being employed in the field was invaluable; we plan to support several data format and publishing options based on recommendations from the demonstration scenarios. Development Seed was able ingest sample 2cm LOUIS imagery from San Diego into their Drupal mapping stack so that future scenarios can use the LOUIS images to supplement the 50cm NGA imagery where greater detail or more current views are needed.

Several applications of LOUIS were discussed, including:

- verification of field reports in a quiet and unobtrusive manner,
- detailed image acquisition in rapid response to intelligence obtained from NGA imagery or more current wide-area surveys,
- tasking LOUIS based on live information from the field such as GeoChat SMS notifications,
- crop monitoring for Afghan farmers,
- and creating highly current image layers for use in Walking Papers deployments.

One recurring theme was the procedures for dealing with large amounts of imagery such that NGOs incur little processing overhead. It was agreed by several parties that map tiles in a spherical Mercator projection could be adopted because of their easy ingestion by the various software technologies involved, and we are working to support the format based on that recommendation. We determined that maintaining a copy or link to the non-tiled data would be critical for simple imagery-based analytical tasks such as quantifying and mapping flood extents. The large amount of images produced by low-flying UAVs (hundreds to a couple thousand per flight) are also a challenge. TerraPan Labs coined the idea of OpenAerialMap (OAM, <http://wiki.openaerialmap.org>) to serve a similar participatory mapping role to that of OpenStreetMap, but for imagery. Our interactions during RELIEF indicate that OAM could be developed to handle these challenges, however a significant design, then software and infrastructure development effort is needed for OAM to manifest. In the meantime, we have been developing a lightweight viewing software that can handle immediate interactive display of hundreds of image frames as soon as UAS data is available. The RELIEF event inspired us to adopt an open source license for this software and continue development of the prototype.

We will maintain contact with other entities that participated in this RELIEF effort. We are preparing our operational procedures so that we have greater capacity to support the needs of NGOs in Afghanistan and also anticipate the needs of Southern Command expressed during this event. TerraPan Labs is looking forward to involvement with RELIEF in the future with scenarios that include live missions of the LOUIS sensor.



Appendix 7: Google

Last week, three Googlers attended an exercise at Camp Roberts near Paso Robles in central California. The exercise, hosted by the Naval Postgraduate School and organized by the National Defense University, brought tech companies together with testers to collaborate on disaster relief, humanitarian aid, and development.

Shortly after we arrived, we disrupted the relative quiet of the Tactical Operations Center (TOC) by spooling up an 8-core Google Earth Enterprise Server to process satellite imagery provided by the National Geospatial Intelligence Agency (NGA). Our immediate goal was to process the imagery—100cm resolution GeoEye IKONOS scenes over Jalalabad, Afghanistan—with Google Earth Fusion to create a 3D globe and set of Mercator map tiles. We then published the tiles to the Earth Server running in an Ubuntu Virtual Machine to be used as a base-layer platform for mashups by Sahana, Development Seed, FortiusOne, Open Street Map, and InSTEDD.



Quickly after we started serving the tiles, Sahana, Development Seed, and FortiusOne imported them into their Content and Disaster Management systems. Now these platforms have the code necessary to pull tiles from Google Earth Enterprise servers so they can more quickly respond to the next disaster.

Open Street Maps printed hard copies of the grid-lined maps to create "Walking Papers." These Walking Papers were then sent into the field to be used in two ways.

First, field personnel made hand-written annotations of roads and structures. Upon return to the TOC, these annotated maps were scanned, which, through some nifty technical automation, pushed the annotations into the map vector database. This paper-and-pen method was a smart, practical way to gather map data in areas without much technology.

Second, field personnel used the maps to identify the sectors in which significant situations (ie. "bridge out" or "building damaged; people trapped") were located. They submitted reports via InSTEDD's "GeoChat," an SMS-based system which translates sector information to lat/long on the fly. The resulting data streams were aggregated and displayed on a map in real time.

This method will be tested soon in Afghanistan. Todd Huffman, a Camp Roberts attendee, is on his way to Jalalabad, armed with GeoChat technology and Camp Roberts RELIEF lessons learned. He will use GeoChat technology to report exit poll results during the upcoming Afghan elections.

In addition to all of this, a few Unmanned Aerial Vehicles (UAVs) were buzzing over the TOC. We had hoped to download and process aerial imagery from the UAVs to test their capabilities as quickly-deployable, low-cost disaster evaluation tools. Unfortunately, with all that was going on—and a few technical issues with the experimental aircraft themselves—we were unable to get to that part of the exercise. We'll save it for next time.

The Camp Roberts RELIEF exercise was very enlightening. From a technical perspective, the Google team reaffirmed the powerful role that geospatial visualization can play in the quest to build sustainable geopolitical structures and mitigate human suffering. And we saw first-hand the range of difficulty technologists face. Some problems were successfully dispatched in 20 minutes; others remained unsolved after 3 days. Far from discouraging us, that set our brains on "simmer." After all, solving hard problems usually makes the biggest impact.

Appendix 8: Crisis Mapping: Opportunities for Civ-Mil Partnerships.

Patrick Meier of the Harvard Humanitarian Initiative and co-chair of the first Crisis Mapping Conference (Oct 2009 in Cleveland) presented on the origin and development of crisis mapping. He divided crisis mapping into four functions:

1. **Sourcing.** Obtaining imagery of a humanitarian event.
2. **Visualization.** Creating one or more visualizations of imagery combined with other data sets (GIS).
3. **Analysis.** Identifying and recognizing patterns of important events in the development of a crisis, including the precursors to mass atrocities and disease outbreaks.
4. **Response.** Using the analysis to plan an effective early response to evolving events in humanitarian events.

Our work at RELIEF related directly to the first three concepts.

1. **Sourcing:** Our work with the NGA and future work with UAVs will improve the resolution available to crisis mappers by more than factor of 30 (15m to 0.5m for satellite, 15m to 0.01m for UAV imagery).
2. **Visualization.** FortiusOne GeoCommons, Sahana, OSM, and DevelopmentSeed each provide visualizations using a combination of basemaps, OpenLayer transparent overlays of data sets, and georeferenced news feeds from web-services based resources.
3. **Analysis.** Walking Papers provides on-the-ground paper-based analysis of our visualizations. In addition, SMS reports provide crowds with the means to provide feedback into analyses performed by teams who may not be located within the theatre of operations.

We strongly recommend exploring how crisis mapping presents an ideal activity for civ-mil partnerships. Each side has an important piece of the puzzle for identifying events in the lifecycle of humanitarian emergencies. Critically, military imagery provides the resolution necessary for civilian crisis mappers to identify patterns and for NGOs to plan effective responses. We also encourage exploring a better term for this field; “crisis mapping” is not inclusive of the many activities around SSTR and international development which make use of similar technologies and methods.

Appendix 9: NGA NextView License

NGA NEXTVIEW (NV) GUIDELINES

DEFINITIONS

- Imagery is the image and associated metadata. Imagery can be further manipulated, enhanced, & processed. Example: GeoPDF, GeoTiff, NITF.
- Image Derived Product (IDP) – any product created from raw imagery – could include image metadata, but generally does not and often referred to as “dumb-image”
- Non-literal Imagery Derived Product is a product derived from the imagery but no longer looks like an image. Example: Line-drawings, maps.
- Third Party Partner – Party otherwise affiliated with the original USG sharing partner, but not the USG directly

YOU MUST:

Properly attribute (mark) all NV Imagery and imagery derived products (IDP) with its Copyright information and educate anyone that receives the data on the license terms

YOU SHOULD SEEK CLARIFICATION BEFORE:

- Publically releasing or openly disseminating imagery or Image Derived Products (IDPs) with image metadata
- Sharing with Educational Institutions for strictly educational/research purposes (even with USG grants)
- Sharing with a company or other entity that might profit from the imagery shared
- Posting imagery to a web site without access controls
- Allowing Imagery or IDPs to be shared with a third party
- Sharing Imagery or IDPs with Universities with USG grant(s)
- Contacting the Vendors directly

YOU MAY:

1. Share imagery or IDPs with anyone directly working with/for the USG, including:
 - U.S. Government Employees/Contractors* (* Contractors’ Government sponsor must provide oversight and approval for this sharing arrangement.)
 - Universities supporting USG via contract(s)
 - State/Local Governments
 - Foreign Governments
 - Intergovernmental Agencies
 - NGO’s & Non-profit Organizations
2. Post properly attributed “dumb” IDPs on public web sites
3. Post/disseminate imagery using access-controlled web/FTE sites

YOU MUST NOT:

Provide/share imagery or IDPs made from NV licensed imagery with anyone planning to sell it or used it for commercial gain

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Excerpt from the NextView license

H.21 NextView IMAGERY END USER LICENSE AGREEMENT

a. General Terms

1. This clause applies to all unprocessed sensor data and requirements-compliant processed imagery, imagery services, imagery-derived products and imagery support data licensed under this Contract. No other clauses related to intellectual property or data rights of any sort shall have any effect related to the unprocessed sensor data and requirements-compliant processed imagery, imagery services, imagery-derived products and imagery support data delivered under this Contract.
2. All license rights for use of the unprocessed sensor data and requirements-compliant processed imagery, imagery services, imagery-derived products and imagery support data provided to the U.S. Government purchased under this NGA contract are in perpetuity.
3. Licensed users may generate an unlimited number of hardcopies and softcopies of the unprocessed sensor data and requirements-compliant processed imagery, imagery services, imagery-derived products and imagery support data for their use.
4. (i) Licensed users may generate any derived product from the licensed unprocessed sensor data; and requirements-compliant processed imagery, imagery services, imagery-derived products and imagery support data.
(ii) Unprocessed sensor data and requirements-compliant processed imagery, imagery services, imagery-derived products and imagery support data licensed under this NGA

contract have no restrictions on use and distribution, but shall contain the copyright markings.

b. Licensed Users

1. The imagery may be used by the U.S. Government (including, all branches, departments, agencies, and offices).
2. The U.S. Government may provide the imagery to the following organizations:
 - State Governments
 - Local Governments
 - Foreign Governments and inter-governmental organizations
 - NGO's and other non-profit organizations
3. In consideration for the flexibility afforded to the U.S. Government by allowing unprocessed sensor data and requirements-compliant processed imagery, imagery services, imagery-derived products and imagery support data to be shared, the United States Government shall use its reasonable best efforts to minimize the effects on commercial sales. Acquisition and dissemination of imagery and imagery products collected within the United States shall be restricted in accordance with law and regulation.

*****END NEXTVIEW LICENSE*****

Appendix 10. Social System Networking Analysis

Camp Roberts Research After Action Report Human Interoperability: Social System Analysis

Dr. Alenka Brown
National Defense University

Preface

Situational awareness in Humanitarian Assistance and Disaster Relief (HA/DR) is a compilation of several essential elements of human and system integration processes involving sharing of information and behaviors and the various stages of strategic communications. Consequently, in addressing SA in HA/DR a viable human interoperable (HI) framework must be part of the overall assessment of any experimental, exercise, or operational planning involving HA/DR architectural design that leads to Building Partnerships and the Capacities.

The end state of HA/DR - HI is to understand the interoperable processes of the inter-relationships of when human and systems are integrated especially across cultural domains for strategic and operational planning to sustain effective and trusted social networks.

For the Camp Roberts TIDES experimentation, human-systems integration and social-networking factors were observed among NGO and their interactions with Department of Defense (DoD) entities. The observations identified four types of interactions: (1) strategic communications, (2) problem solving, (3) mitigation of attitudes/belief systems towards other entities, and (4) inter-relational exchanges in sharing of information and behaviors.

Scope of Work

A social-system engineering team (SSET) was formed to *observe* the human/social-system infrastructure between the NGO and DoD; *evaluate* user interfaces, and the human-system architectural design used in execution of the experiment. (The latter will be especially significant in the execution of USSOUTHERN COMMAND'S PRE-EXISTANCE ASSISTANT KIT (PEAK) experimentations.)

Due to limited funds, the SSET consisted of Dr. Alenka Brown, Principal Investigator, National Defense University, and the Map-Human Terrain personnel. The human

segment of the experiment was based on observations of interactions between NGO, NPS, NGA, and NDU.

The observations of the SSET were as follows:

- ***Understand the social network behavioral process that foster collaboration, cooperation, coordination and communication (4C) between Department of Defense and Non-Government Organizations (NGO) in support of HA/DR.***

Observation: The teams were comprised of primarily NGOs. Naval Postgraduate School responsibilities included serving as the IT support team. They ensured the IT was operable for the NGOs and that the facility provided the means for NGOs to conduct test and evaluation of their products/tools. The National Geo-Spatial Agency's (NGA) did not participate as an on-site team.

The primary observations were on the interactions between NGOs, and the NGOs and NPS' IT, the NPS Hastily Formed Network teams, and NGA:

- There was an appearance of trust among NGO teams. NGOs worked exceptionally well in solving problems once unspoken boundaries were established through non-verbals. The NGOs limited their trust with others not working on ICT problem, and primarily demonstrated "self-orientation," reaching consensus among each other when needed.
 - NGOs were acceptable of the DoD entities (NPS, NDU and NGA) in the roles of support and/or observations.
 - Though most of the NGO's had limited experience in formal experimentation, they did a good job of conducting test and evaluation scenarios of their products. No system engineering architectural design existed showing the phases of the experimentation, the scope of work, tasks/milestones, the deliverables or outcomes, etc. These elements would be required for such initiatives like PEAK as DoD would be the sponsor,
- ***Integrate multiple perspectives of HA/DR that result in a broader human viewpoint of the critical influences of local and outside cultures. Identify the human viewpoints as well as the gaps/barriers of the human viewpoints per policy, doctrine, standards, TTP or Protocols, customs, legality, and so forth per the cultures engaged.***

This was not part of the experiment.

- **Evaluate HSCB analytical models and Social Media tools that capture, assimilate, and validate information to support DoD-NGO-Coalition concepts, policies, standards, and TTP/Protocols for sharing of information and behaviors.**

A scenario was provided to the SSET to examine the cognitive matching of messaging and cultural nuances and bias in an exchange of information between diverse cultures in Afghanistan. The solution was a graphic representation of a hybrid message exchange translator. Reference Figure 1 below.

Issue: How do all participants (i.e. NGO, PRT, Embassy, DoD, Coalition, and Natives) in Nangarhar share messages in spite of issues involving different languages, cultural nuances and bias, and limited Information and Communication Technology.

The SSET worked the issue arriving at the following solution: a hybrid messaging mobile center for translating and narrating SMS and Imagery information as needed among the participants in country.

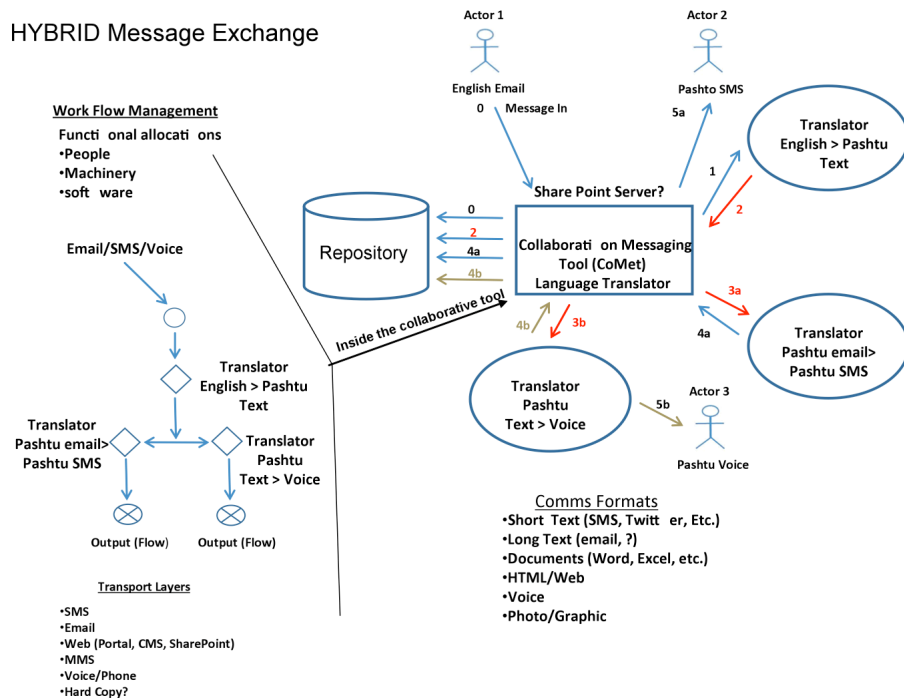


Figure 1: Hybrid Message Exchange

Messages (data, imagery, etc.) would go through a centralized (mobile) system comprised of Native/Middle Eastern or US trained linguistics, non-verbal linguistics experts and imagery analysts [see Collaboration Messaging Tool (CoMet) in Figure 1]. These experts and analysts would translate messages, applying cognitive and cultural matching to the shared information and the behaviors identified as significant. These experts would utilize a technical translator and their own basic knowledge of the language and/or imagery to translate messages to be sent to intended targets, e.g., PRT, DoD, Native, etc.

Posting of messages will be in the manner most acceptable to all users while chosen social-media technologies will be user friendly, adaptive, capable of real-time updates, and interoperable across different cultural domains.

Injecting cognitive-behavioral and non-verbal Subject Matter Expert linguistics with verbal linguistics, the Hybrid Messaging Exchange Center would identify the types of cultural nuances and biases that would be significant within the first hours of communications. For example, in Afghanistan, the predominant cultural cognitive pattern (which maybe different within individuals) is *Kinesthetic-Auditory*, meaning that most Afghans process their internal information from a “feeling” then from an “auditory (hearing)” framework. The culture has a sense of feeling about information and then runs an internal dialogue within and among themselves for expressing this feeling they are internalizing.

Consequently, from these two states (Kinesthetic and Auditory) certain fundamental cultural biases and nuances would be identified as essential in matching cultural communications at the non-verbal and verbal levels. This would be determined within the first few hours of the crisis. Non-verbal cues matched to the verbal language, how Afghans measure time, and their spatial position in respect to others are significant in establishing a matching communications across all the diverse cultures.

For example, the Afghans speak of their future in weeks not months or years, They deal with their environment in first position meaning they are in the moment or in the here and now when working through solutions, making decisions, and so forth.

Knowing such processes enables us to know how to establish on-site rapid rapport for building sustainable, effective social networks. [Reference Figure 2 below.]

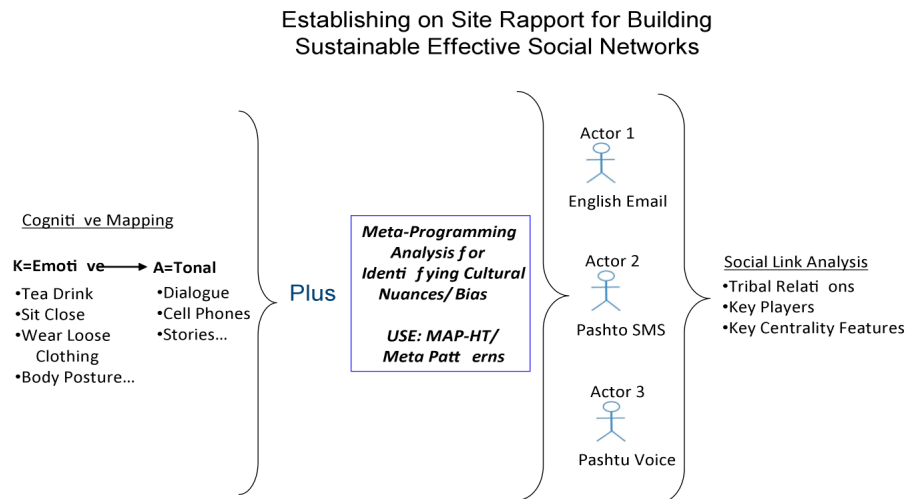


Figure 2: Rapport and Social Networks for Theater Utilization

- *Provide training/learning tools focused on successful HA/DR by incorporating a comprehensive software-system's approach that is inclusive of the human factors and social engineering concepts/standards/best practices. In future experiments, the SSET would implement a System's Engineering Design that is similar to one that is to be used for the NATO Response Force Technical Activity Proposal in FY010-012: Human Interoperability and Human System Integration. [Reference Appendix A.]*

Not part of this experimentation.

- *Evaluate human factors engineering to identify the issues and gaps of the social-media technologies, human system integration design, and the ICT infrastructure for sharing of information and behaviors.*

From observations, it is suggested that the NGOs should study or employ a human factors expert for the development of their systems. No full-scale human factors analysis was conducted of the technologies – not part of this experimentation.

Future human interoperability experiments would incorporate a system's engineering approach using a similar framework outline in Appendix A.

Recommendations

Future SSET Observations for TIDES at Camp Roberts Experimentation

The experimentations will need to expand to include DoD-Coalition participants with NGO for the SSET to begin to explore the issues of social networking between DoD-NGO-USGA. This will be important in support of General McCrystal's effort in Afghanistan and USSOUTHCOM'S PEAK program.

The experimentations will need to include a human-system integration test and evaluation regarding a) problem solving, b) human factors evaluation, c) social-system network analysis, d) cognitive/cultural matching, and e) testing against current policy, standards, and Tactical, Technical and Procedural misalignment among the various participants.

Tracking of displaced persons, vulnerable groups, refugees, etc. is essential element of information in HA/DR. The issue is resisted by many NGO and Local Populace out of fear and suspicion of DoD tracking them for reasons other than crisis location. Proposed that NGO/Natives might implement their own tracking device that would be connected and controlled, by their C2; then suspicion and fear of a tracking device use might be diminished. It is proposed that, in future NGO Camp Roberts experimentations, testing of several such devices might be conducted.

Future Observation in November 2009 Experiment:

The next step of observations will be worked between the NDU, NPS and other interested parties.

It is proposed that NPS, NDU and other HIEWG members work on expanding the design and implementation of the social engineering network, hybrid messaging framework. Future meetings are to be held to determine what needs to be assessed in November 2009 and then in February 2010.

APPENDIX A

A Systems Engineering Approach Example for Future STAR TIDES Camp Roberts Experimentation

Human Interoperability (HI) - Human Systems Integration (HSI) within the NATO Context

Introduction:

The purpose of this paper is to describe the systems engineering approach at achieving the technical deliverables in the NATO TAP HFM-ET-106 section III. In summary, these technical deliverables are to:

- a. Define the data, metrics and processes related to Human Interoperability (HI) of Human Systems Integration (HSI), and
- b. A framework on who will do what in the realm of HI.

These deliverables will form a basis of a symposium that will describe how the NRF can understand and then effectively deal with HI issues. The technical approach to address the deliverables, as described in (a) and (b), is to apply a proven systems engineering approach. This paper describes 13 concurrent and iterative steps that will derive the technical content that will form the basis for the deliverables.

The assertion is that we can treat HI-HSI as a system and apply a systems engineering method. Starting with a definition of a System and taken from *Systems Architecting, Creating and Building Complex Systems, Reclin, 1991*, the following definition applies:

1. A system is a complex set of dissimilar elements or parts so connected or related as to form an organic whole.
2. The whole is greater in some sense than the some of the parts, that is, the system has properties beyond those of the parts. Indeed, the purpose of building systems is to gain those properties.

The following steps are a summary of the activities that will be perform to achieve the desired technical results. While these steps are listed in a logical sequence, they are concurrent and iterative, meaning that one activity will have impacts or update other activities.

1. **Create a Concept of Operations (CONOPS) Document:** The CONOPS is a high level description of the problem that describes key objectives and the desired capabilities or outcomes. This document must answer the questions who, what, where and why to all stakeholders. For example, this document should describe the desired outcomes of HI-HSI as it relates to NATO and the enabling organizations, roles and interfacing entities that are needed to achieve the desired outcome or effects. If there are constraints or performance requirements associated with this “system”, they should also be stated. In essences, this will be a key source document that the analysis will stem from and maintain the focus and clarity of scope.
2. **Collect existing related NATO policies, doctrine, guidance and processes:** It is necessary to establish a detailed understanding of policies, doctrine, guidance and processes. We will capture and structure the information as practical to evaluate gaps and inconsistencies as we develop the HI-HSI process. The idea is to leverage existing NATO approaches and document gaps or issues related to the policies, guidance and processes.
3. **Capture Originating Requirements:** Originating requirements are extracted from the source documents identified in steps 1 and 2. After capturing the requirements, and ensuring they are verifiable, each requirement will be classified as being a constraint, performance or functional requirement. This will facilitate the analysis, traceability and management of the requirements.
4. **Define the HI-HSI Context:** This step defines the HI-HSI system and establishes a boundary between the system and the interfacing external systems. The system that lies within the boundary will be the problem we analyze and decompose while establish a clear definition of the external interfaces.
5. **Derive the HI-HSI Operational Scenarios:** For each external interface between the HI-HSI system and its external systems, an operational scenario will be developed. A scenario starts with a trigger as an input to the system. Based upon the trigger upon the trigger, subsequently a series of activities are performed that results in a response.
6. **Develop the Integrated HI-HSI Operational Behavior:** Using each of the operational scenarios an integrated HI-HSI operational behavioral model will be derived that integrates each of the scenarios, preserving its behavior (sequencing, inputs, outputs and timing). During the integration process, additional behavior will be derived to manage the conditional logic. As necessary, the integrated behavior will be decomposed to address specific role related behaviors.
7. **Define the HI-HSI system structure (detailed roles, relationships/interfaces):** The step defines the HI-HSI system structure as it relates to the organization roles and relationships/interfaces. The outcome of this step will be a system hierarchy and a physical block.
8. **Allocate the HI-HSI Operational Behavior to the HI-HSI roles:** Allocate the activities defined in step 6 and allocated the leaf level activities (behavior) to the roles defined in step 8. Associate the inputs and outputs (communication exchanges) to the relationships/interfaces between the roles.

9. **Add Resource requirements and Interface constraints:** Model the system resource requirements and interface constraints. For example, each role will have an allocated set of activities with corresponding inputs and outputs. These inputs and outputs constitute the functional interface of a role. There will also be non functional interfaces such as the environment.
10. **Define the Supporting IT systems (or physical media) used by the HI-HSI roles: This step documents the (hardware and software) systems used by the roles to perform their activities.**
11. **Dynamically execute the HI-HSI system:** Perform this step throughout the development process. This step will discover dynamic inconsistencies, timing with the affects of resource and interface constraints thus providing insight about the overall behavior of the HI-HSI system.
12. **Document and resolve issues:** Throughout the process, issues as they arise will be documented and resolved with the stakeholders involvement.
13. **Document the System design:** Throughout this process, each activity, role and interface will be described. At each step of the process, using a tool like CORE™ which has document templates set up, the documentation is a by-product of the analysis.

Systems Engineering Tool Recommendation: To effectively and efficiently perform this process, the use of the SE tool, CORE™ is highly recommended. CORE™ provides an integrated SE environment that can support all the tasks that have been identified in this process. If CORE is not used, the task will require multiple tools that will complicate the process in terms of double entry, traceability and documentation.