

Balloons, Drones, Phones

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Abstract

Disaster recovery is best organized in two phases: pre-disaster and post-disaster. More preparation generally equates to less post-disaster, time-sensitive work. This proposal identifies missing critical pre- and post-disaster assets and procedures to specifically minimize post-disaster workload and maximize information availability for rescue coordination.

Information availability and infrastructure outages are primary concerns during a disaster to determine how to prioritize other support services. A large amount of pre-disaster availability information is publicly available through existing standard APIs that will be utilized in coordination with cost-effective standby communications equipment designed to provide temporary infrastructure outage relief. As information availability recovers, so does our capacity to organize and prioritize relief.

Proposal

Organization can be found in centralization, and a centralized emergency reporting tool has been largely requested. The tools to create this effectively already exist and just need to be utilized. We have created a dashboard that enables individuals to get localized emergency reports, find best practice information, and more, all using the existing government disaster management services. In addition, the dashboard is modular as to how emergencies are reported. This allows more than just SMS services for scalability and future development.

We recognize a continuous move toward SMS networks as the networks of maximal availability to citizens and are particularly easy for users to navigate in emergency situations. Temporary SMS network extenders have already been designed that can be launched using balloons by Space Data¹ and Google². These companies' efforts can potentially be extremely helpful given the large percentage of people that rely entirely (or nearly entirely) on their cellular service for news and communication. In fact, the results of balloon-based SMS services has been reported to be excellent. Extend America did the exploratory designs in 2004, raising \$18M within two years before being purchased by Nextel in 2005³. The balloons were designed to be cheap⁴, disposable, quick to launch, and provide SMS network coverage to very large areas, covering up to 100 square miles at 20 miles altitude. Larger balloons have also been tested to cover much larger areas, but are more costly and not disposable, making them less suitable for disaster scenarios⁵.

Balloons of various sorts are launched very regularly, mostly for weather reporting, and have a history of being safe. According to the Wall Street Journal, 1,800 weather balloons were launched world-wide per day as of 2008 "without problems"⁶.

Deploying a small number of cellular extenders immediately following disaster conditions can provide significant coverage for SMS networks regardless of ground conditions. Bandwidth can be scaled with balloon count.

Damage Assessment Using Drones

In any disaster situation, there will be areas that are inaccessible from the ground for a potentially long time. To help assess damage, a program can be

¹<https://www.spacedata.net/government/forestry/>

²<https://web.archive.org/web/20080223105103/http://online.wsj.com:80/public/article/SB1203473,https://x.company/loon/>

³Extend America sold by Ed Schafer, former governer of North Dakota: <https://www.wired.com/2006/01/lofting-balloons-for-cell-service/>, <http://www.inforum.com/content/schafer-company-selling-cell-business>

⁴\$55 per balloon for disposable component, the rest is re-usable upon collection, and can carry a GPS position indicator. <https://www.wired.com/2006/01/lofting-balloons-for-cell-service/>

⁵<https://www.spacedata.net/commercial/coverage/>

⁶<https://web.archive.org/web/20080223105103/http://online.wsj.com:80/public/article/SB120347353988378955.html>

relatively cheaply implemented using drones. They can provide visual information to people who have evacuated and want their homes checked for significant external damage as well as verify the external condition of homes of citizens that have not verified their status using SMS.

Drone flight paths will be either pre-programmed based on situational requirements or based on reports from citizens and using FCC reporting datasets. Drones also afford manual control to further investigate specific situations.

To minimize cellular data usage the drones can store photographic data on-board. The data can be aggregated when the drone returns to a base station, where the battery can be swapped for re-launch.

Based on existing commercial drone models, we estimate 15 drone base stations can provide minimal coverage for the county⁷, with flight routes following roadways and covering areas of concern using a typical path finding algorithm and prioritized DIRS/NORS data. Areas of concern include data pulled from the FCCs outage API, homes of registered disabled people, and community reports.

Data Sources

Two existing services exist for outage reporting (the FCCs DIRS (Disaster Information Reporting System) and NORS (Network Outage Reporting System)), however their data is currently limited to service providers and to programmers that have knowledge of NORS's web API, which is not user-friendly. Both DIRS and NORS are currently configured for communication companies' exclusive use, but their datasets overlap significantly with personal communication issues around which a centralized tool has been requested. Our centralized tool is built to provide a web interface and user-friendly way for individuals to utilize these existing outage tracking resources. Using these two databases in addition to community reported outages, emergencies, and notifications and our drone and our balloon system, we have the most comprehensive notification system with the latest up to date information anywhere.

Landline and Voice-Only

Individuals with limited web access can dial a reporting number. In emergency situations, computers are somewhat of a luxury item compared to a cell phone and other items so it makes sense for us to have a phone based access method. By utilizing telephony services such as Twilio, we can rapidly deploy text and IVR based reporting and checking in to our system. Registration with the dashboard can be restricted to require verification of identity or residence. This will allow

⁷Calculations are estimated, based on commercially available drones with the following specifications: 3 mile drone range, 3 mile per drone max distance from source, 7 mile linear range with pre-programmed route, approximately 426 square miles in county, 45 mph max speed, \$750/drone, \$11,250 minimum investment, can check on several hundred people in 6 hours or less with 30 drones

individuals to submit location-based structured data while keeping abuse to a minimum. We can use Twilio services to register users using phone and SMS based communication as well. Deployment Our idea is based on current technology and is rapidly deployed. Maintaining the software requires little time commitment and the deployment of the drones and balloons could be handled by the current emergency management personnel including CEMA and the local ARES (Amateur Radio Emergency Service).

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