Commentary

Information technology issues during and after Katrina and usefulness of the Internet: how we mobilized and utilized digital communications systems

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Abstract

Even more than in previous disasters, Katrina has proven itself to be a testing ground for a plethora of new technologies. Although not all of these technologies did immediately save lives, in this regard a number of them exhibited considerable potential for the future, and hence there is a need to include them in future contingency plans. However, a need for change in the modes and patterns of technology deployment to maximize their leverage has also become very clear.

In the immediate aftermath of a catastrophic disruption, communication channels break down and must be re-established as rapidly as possible so that emergencies may be reported and first response team efforts coordinated in the field. Cell towers are typically not equipped with sufficient emergency power backup capacities, and backup generators of long-distance switches do not tolerate flooding. As a result, both mobile phone and long-distance phone terrestrial communication suffered an almost complete disruption in Katrina's wake. Over 60% of networks were still down 3 weeks after the event [1].

In comparison, satellite communications remained quantitatively operational and were utilized within minutes of the disaster by FEMA, the National Guard and the Red Cross, as well as by state and local first responders, utility workers, and people in search of relatives. More than 20,000 Globalstar, Iridium and Mobile Satellite Ventures satellite phones and terminals were deployed in the affected region within 2 days after the event. Within the first 72 hours the Iridium network traffic surged by 3000%, and the subscriber base rose by 500%. The provider Globalstar was activating 1400 devices/day, as compared with a typical rate of about 80 devices/day. Mobile Satellite Ventures reported an increase in traffic in the affected region of more than 400%, and supplied satellite terminals to a number of emergency responders (e.g. FEMA's Urban Search and Rescue teams).

Given these recent experiences, the Satellite Industry Association strongly suggested that in future satellite communications must be made an essential part of future critical communication networks; that satellite capacity and equipment must be pre-purchased and pre-positioned, with operator training included; and that satellite operators and personnel must be credentialed as first responders so that they may be admitted to restricted areas [2]. In some cases, however, poor planning (e.g. lack of SIM cards for devices shipped) rendered satellite phones useless [3]. As usual, amateur radio operators (hams) were highly useful in providing decentralized emergency communication services, both for voice and data (packet radio), especially where power was absent and other means of communication unavailable [4,5].

Wireless networks have already played an important role in disasters before Katrina. Today, reliable voice (i.e. VoIP [voice over Internet protocol]), video, and data services (including medical telemetry and control) can easily coexist, even on relatively low-bandwidth links, provided that compression and quality of service for latency-critical signals is supported by the protocol and the end devices. Recent advances in technology have enabled new transmission standards (satellite data, wired, microwave, WiMax for Wide Area Network connections, and WiFi for the local device communication cloud) to debut in the field. This enabled small operators and teams of volunteers to deploy *ad hoc* networks. Mesh radio, a self-organizing failure-tolerant wireless network, was first seen in the wild [6]. Multiple corporations, using their enterprise infrastructure, have donated free connectivity and terminals [7].

FEMA = Federal Emergency Management Agency; GIS = geoinformation system; GPS = global positioning system; UAV = unmanned aerial vehicle.

As general awareness is growing that Internet-based (i.e. utilizing TCP/IP [transmission control protocol/Internet protocol] protocol suite) communication is to become a vital part of the nation's emergency response system [8], the Renesys report on Katrina's impact on the Internet infrastructure [9] indicates that the backbone network and emergency power infrastructure in the chronically hurricane-afflicted area is not sufficiently redundant to become a reliable backbone of services, especially locally and in the last mile. At peak disruption, more than 35% networks suffered an outage, and recovery over the course of the next days was slow. Internet2, a poorly redundant (single-provider fiber) next generation research network, was completely unavailable.

Some spontaneous self-organization up from the grassroots has caused volunteer driven geoinformation system (GIS) efforts such as Telascience [10] to spring up across the Internet. US National Oceanic and Atmospheric Administration provided the initial core of 1500 high-resolution digital aerial images, which two initial collaborators turned into a usable prototype, with open source tools, within half a day, using internet relay chat (IRC) and instant messaging (IM) for developer coordination. A number of other spontaneous contributors from government, academia and research, and open source developers (including members from the National Geospatial-Intelligence Agency [11], National Reconnaissance Office [12], US Geological Survey [13], and US Naval Research Laboratory [14]) donated resources and joined the project, which grew in size, eventually causing new missions to be flown, and came to contain 5000 fully mosaicked and geocoded images as well as different types of data sets [15].

Other volunteers have provided a Katrina data add-on (recently generalized into a generic hurricane package called the 2005 Hurricane Add-on [16]) for the already quite popular NASA World Wind project [17] – a set of online servers and fully interactive, real-time, three-dimensional open source Earth browser. It is remarkable that this small band of amateurs, with no large corporation or government body behind them, has produced far more imagery and better geo-referenced data than the much heavier funded and far more strongly backed Google Earth's Katrina offering [18].

In a very effective application of a GIS system, the Mid-American Geospatial Information Centre helped to rescue more than 25,000 survivors by using a GIS system to match 9-1-1 calls from mobile phone calls in New Orleans hours after Katrina to GPS coordinates and street addresses on emergency switchboards in real time. Rescue teams in the field with mobile computers connected to The University of Texas at Austin's Centre for Space Research by a data link via satellite were guided to the location using global positioning system (GPS) coordinates and satellite imagery. Mid-American Geospatial Information Centre also provided flood depth estimation (using preflood terrain elevation data and post-landfall satellite imagery), and based upon it suggested an appropriate choice of rescue vehicle.

Autonomous military aircraft and tele-operated robotic platforms [19], which have been designed to scan large areas of typically inaccessible terrain looking for human life signatures [20] for prolonged periods, in any weather, with one or many devices for each human operator, are an almost perfect match for finding survivors [21]. Post-Katrina New Orleans has seen the largest yet civilian mission deployment of military unmanned aerial vehicles (UAVs). The Evolution is a lightweight craft, at 6.5 pounds, and it has a range of 10 km. Typically operating at a height of about 300 feet, it is powered by lithium batteries and can cruise for 1–2 hours, depending on mission type. Controlled remotely from a portable computer, it can fly autonomously with a GPS autopilot, can be launched within 15 min after unpacking, and remotely relays color video and low-light TV or passive infrared camera imagery to its operator. Ten Evolution UAVs were flown from the New Orleans Naval Air Station to assess structure damage and flooding data. The heavier but still hand-launched or catapult-launched Silver Fox weighs 22 pounds, is powered by a gasoline motor, and has a range of 240 km, at typically 300 m operational altitude. It can stay aloft for 10 hours (with an engine upgrade in planning permitting a duration twice that long), and allows the operator to look for survivors using a passive infrared (body-emitted, long-wave thermal radiation) camera. Five Silver Foxes were flown in New Orleans [22]. While saving no lives, similar experiences were reported with two other designs of UAVs (a fixed-wing and helicopter) searching for trapped flood survivors in Mississippi by the University of South Florida and the Centre for Robot-Assisted Search and Rescue [23].

As expected, web services (a term for an industry-standard based set of wire protocols and XML syntax) useful for automatically integrating diverse real-time feeds from government and private data such as weather radar, web applications, and classical media such as blogs [24], wikis [25], and web forums for end users and medical professionals [26] sprang up rapidly and have seen considerable use. The volunteer-based PeopleFinder project [27], for example, integrated more than 100,000 missing person and evacuee records within 5 days.

In summary, most of the discussed applications of information technology during the immediate Katrina aftermath were on too small a scale and were insufficiently preplanned to have a major impact in the field. New technologies emerge continuously, however, and must be proactively planned for in future deployment scenarios. Infrastructure must be prestocked and personnel pretrained; in some cases the military or civilian technology needs adaptation for use in a first response emergency theatre.

Competing interests

The author(s) declare that they have no competing interests.

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