Survivable Social Network

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As a direct consequence of the Loma Prieta earthquake in 1989, 154 of 160 telephone central offices in Northern California lost primary power, and some of these also lost their backup power[1]. The impacted communities had an expectation of rapid restoration of communication services – in that day and age, this meant voice calling over POTS circuits. Amateur radio operators were able to provide supplementary voice communications during the recovery efforts because individuals had taken steps to become licensed, build skills and prepare equipment that would operate in the absence of communications infrastructure.

But since that time, both the expectations and the infrastructure have changed in ways that have reduced communications resilience for communities. The rise of the internet and, more recently, smartphones and social networks, have shifted expectations toward mobile IP-based data services (*e.g.*, exchanging health and welfare information from phones via text and images; vesting the storage of critical banking and health information in online services). And the *nature* of this new infrastructure is inherently less robust than central-office-based POTS. Cell sites are constructed with limited backup power (reportedly, more than 25% of the cell sites in the affected area went down during Sandy). Wireless technologies have unique vulnerabilities. Cellular signaling is particularly prone to overloading. Consumer-grade internet services are not engineered to pre-divestiture AT&T standards. And the goodwill services of amateur radio operators are ill-prepared to meet the expectations of restoring broadband IP-based communications.

While full restoration of internet access will be important, it stands to reason that restoring communication infrastructure *within* an impacted community using familiar-feeling communications tools will be among its top priorities in an emergency situation.

The Survivable Social Network (SSN) project at Carnegie Mellon University is developing a solution to this problem. Our approach addresses, among other things, (a) rapidly-deployed replacement infrastructure that can meet basic communication needs and (b) a rich and flexible means for authorities to communicate with citizens. Our solution is built on principles of

- Crowd-sourced infrastructure that can be owned and operated by individuals (in the spirit of Amateur Radio)
    - Social networking services that build upon existing open source tools (*e.g.*, Elgg, The Diaspora Project) and that are readily delivered via ordinary laptop computers or ultra-low-power, low-cost single board computers that are easily battery and/or solar powered
    - Radio access networks built using WiFi (and/or commercial, off-the-shelf GSM implementations operating under Special Temporary Authority from the FCC), including simple antenna setup automated optimization, avoiding the need for on-site expertise
- Scalability
    - Designed-in means to internetwork with other SSN-enabled neighborhoods as well as to SSN-equipped authorities and agencies
- Simple Quality of Service (QoS) controls
    - Restoration of connectivity to the public internet via technologies such as commercial satellite IP providers but with the capability to manage bandwidth allocations based on user type (citizen, CERT member, agency / authority representative) and class of service (voice, text, image, video)
- Ease-of-use
    - Familiar-feeling social network services delivered to citizens using commonly available HTML5 browser-equipped smartphones
    - Straightforward and familiar voice services including directory and routing services

We have demonstrated a prototype of the SSN – implementing social networking services, voice calling, satellite services and agency integration at our recent Disaster Management Initiative Workshop[2]. Development of a more complete set of features is underway, and field trials and broader dissemination are under study.

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[1] *Telecommunications Infrastructure in Disasters: Preparing Cities for Crisis Communications*. Anthony Townsend and Mitchell Moss. Center for Catastrophe Preparedness and Response & Robert F. Wagner Graduate School of Public Service. New York University, 2005.

[2] http://www.cmu.edu/silicon-valley/dmi/workshop2012/index.html

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Areas of Interest:

Mobile and embedded computing, scalable systems, sensor networks, emergency communications systems

Education:

Ph.D. 1988, Electrical Engineering and Computer Science, MIT

Overview:

Dr. Bob Iannucci is Director of the CyLab Mobility Research Center at Carnegie Mellon University Silicon Valley and is known for leading both software and systems research in scalable and mobile computing. Most recently, he served as Chief Technology Officer of Nokia and Head of Nokia Research Center (NRC). Bob spearheaded the effort to transform NRC into an Open Innovation center, creating "lablets" at MIT, Stanford, Tshinghua University, the University of Cambridge, and École Polytechnique Fédérale de Lausanne (EPFL). Under his leadership, NRC's previously established labs and the new lablets delivered fundamental contributions to the worldwide Long Term Evolution for 3G (LTE) standard; created and promulgated what is now the MIPI UniPro interface for high-speed, in-phone interconnectivity; created and commercialized Bluetooth Low Energy - extending wireless connectivity to coin-cell-powered sensors and other devices; and delivered new technology initiatives including TrafficWorks (using mobile phones to crowd source traffic patterns, Point and Find (augmented-reality using the mobile phone's camera for image recognition and "zero click" search) and the Morph Concept (opening new directions for using nanotechnology to significantly improve mobile phone functionality and usability).

Previously, Bob led engineering teams at startup companies focused on virtualized networking and computational fluid dynamics, creating systems that offered order-of-magnitude improvements over alternatives. He also served as Director of Digital Equipment Corporation's Cambridge Research Laboratory (CRL) and became VP of Research for Compaq. CRL created some of the earliest multimedia indexing technologies, and these became part of Alta Vista. In addition, the CRL team and Dan Siewiorek's team at CMU created MoCCA - a mobile communication and computing architecture - that prefigured and anticipated (by more than a decade) much of what has become today's smartphone technology. MoCCA won the IDEA Gold award for its innovative approach to facilitating real-time interaction within teams. Bob spent the earliest days of his career at IBM studying and developing highly scalable computing systems.

Bob remains active as a hands-on systems builder. His most recent iPhone app for radio direction finding is in use in over 70 countries, and he is actively engaged in building WiFi-based "internet of things" devices and the cloud services behind them. He serves as advisor to companies developing new technologies for ultra-low-power computing, mobile video systems, and cloud-connected mobile apps.

Bob earned his Ph.D. from MIT in 1988, and his dissertation was on the hybridization of dataflow and traditional von Neumann architectures, offering advantages over both. He has served on a number of scientific and engineering advisory boards and was on the program committees for the 3rd and 4th International Symposia on Wearable Computing. Bob also served as a member of the selection committee for the Millennium Technology Prize in 2008.

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