CHAPTER 20

What the World Trade Center Attack has Shown us About our Communications Networks

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Abstract. This chapter addresses how communications networks coped with the aftennath of the attacks on the World Trade Center and the Pentagon, and the lessons for the future about the nature of emergency communications. The chapter documents how domestic and international fixed-line and mobile networks, business communication systems, and the internet responded to the huge increase in traffic volume that followed the attacks. While the limitations of cellular networks and major internet content servers in serving millions of users simultaneously were demonstrated, decentralized forms of communication such as email, instant messaging, and bulletin boards performed well. The author concludes that we should revise the basic philosophy of emergency communication from that of the traditional military-style, top-down approach of public safety agencies to a more decentralized system building on lessons from the spontaneous efforts of using internet technology following September 11.

When tragedy strikes, people communicate enormously driven by objective need and subjective compulsion. Have communications networks been up to the task of coping with the aftermath of the attack on the World Trade Center and the Pentagon? What are the lessons? The implications are important to others, since natural and man-made disasters will recur more often than one would wish.

Within minutes of the attack on September 11, 2001, traditional telecommunications were stretched and overloaded. In New York, the collapse of the buildings ,took out a big phone switch with 200,000 voicelines and a large number of private line circuits, right in the middle of the downtown financial district, and about 20 cellphone antenna sites, and 9 TV broadcast stations using the World Trade Center, but that was only part of the problem. Phone networks are not so much destroyed as congested into uselessness. Networks are designed to handle about 10-15 percent of their subscribers at anyone time, to maintain a desired quality of service in terms of blocking probability. But in New York, local traffic volume shot up 2-3 times the usual peak (exact figures are hard to get, since so many calls never made it through to be counted). Long distance voice service on the East Coast became non-functional for a while though it seems to have worked well enough for data traffic. Long distance companies pleaded for people to make only essential calls. They gave priority to calls going out of emergency areas in preference to calls coming in. Some people learned how to beat the system by calling collect, which often worked, but at a price..

A key issue is hence the delicate question of how to allocate scarce capacity in emergency situations when demand is high and supply may be disrupted. Using higher prices as a market-clearing device, as economists might propose, is not likely to be an acceptable solution. Demand is likely to be highly price-inelastic, and the notion of charging grandma $50 per minute to find out if the kids are safe is not likely to be something a phone company's PR department would recommend. Indeed, Verizon, the local phone company, made payphones free for several days. Hence, emergencies require, as a very short-term arrangement, a rationing of scarce capacity that works better than the present random allocation by busy signal. Such a system already exists for official and semi-official use. It is known as GETS (Government Emergency Telecommunications Service) and provides priority to users with special calling cards. Participants include emergency and responsibilities, such as utilities, transportation, and banks. 95 % of GETS calls in New York got through, but that still leaves open how to allocate the remaining capacity among non-official users.

International communications experienced the greatest problems. Trans-Atlantic traffic from Britain was reportedly ten times its normal volume. Less than half of calls from Finland to America got through. 90% of calls from Sweden and Taiwan were blocked. Normally. networks are engineered for congestion of less than 2 percent. Such congestion indicates a huge increase in traffic volume, especially given the vast increase in transatlantic capacity that has come on line in the last few years. What clogged the network was the switching capacity. Transmission has become plentiful, but other bottlenecks remain. To overcome them will be even more important in a society that needs to protect itself against terrorist attacks. Inevitably, various forms of electronic sensors will proliferate, as will the scanning -airport like -of vehicles and cargos. Such scanning is enormously data-intensive, and will require transmissions of high capacity and resiliency.

Cellphones were put to heroic uses, from under the rubble and from hijacked planes. Rescuers got free cellphones from service providers. It seems hard to imagine how after this experience people would ever want to step out without their electronic security blanket. But the cellphones also showed their limitations. For some mobile service providers traffic quadrupled; Everywhere, it seemed, people walked down the street, cell phones glued to their ear, tears in their eyes, but frustration in their face, as they encountered chronic circuit busy signals and eventually ran out of battery power. The cellphone-less huddled around payphones, which seemed to be mostly working, this demonstrating the usefulness of such a "legacy" backup system. The chronic problem of calls not getting through demonstrates the need for the wireless companies to institute a better priority system. A national priority system for mobile phones has been in planning since 1995, but had not been concluded due to insufficient planning funds. For example, one could institute an automatic emergency cutoff of a mobile call after a certain number of minutes. Another solution is "to shift cellphone users from voice to short messaging of text. With an 'always-on' technology, as demonstrated in Japan by NTT Docomo's popular i-mode technology, large numbers of users could always be connected at the same time, because they would occupy a frequency only when they send or receive some bits of information, which for text is not much. More spectrum is needed. But even more important is flexibility in using the available spectrum. This includes enabling handheld transceivers of cellular communications to reach other providers and other wireless services such as unlicensed wireless LAN hotspots. Another possibility is to enable the handset to function in peer-to-peer mode. All this would mean reducing the control of cellular service providers over the subscribers' equipment and its uses.

Business communications, such as companies' private networks and data networks, performed quite well. Financial firms might be expected to be reluctant to discuss internal communications breakdowns, but there were few outside reports about encountering such problems. A record number of SOS "disaster declarations" went out to firms that specialize in running computer backup facilities, but they mostly originated from small firms. Big companies are sophisticated users of information. Their data is backed up, and their networks are configured to adjust instantaneously to emergency conditions. Thank you; hackers of the world, for having kept everybody on their toes.

When it comes to the internet, the experience was mixed. The internet backbones functioned well. But some of the major servers of content and transactions slowed down annoyingly. In particular, the internet did not perform particularly well as a mass medium. News sites like CNN.com, MSNBC.com congested almost immediately as the number of users shot up to record levels. The sites did not scale well. Alter encountering congestion, they were stripped down to basic text information. Before the attacks, CNN.com got typically14 million page views per day. On September 11, there were 9 million page views per hour. The lesson is that if one wants to rapidly provide information of interest to millions of people, more or less at the same time, a superior technology is readily available. It is called broadcasting. Aficionados of news websites may protest vociferously, but in peak situations internet news sites are less efficient and effective, and "synchronous" information shared by millions beats in those situations the "asynchronous" provision of information. The websites are then best deployed to serve the specialized or distant users for whom TV news sources tend to be inadequate. Examples are Argentineans who want to get more information than they can get over their national TV; Americans who wish to see how Arab media cover the event; as Norwegians who, are in the shipping business and want to know the impact of the attack on the price of oil tanker charters.

But where the internet shone brightly was in email, and instant messaging, and bulletin boards. Email messages had no problems in getting through. Maybe they were a bit slower in arriving, but the difference rarely mattered. Instant messaging was even faster, enabling distant correspondents to be in touch in real time. It all worked beautifully. After all, that was exactly what the Internet's predecessor was Originally designed for by the American military: as a network that could not be easily destroyed, because it was decentralized. Furthermore, it diverted billions of voice calls from the long distance telephone networks, thereby also benefiting the email-less. A fi-minute voice phone call consumes as much transmission capacity as about 4,000 typical emails, By sending a batch of email messages instead of making phone calls, people free up congested networks. It's a bit like donating blood. Another great contribution of the internet was the bulletin board systems. Here, people could post that they were well, that someone else was fine, and how could they be reached. The information was available to the visitors of the sites from all over the world, thus reducing the anxiety that accompanies the frustrations of searching by phone for news about loved ones. Other boards listed unofficially the names of persons reported missing. Still others included requests for help locating missing friends and relatives, and it was hard to read them with dry eyes. Some of these bulletin boards are set up by some official organization, or by large portals such as Prodigy. But most seem spontaneous attempts by volunteers. The bulletin sites tend to be linked to each other. In time, sites with search engines emerged, such as elbnet.comlwtc, that would search many of them automatically so that one would not have to visit each.

The internet chat rooms were sometimes touching, occasionally inspiring, and frequently maddening considering people's argumentativeness even in the face of tragedy. But that may have a positive function in letting people blow off steam.

The emergence of these internet tools and practices provides us lessons for the future about the nature of emergency communications. Disasters are a physical problem first, but soon an information problem. Government authorities are just as much in the dark in a catastrophe as individuals are. During the Los Angeles quake, President Clinton's early information sources were his brother and the TV news. When an earthquake hit the city of Kobe, in Japan, the Japanese government labored for hours in the belief that the number of dead was only 5 percent of the actual figure.

It is time to learn from these experiences and revise the basic philosophy of emergency communication from that of the traditional military-style, top-down, public safety agencies, in which information travels up the hierarchical chains-of-command. Traditional emergency communication is exemplified by the '911' system, in which citizens report to the authorities when something goes wrong, and the authorities provide the public with information whose timing and completeness is in the hands of officials working under great pressure.

A more affective approach would be to learn from the spontaneous efforts of using internet technology and supplement 911 by what might be called the 'SIl' system: by dialing SIl(or typing an equivalent URL) over internet-enabled phones, cellphones, or computers, individuals would gain access to a regional 'emergency portal' which links to a variety of official, nonprofit, and spontaneous websites, as well as to other portals, and "meet me" points.

Much of the information would also be available to distant parties and reduce the workload on "hotlmes" that are chronically busy. It would give news organizations detailed information and sources, could link world-wide donors with actual needs, provide "how-to" information, and reach specialized data bases, for example protection against about toxic substances. Certain communications could have to remain confidential or private and require special levels of access authorization, but that could be easily accomplished.

The aftermath of the World Trade Center disaster shows that such a system is emerging spontaneously. It also demonstrates that the public agencies are still far behind in making use of it, encouraging it, or contributing much to it beyond official announcements. One of the main conclusions is that it is essential to have communications systems that are decentralized and duplicative instead of centralized and monopolized by a single firm or technology. All this demonstrates the importance of decentralization: of information sources and of information channels. If one put all one's eggs in one basket they will break. In New York, the public services emergency control center was right in the WTC complex and was destroyed within minutes. A centralized system will in fact attract attacks because to destroy a vital communications mode will have major repercussions.

There is strength in decentralization. Diversity protects. The data packets of the internet found their own way around disasters just as their creators in the 1960s envisioned. Technology is not the solution to the problem of terrorism, but the latter's challenge might spur innovations. What we have seen in New York is that the communications system is much more resistant to attack, than physical assets like skyscrapers or subway lines were. As the physical realm of society becomes more vulnerable, the virtual realm is becoming increasingly robust. This may be a comforting thought, though one wishes for the opposite to have been true on September II, 200I.