Computer Network Communication Failure Issues in Disaster Management

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Abstract— Communication problems are persistent in many disaster situations. Nearly all the case studies of disasters occurring in the last 40 years describe communication problems of some sort. In the present work, we bring out some of the important cases where an underlying proficient communication setup, if in place, could have proved highly effective in mitigating the actual losses.

Key words: Disaster, Management, DTN, Technology, Communication

I. INTRODUCTION

Communication failure is a complex problem because it involves man and machine. Failure can be attributed solely to an equipment problem such as system overload, poor reception, inter-operability of different communication devices, or lack of technology. In other situations failure can occur because certain individuals neglect to pass along vital information or do not think it is important to do so. Failure can occur within an organization, between organizations, or between authorities and the general public. This work is a part of our larger efforts in the direction of employing the use of Delay & Disruption Tolerant Networking for Disaster Risk Reduction along [1][2].

One of the most immediate and significant impacts of disasters is the sudden and wide-scale breakdown or interruption of communications infrastructure [3]. When public communication networks fail, the impact can be widely felt and has the ability to wipe out access to standard mobile or landline telecommunications, in addition to Internet and even satellite-based emergency communication devices. Whether these systems are completely or just partially knocked offline, communications systems during a natural disaster can be the difference between life and death for those affected. [4] describes the emerging role of communication technologies in mitigation, preparedness, response and recovery phases of disaster management and highlight the emerging challenges in making the application of these technologies effective.

The primary technological challenge after a disaster is rapid deployment of communication systems for first responders and disaster management workers. This is true regardless of whether the communications network has been completely destroyed (power, telephone, and/or network connectivity infrastructure), or, as in the case of some remote geographic areas, the infrastructure was previously nonexistent. Deployment of a new system is more complicated in areas where partial communication infrastructures remain, than where no prior communication networks existed [5].

Locating those who may be trapped or injured becomes nearly impossible for emergency responders, and rescue efforts are further complicated by the inability to coordinate via standard methods of communication. If a cell tower is severely damaged or even knocked down, it not only causes major disruptions in the area's wireless communications but is extremely expensive to replace and will remain a significant problem until the service provider is able to get a repair crew into the affected area. Likewise, damage to fiber-optic cables can be an even greater challenge to repair. Because the cables are concealed underground, large portions of earth and roadway may need to be excavated just to pinpoint the exact location of the damage. Wireless links are also susceptible to disruption or damage during disasters, as different wavelength signals can be cut off by heavy rain, snow, or fog.

Authors in [6], present evidence of ICT use for re-orientation toward the community and for the production of public goods in the form of information dissemination during disasters. Results from this study of information seeking practices by members of the public during the October 2007 Southern California wildfires suggest that ICT use provides a means for communicating community-relevant information especially when members become geographically dispersed, leveraging and even building community resources in the process. In the presence of pervasive ICT, people are developing new practices for emergency response by using ICT to address problems that arise from information dearth and geographical dispersion.

In [7], authors sketch requirements and innovative technology for an integrated disaster management communication and information system, addressing in particular network, configuration, scheduling and data management issues during the response and recovery phases.

A report [8] establishes a framework for understanding the interaction between large urban disasters and telecommunications infrastructure, drawing upon the experiences of the 1990s and 2000s. While the majority of past research on telecommunications in disasters has focused on the emergency response phase, this article analyzes the critical role of communications infrastructure in all of phases of disaster prevention and recovery, which can stretch for years after the event. Finally, this report does not focus only on official communications channels, but is concerned with the entire universe of civil telecommunications infrastructure that plays a crucial role in crisis communications.

II. FEW INSTANCES

The Morbi dam failure, back in 1979, has been listed as the worst dam burst in the Guinness Book of Records. The book 'No One Had A Tongue To Speak' by Tom Wooten and Utpal Sandesara debunks the official claims that the dam failure was an act of God and points to structural and communication failures that led to and exacerbated the disaster [9]. The state of the art in science and communication technology might have posed a difficulty

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then but many advancements and improvements have taken place after that.

In 2014 [10], with Jammu and Kashmir under worst-ever floods in over 65 years, rescue personnel pulled all stops to help people who were marooned in different areas of the state. It was the breakdown of communication, which caused many problems. National Disaster Response Force personnel were using wireless sets and requested the public telephone and internet service provider company MTNL to set up telephone lines so that stranded people could contact their relatives.

A mock drill organized by the National Disaster Management Authority in May-June 2011 in three districts of Uttarakhand had raised many crucial questions [11]. It was found that the communication failed due to damage to roads, the kind of terrain and no alternate communication routes as nothing can actually be done to ensure completely that communication does not break during calamities. Many solutions were offered to reduce damage in the state in the event of a disaster but none was implemented which turned out to be a reason for huge losses three years later.

For several years, fishermen in Nallavadu, a coastal village in the eastern India state of Tamil Nadu, have benefited from a small telecommunications centre linked to the Internet, set up by the M. S. Swaminathan Research Centre in Chennai. The main purpose of this facility, widely cited as a successful example of the application of information and communication technologies to rural development, has been to provide access to satellite data of weather patterns in the Bay of Bengal. The Internet connection has already been credited with providing the fishermen with valuable information about anticipated storms that has saved several lives. But the warning that arrived on the morning of 26 December 2004 came by a different route. The son of one of the fishermen was in Singapore, watching a news item about the earthquake that had just occurred off the coast of Indonesia. Worried about the potential impact on his family of giant waves that were reported to be spreading across the Indian Ocean, he telephoned his sister in Nallavadu, who told him that water was already beginning to seep into her home. But without direct channels of communication, either to senior policy-makers, or to local decision-makers and the communities under threat, there was no way that this information could be spread to the tens of thousands whose lives it might have saved if it had reached them in time. Indeed the whole disaster could be described as the world's biggest failure of science communication [12].

Use of communication technologies for disaster risk management has brought players together with the aim of avoiding the effects of these phenomena on global public health. [13] analyzes discursive explanations about the use of these technologies in São Paulo, Brazil, given by specialists, managers and volunteers.

Walker in [14] explored technological solutions that need to be in place in every US state to avoid another disaster like Hurricane Katrina. Hurricane Katrina suffered not only from technological breakdowns but direct communication failures that could have been avoided. Moreover, a study [15] proposed Hurricane Katrina as an example of risk communication failure and highlighted important lessons learnt from the same.

When a terrorist struck Nice, France, on July 14, 2016, a new French government app designed to alert people failed. Three hours passed before SAIP, as the app is called, warned people in and around Nice to the danger on the city's waterfront during Bastille Day festivities [16]. But as the failure of the French app during the Nice attack illustrates, communication is almost always a problem during disasters – no matter what kind of problem it is: weather-related, an attack of some kind or even just a power outage. Effective communication, such as an evacuation alert as a hurricane approaches, can save lives.

When telecommunications experts arrived in Haiti to aid the earthquake-recovery effort in 2010, they found unimaginable devastation. The event provides a stark reminder of why disaster-communications planning and resources are vitally important — something that every government entity should heed, because one never knows when and where disaster will strike [17].

The United Nations once predicted there to be 4,270,000 Syrian refugees by the end of 2015. The humanitarian aid effort is led by UN agencies working with the national governments and a multitude of non-governmental aid organizations (NGOs). The momentous task of registering and delivering aid such as food, healthcare and education relies on an array of often innovative information and communications technology (ICT). All these digital forms of aid have one underlying dependency – and that is robust networks. None of this will actually work unless people – both the aid workers and the beneficiaries – have access to communications. Where communications was a 'nice to have' at one point, now it is a 'need to have'. The Syrian refugee crisis has engulfed the Middle East, but technology is thus proving to be an essential tool to help aid organizations support displaced people [18].

III. CONCLUSION

Going through the content above, there is no much doubt left in confirming that the first hitch in almost any disaster situation is posed by the underlying conventional communication infrastructure. The amount of damage and response time can be reduced to a large extent if a proper communication system is maintained in the first place. The delay tolerant network technology, as part of our larger work promises a huge potential in this very direction.

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