

Element A

Problem Statement:

During disasters, both natural ones and ones we inflict upon ourselves, victims often require substantial, complex, coordinated medical response. During this response, first responders often struggle to effectively communicate with each other and with medical facilities in order to efficiently address victims. If solved, this issue of communication would save lives.

Problem background/statistics:

Hurricane Maria and the recent Las Vegas shooting have demonstrated a distinct lack of preparedness in the United States disaster response system. FEMA did not have adequate communication networks to account for 95% of cell towers going down. (Long) This lack of communication combined with staffing shortages lead to unnecessary deaths among treatable victims. In hurricane Maria specifically, 2975 deaths could have been prevented through better transportation networks, hospital communication and warning response. (Goldman)

Brock Long, the administrator of FEMA, observed that during Hurricane Maria, plans for disaster response plans could not be carried out as intended due to unforeseen loss of cellular communication networks (Long). The government's response to this issue of communication between first responders has been inadequate. During 9/11, firefighters were stuck using bullhorns to communicate evacuation orders to each other, given limited range of the radios they were using. (Kerry). Congress was pressured by the National Commission on Terrorist Attacks Upon the United States to authorize a new program to strengthen communications and created the firstnet program. (Kerry) This program has been through constant delays, and there has yet to be a major improvement to the situation. (Sasso).

Validation of Problem:

Issues taking disaster communication to the 21st century have been observed by many experts. We haven't spoken to any of them yet, but there exists no satisfactory solution at the moment, as cellular based devices fail with no connection and radios have limited functionalities.

Element B:

We acquired our information by scouring the internet for examples of current solutions, but also the problems with these solutions that are limiting communications between first responders. We read over multiple disaster reports and in each case there were communication problems due to the lack of a system or procedure that resulted in many unnecessary deaths.

One of the current systems set up is a service called FirstNet which was created post 9/11. Firstnet is a government organization collaboration between the Chamber of Commerce and AT&T working to combine all first responder networks into one broadband, in order to enable large scale communication in times of disaster. It gives priority calling to those registered as first responders. Firstnet also has extra cell towers on trucks ready to roll out in cases of emergency as well as drones. Firstnet is limited in its association with AT&T. Cell phones lacking the specific sim card cannot reach the network, and can result in problems in communication that can affect the efficiency. The program has also faced delays in implementation and funding issues. (Brill)



Two ray radios are utilized by fire departments utilize the Motorola MOTOTRBO digital radios, which is waterproof, has a 15 hour battery life, all while weighing under 180 grams.

Patent Number: US5278990A

Patent Abstract: “A radio communication system includes a central station, such as a repeater for transmitting FM signals to a plurality of radios. The repeater 11 is capable of receiving both analog speech FM signals and compressed voice signals. This permits the use of energy efficient transmission schemes by some of the radios operating in the system while permitting the use of both types of transmission by the various remote radios.”



Standard radios like this can be great when coordinating short term responses, but in cases of large scale disaster, these radios are inadequate due to their one at a time nature. When large scale communication is necessary, hundreds of channels are used. Communicating specific data is hard, as each channel has its own discussions, and there is no easy way to figure out what information is available on each channel. Also somewhat expensive, costing \$75 (Brandom).

Patent Number: 6568504

Patent Abstract: A multi-purpose device for use in a wide variety of circumstances including at sporting events. The device can (1) serve as a hat or headgear, (2) it can amplify a user's voice, (3) it can be used as a hearing aid, (4) it can be used as a carrying utensil, (5) it can serve as a banner to advertise a logo, (6) it can be used as a traffic safety cone, and (7) it can serve as a Christmas ornament. The device is tubular in shape; however, the tube is larger at one end than at the other end. The small end is about the size of the



mouthpiece and the large end is several times larger than the small end. The device is made of a soft material that can fold and the inside of the device has sound reflective properties. The device is made of semi-flexible material that can support its own weight when held at the ends.

Megaphones are a simple tool that can amplify sound to allow it to travel much further, and reach places radio and cellular waves could not. The device also requires no receiver, as the sound is transmitted directly. However, it struggles in disaster situations due to not being two way. The person using the device has no way to get responses using the device. It can also only reach areas nearby, while radios can have massive ranges. Finally, in a loud and chaotic disaster, even the increased sound can often not be loud enough to reach very far, while a radio or cell phone can simply be moved directly to the ear. (Price: approximately \$100).

Element C:

After looking at the problems surrounding each current form of communication, one major issue stood out. At the moment, there is simply not enough bandwidth to support the massive amounts of communication necessary in the event of a disaster. While steps are being taken to help provide this network, it's a multibillion dollar expenditure, and out of scope. As such, we will be attempting to attack the issue from another angle. Instead of trying to improve the range of connectivity, we will instead be trying to provide first responders with additional utility in their communication besides just the speech radios give. We also need to avoid using cellular towers, as we have found that in most large scale disasters, cellular connections are both overwhelmed and destroyed. Our device must be both portable for field use and reliable without the internet. Our exact parameters we have established are as follows:

(In order of importance)

1. The device must function without direct cellular connection
2. The device must have a long battery life or not require direct power
3. The device must be cheap to produce (under \$25)
4. The device must offer some functionality not offered by current Motorola MOTOTRBO Radios
5. The device must be light enough to carry in times of disaster (less than 1kg)
6. The device must be simple to use, and require less than half an hour to gain basic operational knowledge

This project is intended to primarily be used by first responders. This includes paramedics, emergency medical technicians, police officers, firefighters, rescuers, military personnel and public workers. We want to give the tech directly to them, in order to keep the project purely for the public good. We looked into disaster reports and investigations into communication failures in order to see exactly how these problems manifested. During Hurricane Maria, the failure of cell towers was demonstrated. During 9/11, radios failed to penetrate the building, and stopped some firefighters from hearing evacuation orders.

Bibliography:

“2017 Hurricane Season FEMA After-Action Report.” *2017 Hurricane Season FEMA After-Action Report* | FEMA.gov, FEMA, 12 July 2018, www.fema.gov/media-library/assets/documents/167249.

Baziyar, Jafar, et al. “Triage Systems in Mass Casualty Incidents and Disasters: A Review Study with A Worldwide Approach.” *Open Access Macedonian Journal of Medical Sciences*, Republic of Macedonia, 12 Feb. 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6390156/.

Duhaime-Ross, Arielle, and Russell Brandom. “Why Are We Still Coordinating Disaster Relief over Radios?” *The Verge*, The Verge, 14 May 2015, www.theverge.com/2015/5/14/8607371/disaster-relief-radio-ems-fire-police.

Goldman, Lynn R. “Opinion | We Calculated the Deaths from Hurricane Maria. Politics Played No Role.” *The Washington Post*, WP Company, 17 Sept. 2018, www.washingtonpost.com/opinions/we-calculated-the-deaths-from-hurricane-maria-politics-played-no-role/2018/09/15/2b765b26-b849-11e8-94eb-3bd52dfe917b_story.html.

Kerry, Bob. “National Commission on Terrorist Attacks Upon the United States.” *Great Seal of the United States*, www.9-11commission.gov/report/.

Kipnis, Ken. “Triage and Ethics.” *Journal of Ethics* | *American Medical Association*, American Medical Association, 1 Jan. 2002, journalofethics.ama-assn.org/article/triage-and-ethics/2002-01.

Pavlus, John. “How One ER Handled Hundreds Of Las Vegas Shooting Victims At Once.” *Fast Company*, Fast Company, 9 July 2018, www.fastcompany.com/90151007/how-one-er-handled-hundreds-of-las-vegas-shooting-victims-at-once.

“Disaster Emergency Communications.” *Disaster Emergency Communications* | FEMA.gov, www.fema.gov/disaster-emergency-communications.