## Technical Barriers in Disaster Rescue Operation

Maintaining MANET connectivity and quality of service (QoS) in disaster-affected areas is one of our primary research areas. The operational range of the IEEE 802.11b WiFi is typically between 30 - 100 meters. There is a tradeoff between the WiFi power setting and the operational distance as a device transmitting at a higher power level covers a wider operational area but results in a shorter battery life. Each device's actual operational range is further limited due to other environmental factors like obstacles, debris, difficult terrains, antenna angle/orientation, and more. In certain test cases, we found the actual OLSR routing path not to be what we had anticipated. Variants in device power settings and WiFi chipsets could result in one mobile device choosing a physically farther device as its preferable MPR instead of choosing a physically nearer one.

The default OLSR implementation assumes homogenous network and does not take into account the different characteristics of the links when computing MANET routes. For example, the OLSR's neighbor discovery mechanism (i.e. HELLO) does not distinguish a next hop WiFi neighbor that transmits at 10mW from a next hop WiFi neighbor that transmits at 100mW. Likewise, it does not distinguish a regular WiFi link from a link that incidentally passes through a satellite tunnel (i.e. through the VPN bridge.) One of our research aims is to introduce link characteristic awareness into OLSR.

The use of small low-cost WiFi access points which have been flashed with OLSR firmware [9] is one of our research interests because these access point devices have been equipped with better antennas and may supplement purely as OLSR routers. We are also interested in MANET topology formation along with GPS-capable devices coupled with OLSR extension, as rescuers still have certain control over the MANET topology should they experience bad signal reception. A MANET environment has variable bandwidths, topology changes and oftentimes severe packet losses. The long propagation delay of the satellite channel also deteriorates the quality of interactive streaming audio. The common E-model [9] would predict bad-quality voice over IP (VoIP) experiences in most of our test scenarios. The need to improve the quality of video and audio streaming, especially through the uses of powerful codec and error correction methods, is highly apparent. In addition, emergency response applications must be resilient in the MANET environment.

We understand the importance of automated identification of victims and objects. Automated online identification and classification enhances rescuers' capabilities to recognize victims and objects beyond initial trainings. There have been significant research progresses in the field of human face recognition [8]. Digital images obtained from the field may appear occluded, obscured, disoriented, or distorted, making identification task difficult. Our present implementation of face image identification works on still images. We look forward to incorporating effective and efficient image/video content identification techniques as a part of our emergency response applications.

Scaling the emergency response platform to work with several disaster sites simultaneously is an important investigation. The 2004 tsunami disaster actually damaged several shores across Andaman sea and Indian ocean. MANET typically works well in small to medium sized homogenous wireless networks. We need to devise a practical way to effectively communicate among many disaster-affected sites, potentially located in different geographical regions. Additionally, equipment durability could be another concern, as rescuers may have to enter tough areas such as ones at high-altitude, having rough terrains, being underwater, or having extreme temperature/humidity.

Deploying OLSR-capable sensor equipments in DUMBONET is one of our research investigations. Sensor information allows rescuers to better judge situations when responding to specific threats. Sensor information can also be used in simulation or computational models to predict or evaluate potential outcomes or to warn rescuers of dangers.

Providing security capabilities for DUMBONET and emergency response applications is also necessary as medical and personal information will have to pass through this system. There are needs to integrate encryption, authentication, verification and access control methods into DUMBONET along with the emergency response applications.