CAREER: Enabling Operational and Reliable Data Services for Large Scale Disaster Rescue Through Integrating Communication, Computation, and Caching

Overview. The objective of this proposal is to enable the provision of operational and reliable data services for large scale disaster rescue where communication networks are usually congested or even damaged. Under this situation, traditional models that rely on centralized information processing and access become nonrealistic. This means that the critical, newest information will not reach the disaster field office and rescue staff, which will cause a lot of problems such as: a real-time road map is unavailable for the navigation of emergency rescue vehicles; the newest status about buildings in danger, people trapped inside, and the building plans are not known for making optimal rescue and evacuation plan timely; the ambulance staff are not aware of the newest residence and doctor capacity of a hospital to which seriously injured patients are sent to and cause the loss of life. To address the challenge, we propose to build a mobile cloudlet like architecture on top of the proximity service and limited wide area network access in provision of critical information generation and delivery. It requires delicate research in several areas to implement such an architecture: (i) A framework to bring together local resources in communication, computation, and storage that enables the collaboration and conflict resolutions among different resources; (ii) Scheduling, routing, and caching strategies that enable the most efficient information generation and delivery of information; (iii) Methods in achieving high reliability of information generation and delivery while handling the dynamics of resource availability.

Intellectual Merits: The proposed research advances knowledge by addressing a broad question: how to provide reliable and timely information needed by rescue operations with limited outgoing bandwidth? The principle behind the proposed mobile cloudlet architecture is to facilitate most economical data flow in merging raw data and distributing ready-to-use information to the needed destinations. The research will reveal the necessary architecture to allocate and coordinate computing and caching among multiple nodes to minimize the communication cost for both information generation and delivery.

This proposed research builds on mobile cloud computing and will explore the interactions with proximity service and information centric networking. One new challenge is to address the dynamics of computing nodes to provide reliable information service. This research will broaden knowledge in more efficient use of mobile terminals for building reliable cloudlets and extend the information centric networking research beyond named data.

Broader Impacts: The proposed research has tremendous social impacts since it will enable smooth disaster rescue and thus better effects in saving life and protecting property. This fundamental research in mobile cloudlet will unveil the capability of real-time information generation and spreading with the least infrastructure support. The ns3 simulation modules and testbed regarding LTE proximity service based mobile cloudlet to be shared to the research community will provide a valuable platform for other researchers to evaluate or validate their research in proximity service or mobile cloudlet. The simulation modules and the testbed will be expanded to include education modules targeting: (i) Motivating minority and female students toward a computing and networking related major, through the PI's participation in an educational outreach program. (ii) Raise the interest in practical hardware centered programming targeted at a wide audience within the University of Wisconsin-Whitewater, in which engineering-oriented education is scarce; (iii) Enhance the awareness of disaster rescue and core technologies among general audience in our community through seminar at UW-Whitewater in Monona .