Optimal Resource Planning for Situational Information Extraction During Post-Disaster Scenarios

A thesis submitted for the degree of
Doctor of Philosophy

by

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July 8, 2022

Abstract

In the case of large-scale post-disaster scenarios, telecommunication (cellular/internet) and other public infrastructures (such as roadways, power lines, and others) are often damaged or non-operational. Such breakdown of telecommunication and public infrastructures prevents the rescue workers from communicating the situational information among different stakeholders such as rescue volunteers, coordination centres, disaster management personnel, and others in the disaster area seamlessly. In such scenarios, a temporary communication infrastructure that can be formed by utilizing portable network resources such as smartphones, unmanned aerial vehicles (UAVs), portable communication towers, etc., is a promising solution to fulfil the communication gap among different stakeholders in the disaster area. However, the deployment of such communication infrastructure is often challenged by the limited availability of network resources. Such limited availability of network resources occurs in case of low economy zones, where there is limited budgetary to deploy post-disaster communication network, or in cases where the disaster area is very large. Such challenges are not focused on the existing research. Again, in the recent past, portable hand-held devices, like smartphones, tablets, etc., have been utilized for collecting and opportunistically disseminating situational information in offline mode among the stakeholders during post-disaster scenarios due to their standalone battery power and ease of use. However, such hand-held devices have limited resources (battery power and processing power) for processing the data. Thus, when a large amount of data is generated in the disaster area, it is very challenging to collect concise, useful, and actionable information utilizing such hand-held devices. Thus, to do this in such devices there is a need for a lightweight and energy-efficient data filtering and summarization approach. However, to the best of our knowledge, there is no such existing research to fulfill such need.

To address the above challenges, in this thesis, *firstly,* We propose designing novel strategies that rationally and intelligently make the deployment of the *limited* set of network resources in the disaster area to create efficient network infrastructure for post-disaster communication under the resource-constraint scenarios. *Secondly,* to analyze the feasibility of the proposed approaches, we design a small-scale pilot deployment by addressing the implementation level challenges; we also design a software-based tool that gives a near-optimal plan for deploying the available network resources to form a post-disaster communication infrastructure when the number of available network resources and disaster area map is given. *Thirdly,* we design a resilient topology of multi-UAV networks by utilizing a minimum number of UAVs to ensure reliable end-to-end communication services to the wireless devices (or ground users) in the disaster area that is robust against any kind of UAV node failures. *Fourthly,* we design four classes of energy-aware text summarization approaches which can run in hand-held devices sustainably while maintaining a trade-off between energy efficiency and summary quality.