Distributed Service Recovery for Open Information Gateway

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Abstract

Successful disaster response requires collaborations among many parties, including telecommunication service providers, web service providers, rescue agencies, rescue coordinators and general public. When a disaster occurs, physical and network infrastructures in affected areas may be severely damaged or simply unavailable. How to enable information exchanges among victims, rescuers, and decision makers is one of the most critical challenges.

It is unquestionable that the research community and industry should continue their efforts to develop new sensing technologies and affordable communication devices for disaster rescue. In the meantime, how to assure that existing and widely available (tele-)communication devices can be federated into disaster management systems in harmony is critical to rescue efforts. This is the motivation of our research on how to recover the communication network and assist victims and rescuers to communicate with each others during and after disasters, how to orchestrate the information and facilitate their flows to their destinations, and how to acquire the information in timely manner. This work is aimed at the design and prototype of a distributed middleware called Open Information Gateway (or OIGY for short) that can enhance responsiveness and availability of information exchanges for disaster response.

Specifically, a major thrust of our work is directed towards information exchange services provided by ISDM (Information Systems for Disaster Management) to support effective rescue. Before issuing rescue operations in response to urgent disastrous situations, acquiring current and accurate data is most critical. In general, data are gathered from a collection of pre-installed or quickly-deployed sensor devices, monitoring stations and satellite images, as well as civilian witness reports. Each of the data sources has its individual characteristics, including its physical properties (e.g. proximity of observation location), temporal properties (e.g. how often data are reported), numerical properties (e.g. sensitivity and capability), and even rational properties (e.g. observations under human emotional stress). An ISDM must be able to select and integrate data from multiple sources into a coherent information service. Such a service must take into account the timeliness and run-time service composition of each an information exchange and must be sufficiently resilient even when physical and network infrastructures in disaster-affected areas are severely damaged or unavailable.

This presentation will first discuss the challenges in building an OIGY. Timeliness, scalability, and availability are desirable features of information exchange services. How to exchange information between parties in a mega-scale disaster management system is one of the fundamental challenges to overcome in order for the system to be effective in supporting timely and effective disaster response and relief. The presentation will then describe key components of OIGY, including communication protocols and distributed service recovery algorithms. The algorithms aim at recovering real-time publish-subscribe services without the global information on network topology, available service brokers, and publish/subscription databases. To evaluate the merits of the distributed algorithms, we will compare its performance with that of centralized/landmark-based algorithms.

Keywords: Information Exchange, Public-Subscribe Service, Disaster Response and Rescue