Chapter 27
Knowledge as a Service Framework for Collaborative Data Management in Cloud Environments – Disaster Domain

Katarina Grolinger
Western University, Canada

Miriam A. M. Capretz
Western University, Canada

Emna Mezghani
Université de Toulouse, France

Ernesto Exposito
Université de Toulouse, France

ABSTRACT

Decision-making in disaster management requires information gathering, sharing, and integration by means of collaboration on a global scale and across governments, industries, and communities. Large volume of heterogeneous data is available; however, current data management solutions offer few or no integration capabilities and limited potential for collaboration. Moreover, recent advances in NoSQL, cloud computing, and Big Data open the door for new solutions in disaster data management. This chapter presents a Knowledge as a Service (KaaS) framework for disaster cloud data management (Disaster-CDM), with the objectives of facilitating information gathering and sharing; storing large amounts of disaster-related data; and facilitating search and supporting interoperability and integration. In the Disaster-CDM approach NoSQL data stores provide storage reliability and scalability while service-oriented architecture achieves flexibility and extensibility. The contribution of Disaster-CDM is demonstrated by integration capabilities, on examples of full-text search and querying services.

INTRODUCTION

Each year, a number of natural disasters strike across the globe, killing hundreds and causing billions of dollars in property and infrastructure damage. As the number of such events increases, minimizing the impact of disasters becomes imperative in today's society.

DOI: 10.4018/978-1-4666-9840-6.ch027

The role of information and communication technology in disaster management has been evolving. Large quantities of disaster-related data are being generated. Behavior of critical infrastructures is being explored through simulation, response plans are being created by government agencies and individual organizations, sensory systems are providing potentially relevant information, and social media (Twitter, Facebook) have been flooded with disaster information (Hristidis, Chen, Li, Luis, & Deng, 2010). Traditional storage and data processing systems are facing challenges in meeting the performance, scalability and availability needs of Big Data. Current disaster data storage systems are disparate and provide few or no integration capabilities and limited potential for collaboration. To meet the needs of Big Data and make the most of available information, a reliable and scalable storage system supported by information sharing, reuse, integration, and analysis is needed.

Another vital element of a successful disaster management is collaboration among a number of teams including firefighters, first aid, police, critical infrastructure personnel, and many others. Each team or recovery unit is responsible for performing a well-defined task, but their collaboration is essential for decision-making and execution of well-organized and successful recovery operations. Such diverse disaster participants generate large quantities of heterogeneous data, making information gathering, storage, and integration especially challenging.

The activities of various disaster participants can be observed through four disaster management phases, as illustrated in Figure 1: mitigation, preparedness, response, and recovery (Coppola, 2011). *Mitigation* includes all activities undertaken to reduce disaster effects by avoiding or decreasing the impact of a disaster. The *preparedness* phase is concerned with preparing for disaster occurrence and includes activities such as planning, establishing procedures and protocols, training, and exercises. The transition from the preparedness to the response phase is triggered by disaster occurrence. The *response* is focused on addressing the direct, short-term effects of a disaster and includes immediate actions to save lives, protect property, and fulfill basic human needs. The transition to the *recovery* phase starts when the direct disaster threat subsides and includes activities focused on bringing society into a normal state. The approach presented in this chapter carries out both data collection and delivery through all four phases; however, the focus is on data collection during the mitigation and preparedness stages,

Figure 1. Disaster management phases