Chapter 27
Framework for Graphical User Interfaces of Geospatial Early Warning Systems

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ABSTRACT

An important component of Early Warning Systems (EWS) for man-made and natural hazards is the command and control unit's Graphical User Interface (GUI). All relevant information of an EWS is concentrated in this GUI and offered to human operators. However, when designing the GUI, not only the user experience and the GUI's screens are relevant, but also the frameworks and technologies that the GUI is built on and the implementation of the GUI itself are of great importance. Implementations differ based on their applications in different domains but the design and approaches to implement the GUIs of different EWS often show analogies. The design and development of such GUIs are performed repeatedly on some parts of the system for each EWS. Thus, the generic GUI framework of a geospatial EWS for tsunamis is introduced to enable possible synergistic effects on the development of other new related technology. The results presented here could be adopted and reused in other EWS for man-made and natural hazards.

INTRODUCTION

As part of an Early Warning and Mitigation System (EWMS), the Decision Support System (DSS) provides processing, assessment, visualization, decision support, analysis, warning and management functions for the purpose of supporting disaster management related activities regarding threats (Raape et al., 2010) of natural or man-made hazards such as tsunamis. Thus, the DSS is intended to help the officer on duty to become aware of a current situation, to assess incoming information, to exploit synergies of information fusion and analysis, to assess the impact and consequences and to make informed decisions (Raape

DOI: 10.4018/978-1-4666-2038-4.ch027

et al., 2010). As a result, the DSS and especially its user interface are taken into account for a tsunami EWMS initially designed and implemented in the project Distant Early Warning System (DEWS). Hammitzsch et al. (2010) outline that the DEWS project has the objective of creating a new generation of interoperable early warning systems based on an open sensor platform. This platform integrates Open Geospatial Consortium (OGC) Sensor Web Enablement (SWE) compliant sensor systems for the rapid detection of hazardous events, such as earthquakes, sea level anomalies, ocean floor occurrences and ground displacements for the case of tsunami early warnings. Based on the upstream information flow, DEWS focuses on the improvement of downstream capacities for warning centers, especially by improving information logistics for effective and targeted warning message aggregation for a multilingual environment. Even though DEWS was primarily focused on tsunami early warning in the Indian Ocean region, Lendholt and Hammitzsch (2011) explain that the system offers a modular design that serves as a reference architecture for early warning systems independent of the hazard type and region. A generic reference architecture for early warning systems should have components designed for serving in new deployments and new sites without re-programming or compilation procedures. Instead, deployment-specific add-ons or plug-ins should be easy to add in a configurable system based on the needs of a specific scenario. This means, also, that the user interface has to be not bound to specific hazard characteristics and must be developed and implemented independently from specific infrastructure characteristics. Wächter et al. (2011) report that these developments are resumed and continued by the project Collaborative, Complex, and Critical Decision-Support in Evolving Crises (TRIDEC, TRIDEC 2010) focusing on real-time intelligent information management and including the design and implementation of a robust and scalable service infrastructure supporting the integration and utilization of existing resources with accelerated generation of large volumes of data.

METHODOLOGY

After providing the motivation for the presented results and the application of free and open source software (FOSS), the technological framework for a command and control unit's GUI to be applied in each EWS for man-made and natural hazards is introduced with a simplified architecture for the Command and Control User Interface (CCUI) used in natural crisis management (NCM) for tsunamis developed in DEWS and TRIDEC. In this context, the selected GUI frameworks and geo frameworks are introduced together with an application oriented Geographic Information System (GIS) and the relevant standards and technologies.

MOTIVATION AND PRECONDITIONS

In 'The Global Survey Of Early Warning Systems,' Annan (2006) concludes that considerable shortcomings and gaps remain, especially in developing countries, where basic capacities, equipment and resources are often not available. The UN (2006) reports that systems for some hazards, such as tsunamis, are often absent. In this regard, Löwe et al. (2011) summarize that the Boxing Day Tsunami of 2004 killed over 240,000 people in 14 countries and inundated the affected shorelines with waves reaching heights of up to 30 m. Whereas tsunami early warning capabilities have improved in the meantime by continuing the development of modular Tsunami Early Warning Systems (TEWS), recent tsunami events, such as the Chile 2010 and the Honshu 2011 tsunami, demonstrate that there are still shortcomings in the systems. Furthermore, most of the disaster management systems currently in place are proprietary systems (Chen et al., 2010). These proprietary systems are, however, challenged by limitations such as high

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