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A Ubiquitous Urgent Computing Framework for Ensembles of Flash Flood Forecasts

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Flash flood is a common weather abnormality that plagues many countries including Germany. It is arguably the most dangerous type of floods as it can form swiftly due to high or extremely high rainfall rates with little or no prior warning. According to the findings of a flood risk assessment study [1] carried out by the European Commission (EC) Joint Research Centre (JRC), the frequency and damage of floods in Europe are expected to increase sharply over the next decades. In Germany, it is expected that 170,000 to 323,700 of the population to be affected by the floods with a damage of 5.3 to 33.9 billion EUR in 2080.

Flash flood numerical forecasts can generate information and provide predictions to facilitate the process of making timely decisions for managing affected areas and reduce casualties. If the forecasts have to be computed within a (short) required timeframe, this class of computing is referred to as urgent computing [2]. Urgent computing enables responsible authorities to make educated decisions by providing simulated predictions of disasters, the impact and required evacuation zones, etc., within a small lead time.

The need to access the framework from anyway and at anytime, leads to the construction and implementation of a task-based ubiquitous (TbU) approach [3]. This approach facilitates access to the underlying distributed resource sets from ubiquitous end user device, which is particularly crucial in the chaotic environment that entails a disaster. The inherent unpredictability of disasters can render any best made plans to prepare resources in advance futile.

Additionally, due to the inherent uncertainties in most forecast models, stochastic methods based on an ensemble of forecasts are recommended. Enabling multiple forecasts with varying execution time to complete within a deadline, require a number of different resources. It is thus also essential to acquire the ability to swiftly organise a set of resources, while facing uncertainty in computation requirements and dynamism of computing environments on heterogeneous distributed resources. Consequently, an adaptable framework that can swiftly and effectively manage and allocate multiple resources for such computations is designed.

Thus, a ubiquitous urgent computing framework is designed to efficiently allocate ensembles of forecasts on a set of heterogeneous distributed resources robustly and reliably in an energy aware manner [4]. E-Infrastructures [5] like PRACE and EGI, are good candidates to integrate this framework.

1. EM-DAT The International Disaster Database, Centre for Research on Epidemiology of Disasters – CRED, Belgium, viewed 5 November 2015, < http://www.emdat.be/>
2. S. H. Leong and D. Kranzlmüller. Towards a General Definition of Urgent Computing. In ICCS, volume 51 of Procedia Computer Science, pages 2337 – 2346. Elsevier, 2015.
3. S. H. Leong and D. Kranzlmüller. A Task-based Ubiquitous Approach to Urgent Computing for Disaster Management. In ICT-DM, 2015. To be Published.
4. S. H. Leong and D. Kranzlmüller, "Robust Reliable Energy-Aware Resource Allocation Heuristics on Distributed HPC Resources for an Urgent Computing Ensemble Forecast," Submitted.
5. S. H. Leong, A. Frank, and D. Kranzlmüller. Leveraging e-Infrastructures for Urgent Computing. In ICCS, volume 18 of Procedia Computer Science, pages 2177–2186. Elsevier, 2013.

Summary

A ubiquitous urgent computing framework for ensemble flash flood forecasts that can potentially leverage on distributed e-Infrastructures, e.g. PRACE and EGI, is shared.

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