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Middleware support for Decision Support Tools in Water Engineering

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Impact

Water is an increasingly valuable resource. Utilities that provide this resource to customers need to provide a safe and reliable product while keeping costs to the customer as low as possible. There are also pressing enviromental issues, as water becomes an increasingly scarce resource (particular in hot summers produced by climate change). For example leakage accounts for between 25% and 30% of water use in the UK. Not only is this wasteful but also the leakage can compromise the networks by loosening the soil in which it is embedded. In the work we descibe, software developed by research projects in the UK e-Science programme is being trialled in real engineering situations. We have given reasons why the existence of large amounts of computational power is essential to this effort, but this power must be harnessed within a framework that provides information that is useful to a distributed workforce. This has produced a number of insights that are of interest in the future development of middleware to support large scale distributed computing.

References

"Bringing simulation to engineers in the field: a Web 2.0 approach", R. Haines, K. Khan, J.M. Brooke, Philosophical Transactions of the Royal Society A, 2009

"A Distributed Computing Architecture to Support Field Engineering in Networked Systems Software Intensive Systems". K. Khan, R. Haines, J. M. Brooke, in Proceedings of the 4th International Conference on Complex, Intelligent and Software Intensive Systems (CISIS 2010), Feb 2010, Krakow Poland.

"Predictive Decision Tool for Lightweight PDA Devices to Optimize Operation Work on Water Distribution Network", K. Khan, R. Haines, and J. Brooke, Proceedings of 3rd Biennial Conference of the UK Network on Potable Water Treatment & Supply, 2009

URL

http://www.cs.manchester.ac.uk/~jbrooke/water

Summary

Water distribution networks are large and complex engineering structures that require maintenance and intelligent operation to prevent customer complaints and wastage of an increasingly precious resource. This paper describes a collaboration between water distribution companies and Grid reseachers to apply methods of distributed computing to monitor and control water networks. This involves the integration of data from sensor networks with grid computing resources and the development of middleware that can enables field engineers working with mobile devices to access and visualize information from the processing of the sensor data to support them in their engineering decisions. This involves answering "what-if" questions, e.g. "what would happen if I open this valve", "at what speed should I open this valve so that I do not increase the flow too abruptly causing contamination by sediment."

Description

Since most of a water distribution network is underground and inaccessible, sensors can only be placed at certain points in the network. Substantial computation is needed to convert the readings of the sensors into a usable prediction of the actual flows and pressure in the networks. We also need to take into account major uncertainty about the actual state of the water network, pipes may be badly corroded, pipes may not be in the expected position because information was incorrectly recorded when they were installed. Grid and cloud computing can supply large amounts of processing power for ensemble simulations that can model this variability, this is very similar in concept to the data assimilation computing used in weather forecasting. However, even if this is done, the results may be too complicated for the needs of engineers who need to make decisions in the field. They typically have mobile devices (e.g. laptops, tablets) that can access the results from the Grid. In our work we have built an interface between the Grid component of the modelling and the mobile devices that uses the principles of distributed computing architectures (e.g REST, reliable messaging) to keep the engineers devices in touch. We have also build visualization tools that run on the mobile devices to display the results of the Grid simulations in a form that is directly useful to the field engineers. Our software is currently being evaluated by water utilities in the UK and we will present in results from these trials. Our work has also highlighted important issues in distributed computing, principally the middleware support required by a workforce using mobile devices that connect to simulations hosted on Grid and Cloud resources.

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