Mobile Environmental Sensing System Across Grid Environments

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MOTIVATION

Understanding the generation, distribution and impacts of urban and regional air pollution is a major scientific challenge. The transportation sector is a significant source of air pollution and consequently air quality considerations feature heavily in transport policy (e.g. London Low Emissions Zone). However, both academic and practical work is limited by a lack of data of adequate temporal and spatial granularity. Current trends in sensor, communications and computing technologies open up enormous opportunities for pervasive, high-resolution data capture from portable devices. The MESSAGE consortium, lead by Imperial College London, has brought together internationally leading (6* and 5*) specialist research groups in the fields of eScience, transport, sensors and communications technologies from Imperial, Cambridge, Leeds, Newcastle and Southampton. In partnership with our non-academic collaborators we are addressing the challenge of how to most effectively capitalise on this simultaneous improvement in both the quality and availability of data.

A MOBILE WIRELESS SENSOR NETWORK

The project has developed and demonstrated the potential of diverse, low cost sensors to provide data for the planning, management and control of the environmental impacts of transport activity at urban, regional and national level. This includes their implementation on vehicles and people to act as mobile, real-time environmental probes, sensing transport and non-transport related pollutants and hazards.

Three sensor platforms have been developed as part of the project. Cambridge are investigating the potential for personal devices (mobile phones) to support a sensing system. Newcastle have developed a “smart-dust” network using Zigbee (IEEE 802.15.4) motes, while Imperial have devised a network that utilises WiFi (IEEE 802.11.g) and WiMax (IEEE 802.16) technologies for communications and positioning, and a set of novel sensor designs. All platforms integrate with a common data processing system (see right).

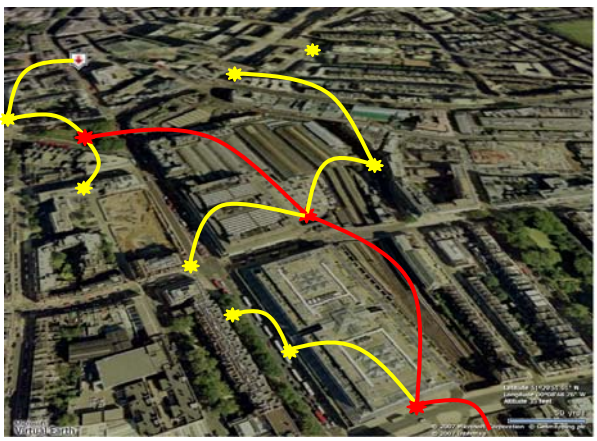

FIGURE 1 Vehicle-based Ad hoc mobile Network (VANET)

FIELD TRIALS

Field trials have been taking place throughout the project to aid in the development of the system and to investigate specific areas of interest to both academic and non-academic project participants. The table below summarises the characteristics of the major forthcoming sensor deployments:

	London	Gateshead	Leicester	Cambridge
Mobile Sensors	Gusto (5-10) & Motes (<50) & Mobile phone (10)	Motes (10) with GPS	Motes (50) with GPS	Mobile phone with sensor payload (30)
Static Sensors	AQM (~90)	Motes (40)	Motes (100)	AQM (5)
Main objectives:	High resolution mobile sensing	RT pervasive sensing & comms	RT pervasive sensing & comms	Pervasive personal sensing
	Dynamic Env. Modelling	Integrate data-bases/models	Integrate with Leicester UTC	Integrate with TIME-EACM
	Information & Traffic control	Smart market demand mgt.	Real-Time traffic control	Enhanced mobile phone
Parameters	NO_2, NO, O_3, SO_2, C_6H_6, °C, Humidity	CO, NO_2, noise, °C, humidity/pressure	CO, NO_2, noise, °C, humidity/pressure	CO, CO_2, NO_2, noise

TABLE 1 Overview of field trial characteristics

eSCIENCE & DISTRIBUTED GRID COMPUTING

The project has developed a single eScience infrastructure to support a wide range of scientific, policy-related and commercial uses and applications for the sensor data. This is being used to demonstrate the operation and utility of this infrastructure in selected case study applications as identified during requirements capture. This also includes integration with a variety of external data sources and use of a scalable grid computing architecture (see Figure 2). Specific research objectives include the investigation of techniques for in-network data mining, distributed on-demand processing of real-time environmental models and the development of workflows to support specific analyses (see Figures 3 and 4).

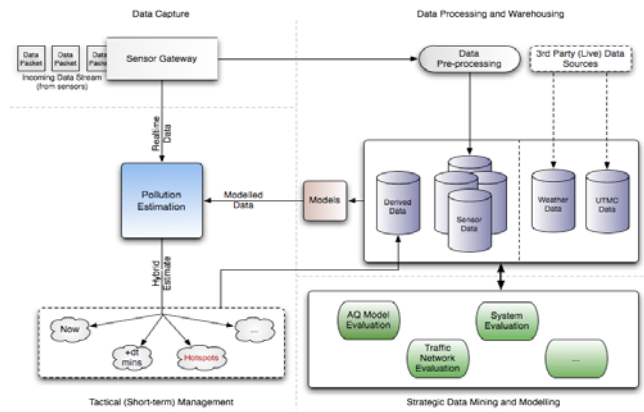

FIGURE 2 MESSAGE eScience architecture

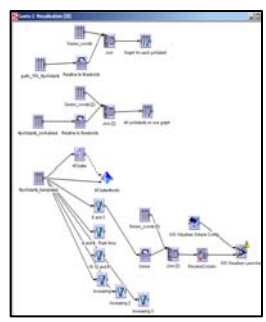

FIGURE 3 Workflow structure

FIGURE 4 Visualisation of simulated data

ACKNOWLEDGEMENTS

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