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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, brings 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 will address 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 will develop and demonstrate 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 will be developed as part of the project. Cambridge will investigate the potential for personal devices (mobile phones) to support a sensing system. Newcastle will develop a "smart-dust" network using Zigbee (IEEE 802.15.4) motes, while Imperial will devise 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 will integrate with a common data processing system (see right).



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

### eSCIENCE & DISTRIBUTED GRID COMPUTING

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

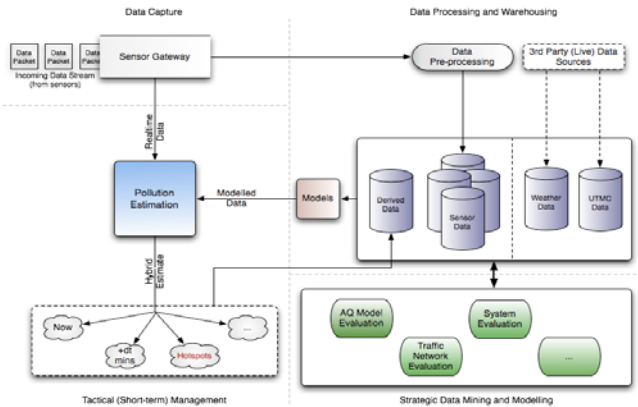


FIGURE 2 MESSAGE eScience architecture

### FIELD TRIALS

Field trials will take 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 sensor deployments:

|                      | London  | Gateshead  | Leicester  | Cambridge   |
|----------------------|---|--|--|---|
| Mobile Sensors       | Gusto (5-10) & Motes (<50)  | Motes (100) with GPS   | Motes (<100) with GPS  | Mobile phone with sensor payload (25)                   |
| Static Sensors       | AQM (~90)   | Motes (200)  | Motes (200)  | AQM (5)   |
| Main objectives:     | RT. sensing & comms   | RT pervasive sensing & comms   | RT pervasive sensing & comms   | RT Pervasive sensing & comms                            |
|                      | Dynamic Env. Modelling  | Integrate databases/models   | Integrate with Leicester UTC   | Integrate with TIME-EACM                                |
|                      | Information & Traffic control                                       | Smart market demand mgt.   | Real-Time control  | Mobile phone network                                    |
| Candidate Parameters | CO, CO <sub>2</sub> , NO <sub>2</sub> , SO <sub>2</sub> , noise, °C | CO, CO <sub>2</sub> , NO <sub>2</sub> , SO <sub>2</sub> , noise, °C, humidity/pressure | CO, CO <sub>2</sub> , NO <sub>2</sub> , SO <sub>2</sub> , noise, °C, humidity/pressure | CO, CO <sub>2</sub> , NO <sub>2</sub> , SO <sub>2</sub> |

TABLE 1 Overview of field trial characteristics

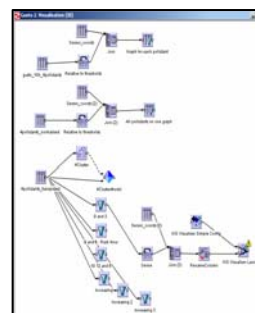


FIGURE 3 Workflow structure

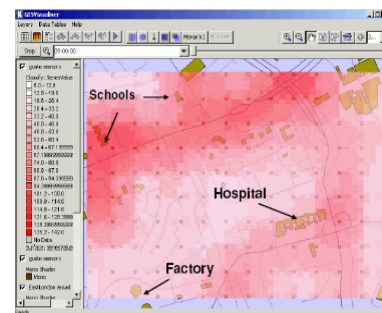


FIGURE 4 Visualisation of simulated data

### ACKNOWLEDGEMENTS

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