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Smart Transport for Smart Cities: Challenges and Opportunities

Professor John Polak
Chairman, Centre for Transport Studies
Director of Research, Department of Civil and Environmental Engineering
Director, Low Carbon Cities Programme, Climate-KIC
Imperial College London
j.polak@imperial.ac.uk

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Questions

- How can we be smarter in our management of urban mobility?
- What lessons can we learn from the experience of Intelligent Transport Systems?
- What are key challenges and opportunities?
- What are the next steps?

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The context of urban mobility

- Cities are pivotal
  - Majority of the world's population already live in cities, and this trend is accelerating
  - Cities directly and indirectly account for ~70% of CO_2 emissions
  - Cities of the crucibles of economic, institutional and cultural value
- Cities are uniquely vulnerable
  - Ageing and inadequate infrastructure and supply networks
  - Natural hazards
  - Hostile threat
- Cities are under enormous pressure to change
  - Broken functional and governance models (e.g., transport, healthcare, water resource management)
  - Economic transformation
  - Adaptation to climate change

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Intelligent transport systems

"The application of advanced sensor, computer, electronics, and communication technologies and management strategies - in an integrated manner - to increase the safety and efficiency of the surface transportation system"

UK Department for Transport

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50 years of ITS in Cities

- ITS has a long and largely very successful history of application in urban areas, e.g.:
  - 1960s: Isolated adaptive traffic signal control
  - 1970s: Area wide coordinated traffic signal control
  - 1980s: Fleet management systems
  - 1990s: Automatic payment systems
  - 2000s: Public transport information systems
  - 2010s: Personal navigation systems
- We can learn some important lessons from this history, to help us shape the future

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Some key lessons

- Increasing convergence across sectors:
  - Transport
  - ICT
  - Automotive
  - Defence and security
  - Energy
  - Retail
- Increasing complexity and scope of the problems being addressed
  - Congestion
  - Business efficiency
  - Air quality
  - Climate change
  - Economic competitiveness
  - Threat, vulnerability and security
- Maturity means solutions that are technology-enabled but demand-led
- In the end what matters is decision support

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Key challenges

- Holistic understanding
  - Traditionally, the different sub-systems within cities (e.g., transport, water, waste, energy etc.) have been developed and operated independently
  - This is no longer a tenable approach – we need the capability to understand cities holistically
- Having the right information
  - To support this holistic perspective we need a step change in the information available on the function and performance of cities and the activities within them, both historic and real time
- Taking the right decisions
  - New understanding and data need to be translated into effective decision support that catalyses behavioural innovation and adaptation
  - This capability needs to be available at all levels from the individual citizen to corporate and government entities

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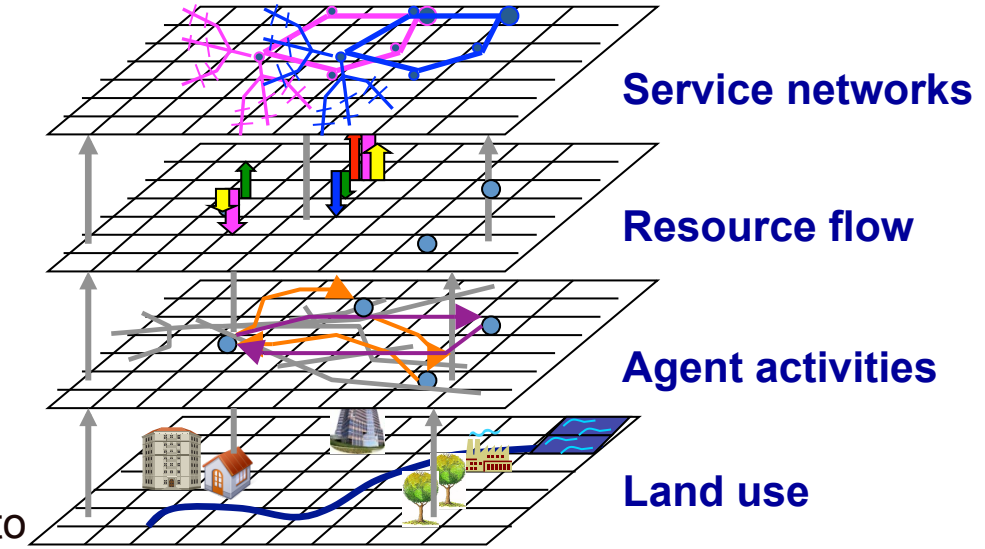
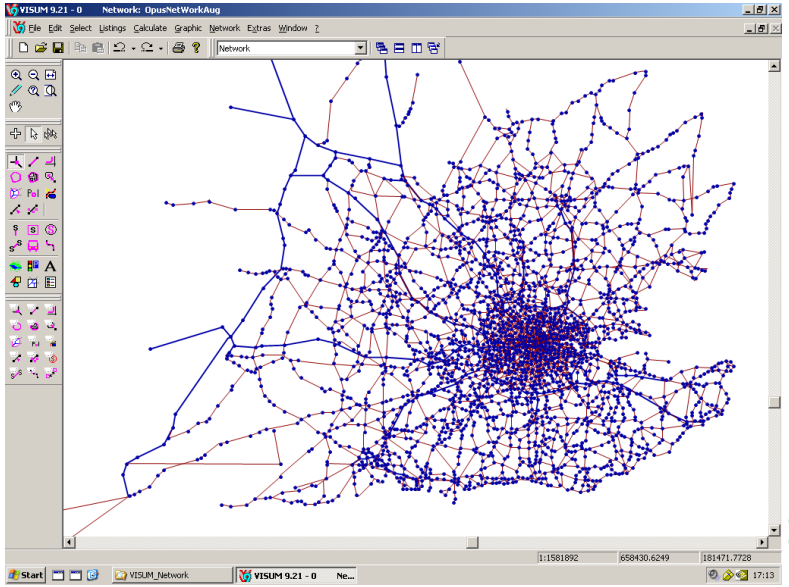
Urban Energy Systems

- **Vision**
  - 5 year research programme, funded by BP
  - Create integrated model of energy supply, distribution and use in a city
  - Quantify benefits of integrated design
  - Identify pathways to implementation
- **Implementation**
  - Develop novel agent-oriented model linked to design optimiser
  - Leveraging state of the art methods in transport, land use and energy systems modelling
- **Application**
  - A number of case study applications are underway both ‘new build’ and existing cities (including London, Atlanta, Beijing and Lingang)





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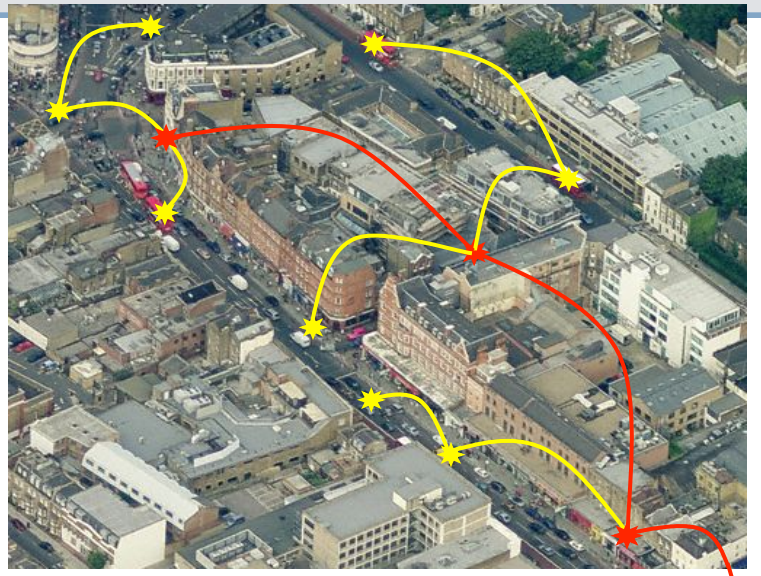
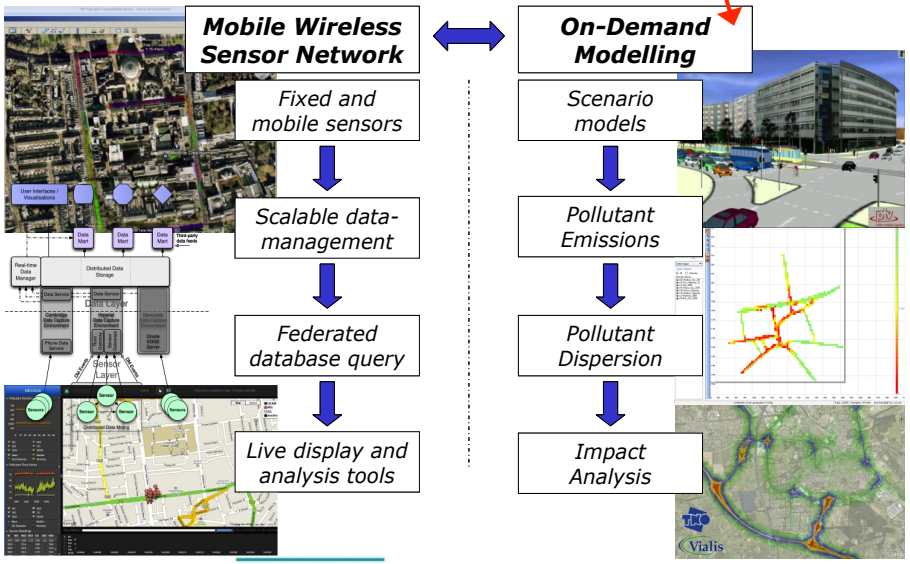
MESSAGE

- **Vision**
  - Create an entirely new type of data collection infrastructure to manage traffic related emissions to support research and practice
- **Implementation**
  - Network of heterogeneous fixed and mobile air quality sensors on infrastructure, vehicles and people
  - Sensors communicate via wireless networks
  - Positioning via GPS + wireless & cellular ranging
  - Integration of processing along the data path
- **Application**
  - Improved pollution hot spot prediction, detection and mitigation for Transport for London
  - Improved air quality information for individual travellers





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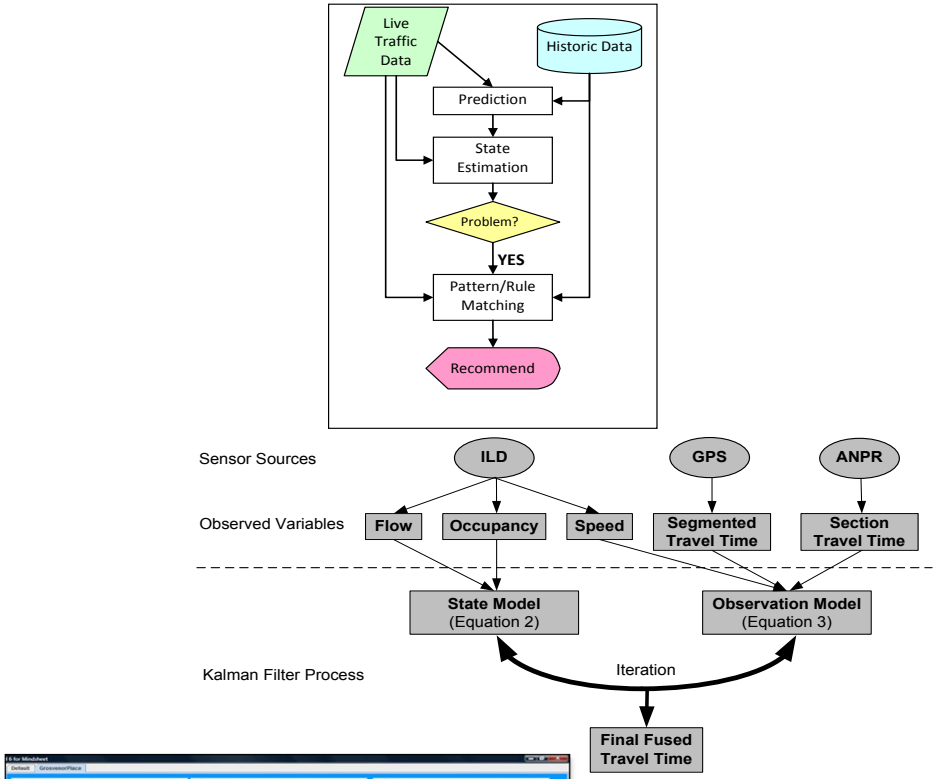
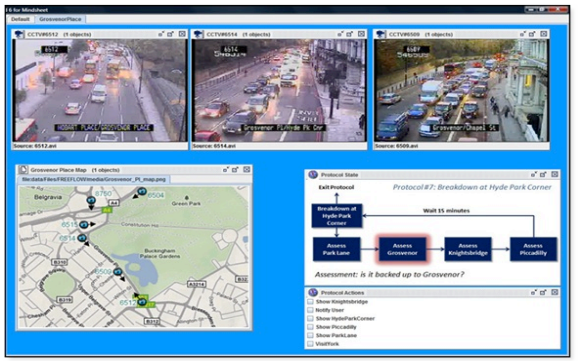
FREEFLOW

- **Vision**
  - Develop a platform for traffic intelligence, leveraging military situational awareness technologies
- **Implementation**
  - Traffic sensor processing and data fusion + network state estimation and prediction (e.g., where are the queues/incidents, are they growing or clearing, where will the next problem occur?)
  - Strategy development and selection (e.g., what should we do, what worked in the past, what does modelling tell us?)
  - Tools for integration, visualisation and collaborative decision support (e.g., how do I get at and use all this intelligence?)
- **Application**
  - Case study applications (including London, York and UK motorway network)





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What next?

- A pervasively sensed world will generate massive amounts of data – states, processes, intentions, preferences, perceptions (w.r.t. infrastructure systems, assets, services, money and people)
- The most useful innovation will happen at the edges not at the centre
- Innovators need access to these data and their semantics but shielding from the underlying sensor technologies
  - Traditional middleware and mash-up technologies serve particular data to particular applications
  - But they lack an understanding of the semantics of the whole
  - We need a capability that abstracts the data but encapsulates the semantics
  - And which adds value by means of exploiting structural knowledge to provide a predictive capability

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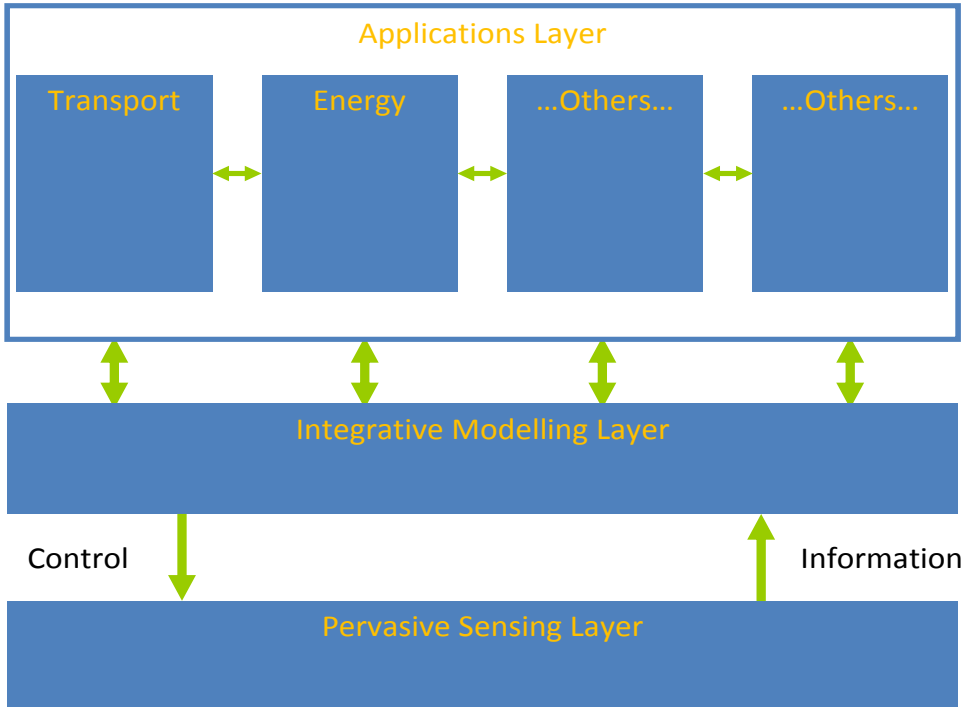
Digital City Exchange

- **Vision:** Demonstrate how existing and new transport and energy data streams can support the development of new applications and services
- **Implementation**: Develop an *integrative layer* that understands the semantics transport and energy networks ('OS for the city')
  - Coherent but extensible multi-scale model of urban systems
  - Sensor data assimilated into the model
  - Model capable of generating short term predictions
- **Outputs**: IL + business cases + pilot applications for e.g.,
  - Personalised energy management transport and space heating
  - Home delivery scheduling and re-scheduling
- **Partners**
  - Transport for London, Sainsburys, National Grid, Arup and others…



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Thank you