

WINES II Project
Smart Infrastructure:
**Wireless sensor network system for condition assessment and
monitoring of infrastructure**

Imperial College
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Ageing Engineering Infrastructure

- **Water Supply and Sewer Systems**

- Thames Water

- 31,000 km of pipelines
 - 1/2 more than 100 yrs old, 1/3 more than 150 yrs old, ~30% leakage

- *Difficulties in implementing RTC with conventional technologies*

- **Tunnels**

- London Underground (LUL)

- Tunnels 75 – 100 yrs old
 - Deterioration of linings
 - Minimal clearance to tunnel wall
 - Risks from 3rd party construction

- *Four of the UK's busiest road tunnels are among the 10 most dangerous in Europe (Blackwall Tunnel)*

- **Bridges**

- Highway Agency/LUL/ Humber Bridge

- ~150,000 bridges in UK
 - Critical links in road/rail infrastructure
 - Deterioration
 - Many structures below required strength



Oxford Street



LUL tunnel



Blackwall Tunnel



Collapsed Tunnel



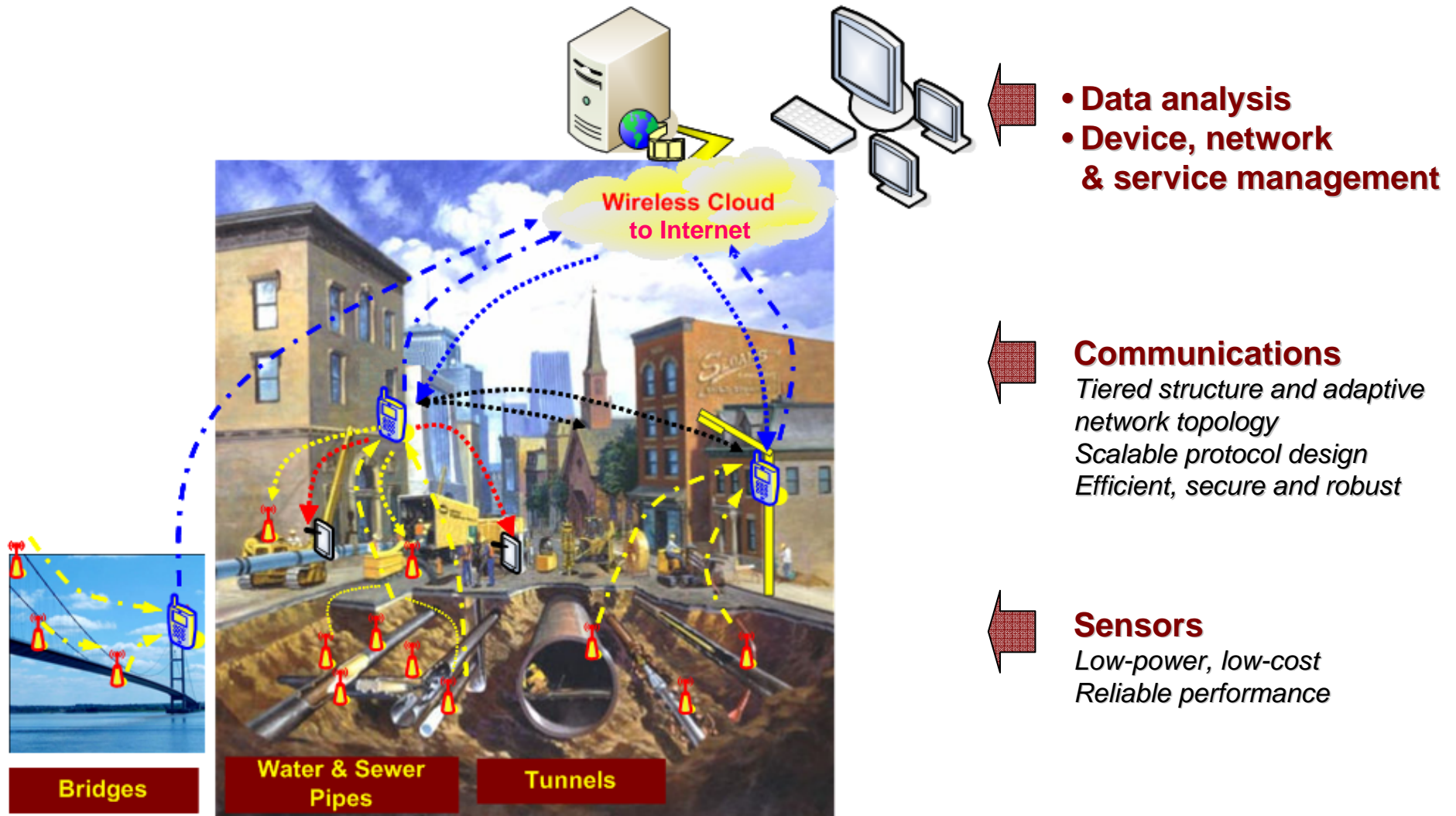
The Humber Bridge



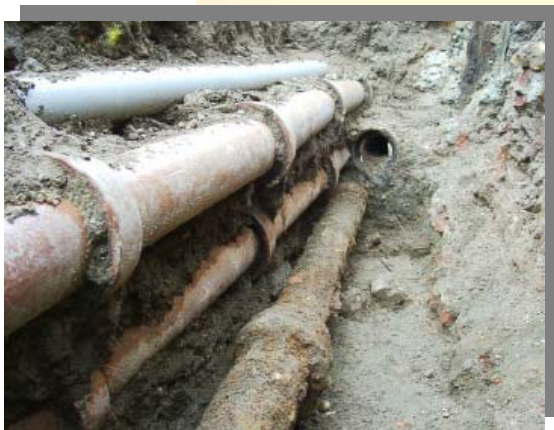
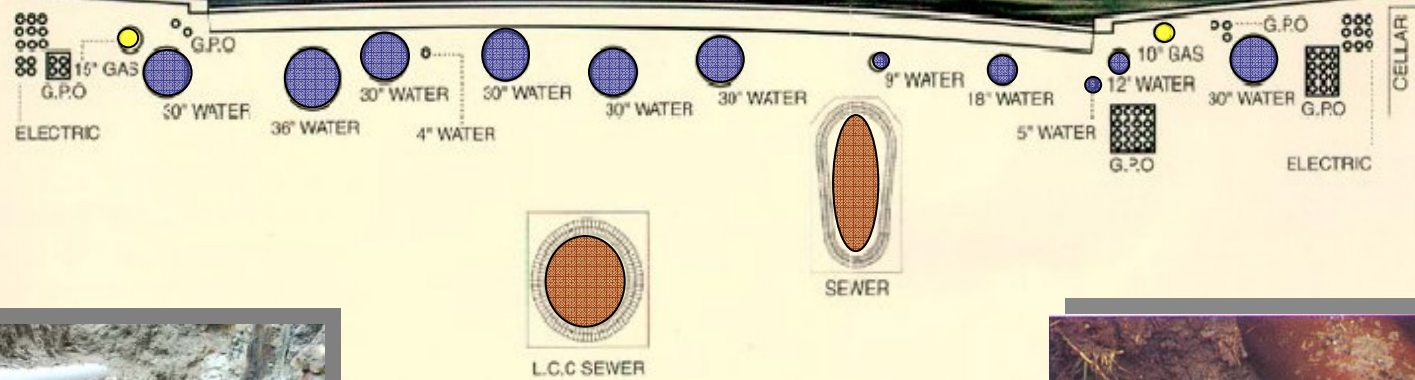
Generic/Pervasive Sensor Networks

Major goal of this project: Generic/Pervasive sensor networks

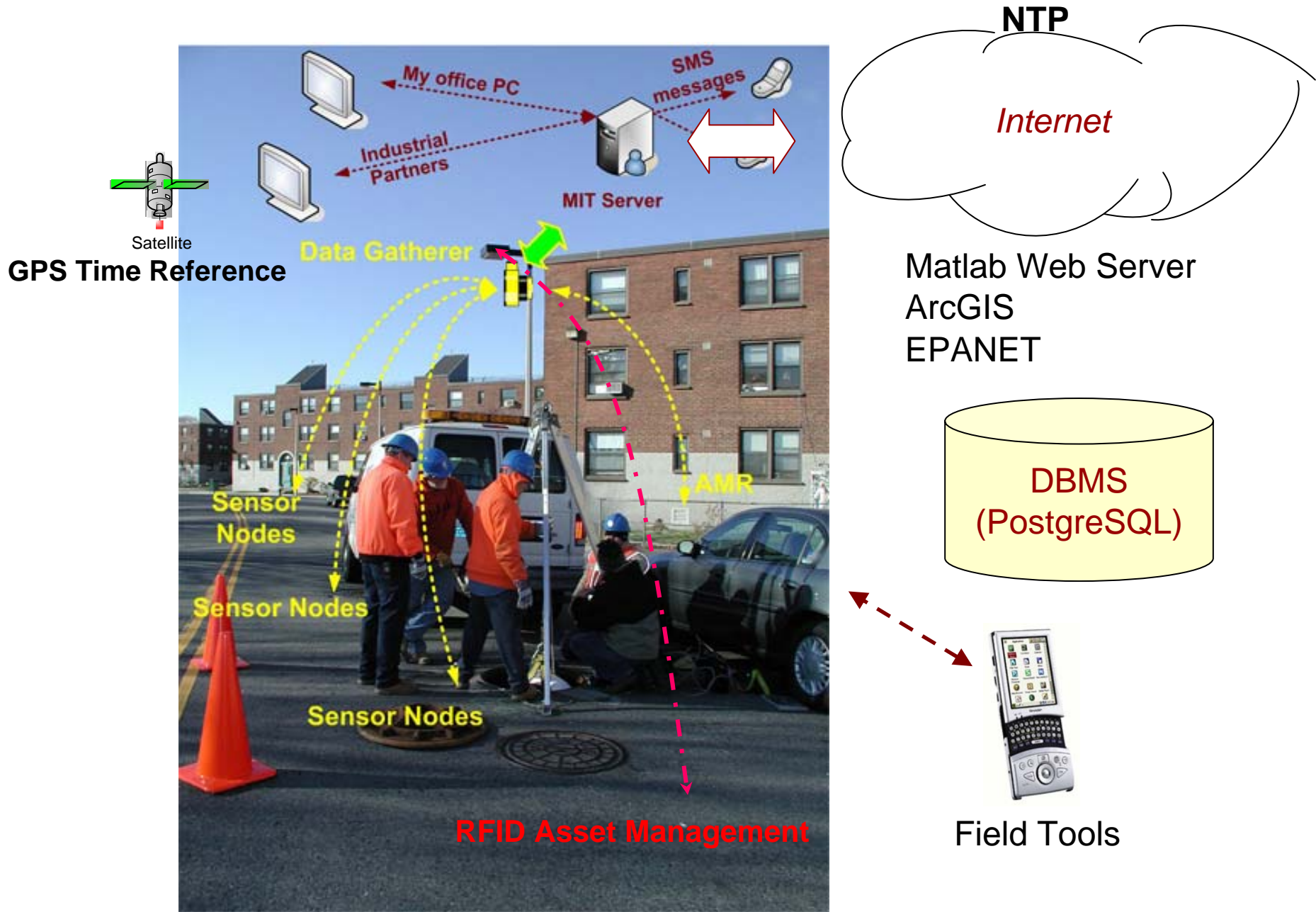
- Sharing of equipment for monitoring of multiple types of infrastructures
- Exploit common characteristics of different infrastructures to advance sensor network design



Underground Infrastructure



Boston Water Project: <http://db.csail.mit.edu/dcnui/>



Sensor Networks for Monitoring Water Supply Systems

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SELECT...

APPLICATIONS

- WATER SUPPLY
- SEWER

SENSOR NETWORKS

FIELD DEPLOYMENT

- WATER SUPPLY
- SEWER

RESEARCH

PHOTO GALLERY

LINKS

LOGIN

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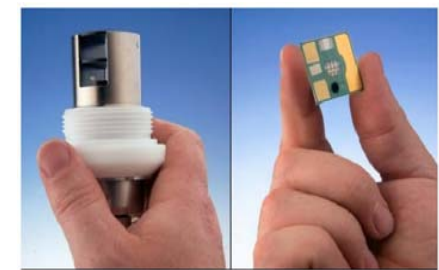
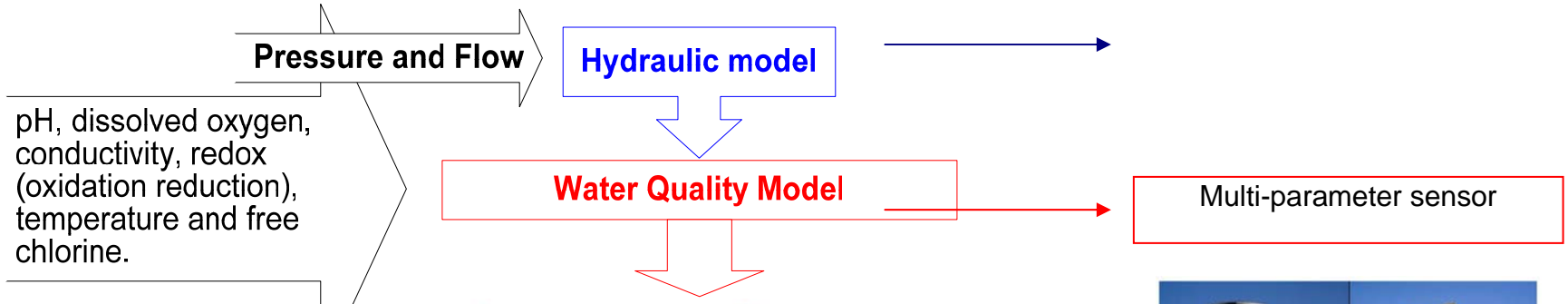
welcome

Please select a sensor location:

[Please click on the markers to select a location]



Water Quality Monitoring

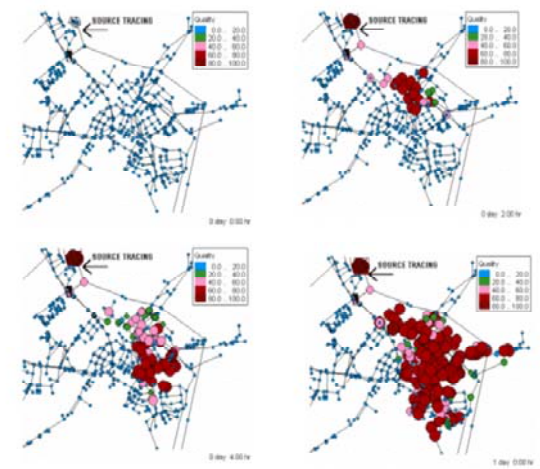
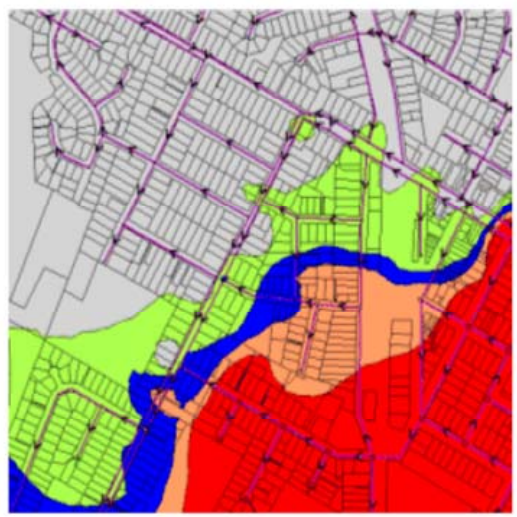


CENSAR chip

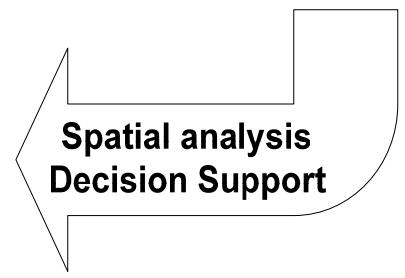


**Sandia, Tenix,
and CH2M Hill:
automated water safety
sensor units**

GIS

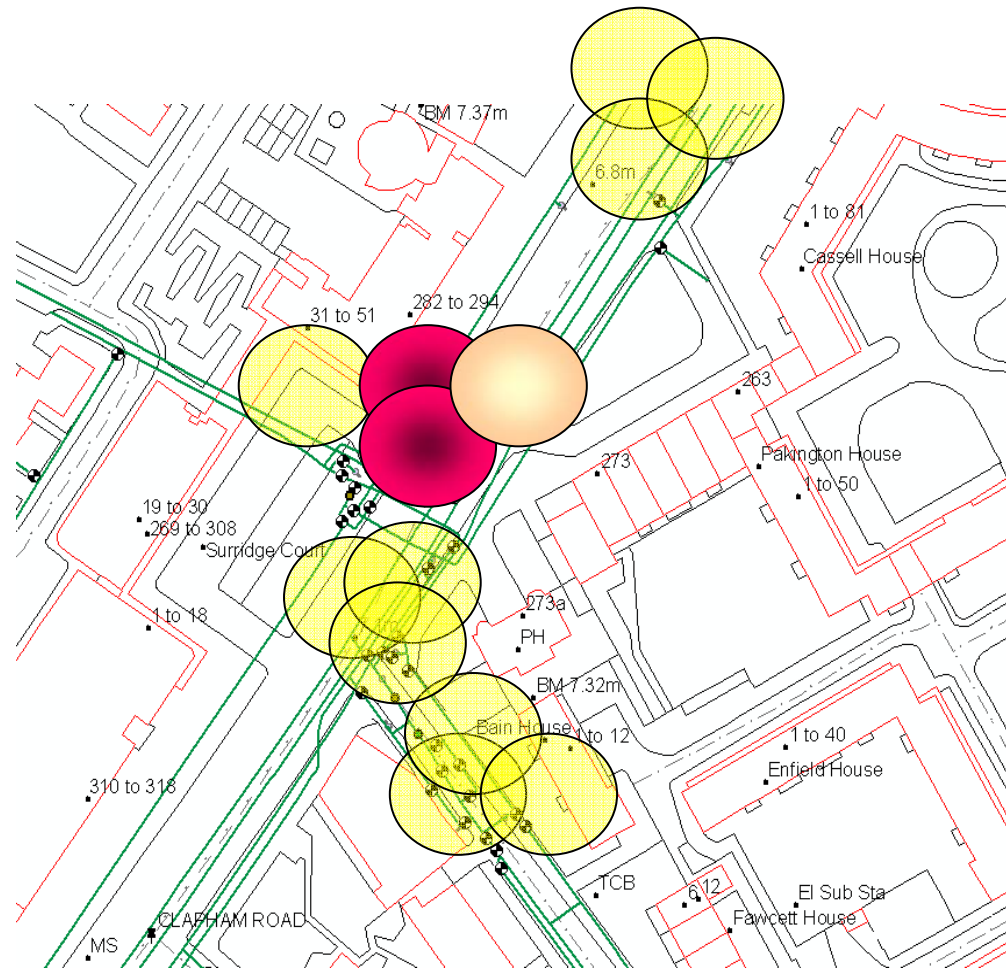


**Detection and Propagation of a Contaminant
0, 2, 12, 24 hours**



Research Challenges

- In-network processing of high-frequency data;
- Development of a Self-Validating sensor (SV-sensor);
- Continuous query processing and signal processing on sensor data streams;
- Handling heterogeneous data from large number of sensors
- Back-end integration



Local Analysis and Cross-correlation of vibration sensors

Research Challenges for Large-Scale Wireless Sensor Networks (WSN)

- **Scalability and adaptability**
 - Cross-layer protocol design
 - Protocols linking WSN and Internet for management and control
- **Efficiency**
 - Limited power supply
 - Harsh radio propagation environments
 - Tradeoffs between communication and computation
- **Security and reliability**
 - Distributed network architecture with no single point of failure
 - Protection measures against attacks and for privacy
 - Low-power public key cryptography
- **Testing and deployment in real operating infrastructures**
 - Not an easy task!
 - Asset owners have committed to provide assistance

Summary

- **A multi-disciplinary team with a strong and appropriate track record**
- **Proposed research addresses important and urgent needs in the U.K.**
- **Build upon expertise and tested platforms.**
- **Strong industrial participation**

Thank you