BRE Centre for Fire Safety Engineering

Introduction to FireGrid

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The Dalmarnock Fire Tests: Experiments & Modelling

Wednesday 17 November 2007

The Royal Museum Lecture Theatre

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Dalmarnock experience!

Vision of FireGrid

- **Facilitate transformed emergency response**
- **Via information on incident evolution**
  - Real time status
  - *Prediction* of future hazard
- **Innovative simulation tools**
  - Grid-enabled
  - Sensor-linked
- **Command and control**
  - Intelligent systems for end users

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http://www.firegrid.org/

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Science and Engineering at The University *of* Edinburgh

School of Engineering and Electronics

NEWS

FireGrid Cluster for Next Generation Emergency Response Systems

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Our mission is *to establish a cross-disciplinary collaborative community to pursue fundamental research for developing real time emergency response systems, using the Grid, beginning with fire emergencies.*

The challenges are:

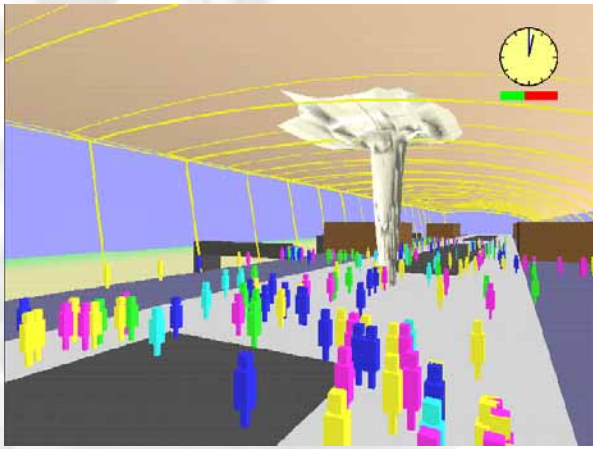
- **Sensing**: Data collection from the emergency location with instantaneous and continuous relay to the emergency response system (involving a large array of sensors communicating with each other as a network and with the response system via the Grid);
- **Modelling**: Simulation tools running in a predictive mode to model the evolution of the fire, establish its impact on the structure (and therefore predict the collapse), while also analysing the intervention alternatives and evacuation strategies;
- **Forecast**: All simulations, analyses and communications to be achieved faster than the evolution of the emergency in real time;
- **Feedback**: Processing of the continuously updated sensor and simulation data relayed back to the active response systems at the emergency location and to the emergency services to assist their intervention;
- **Response**: Effective co-ordination of all intervention by a command and control system using an intelligent execution support aid.

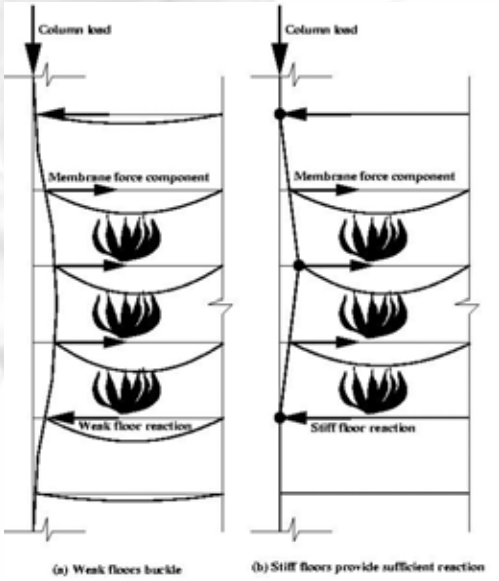
NEWS & EVENTS: DTI FireGrid Project is ongoing

Done

Model integration & grid

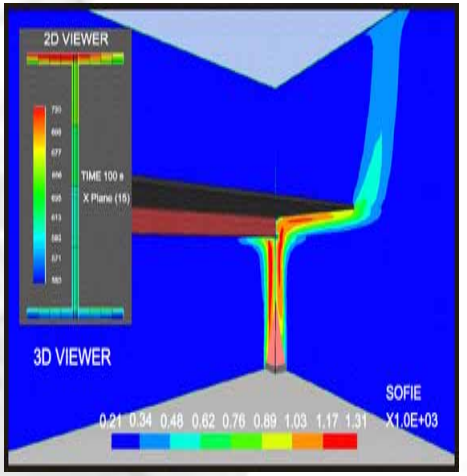
- **Simulation tools for**
  - Fire development
  - Human behaviour
  - Structural response
- **Provide support for**
  - Early fire detection
  - Guiding egress
  - Hazard prediction, including collapse

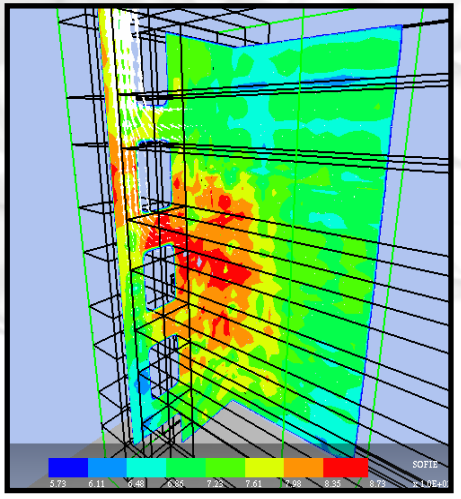




Current limitations

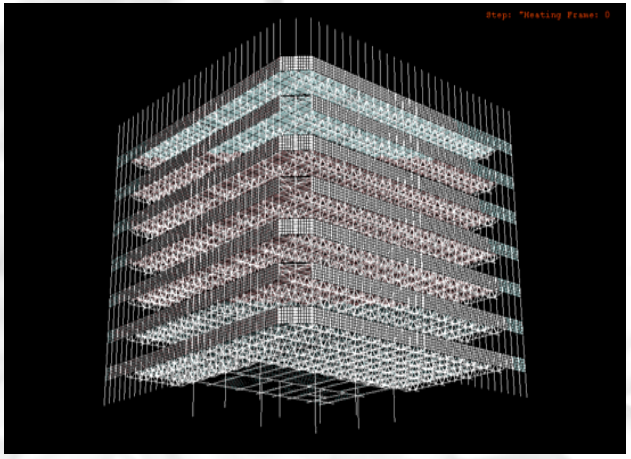
- **Disparate technologies**
  - Hardware and software
- **Not fast enough!**
  - Particularly advanced simulation tools
- **Require**
  - Holistic approaches
    - Hierarchical
    - Redundancy
  - Grid enablement
  - Sensor-linking

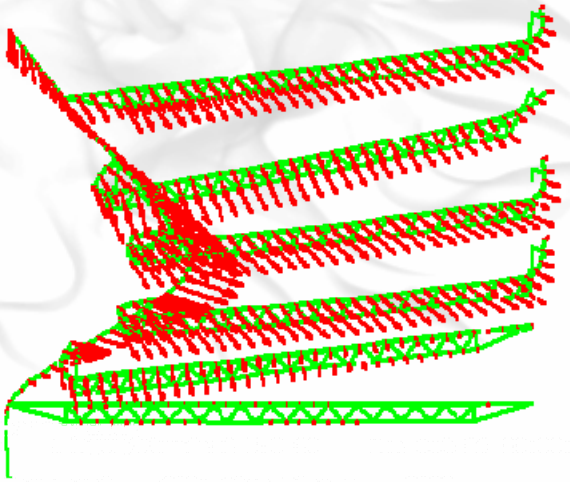




Grid / HPC

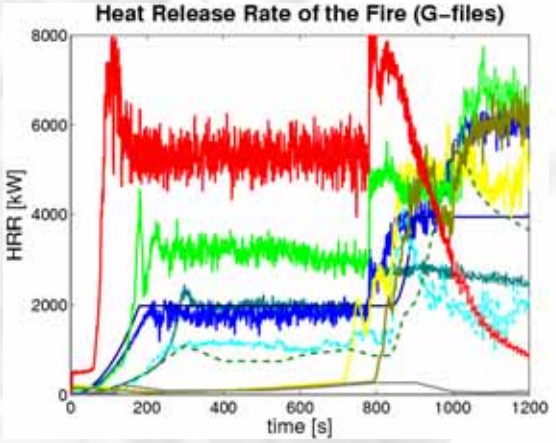
- **Grid**
  - Dynamic discovery and co-ordination of distributed computing resoruces
- **HPC**
  - High performance computing
  - Parallel processing
- **Issues**
  - On-demand access
    - Priority scheduling, escalation
  - Security
    - Authentication and authorisation

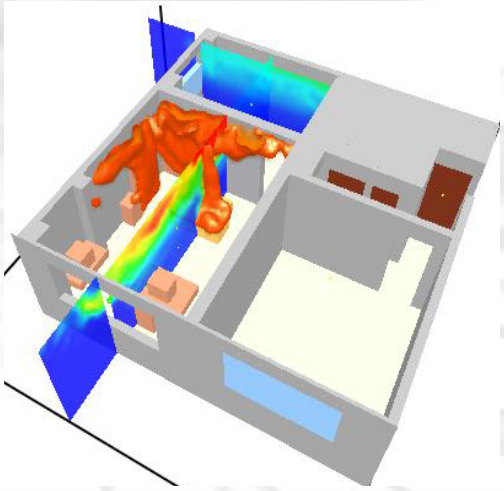




Dalmarnock experience

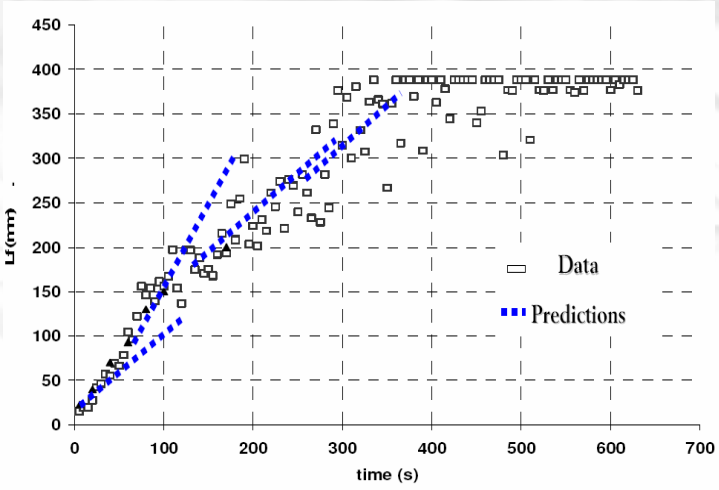
- ***A-priori* simulation**
  - A big challenge
  - Wide scatter in predictions
- ***A-posteriori* simulations**
  - Also challenging!
  - Complexity of fire phenomena
    - Multi-fuel
    - Wind effects
    - Random aspects
- **Model “steering” via sensors**





Sensor linking

- **Key innovation**
- **Potentially overcomes model limitations**
  - Even the most sophisticated simulation tools
- **Challenge in implementation**
  - Integrating two complex representations of reality
    - Modelled state
    - Measured state
  - Significant uncertainty in both
    - Data assimilation

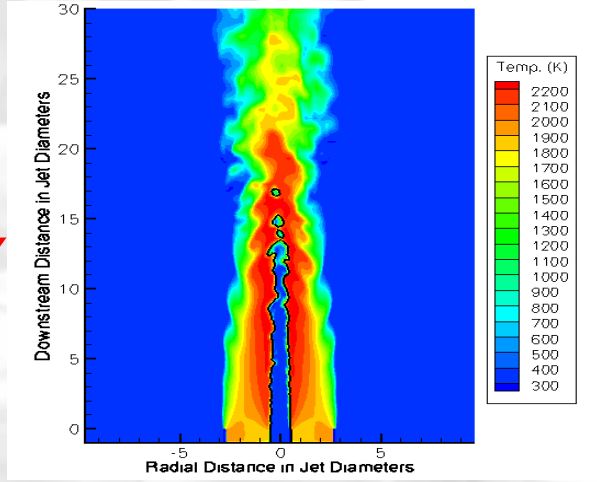


Sensor linking

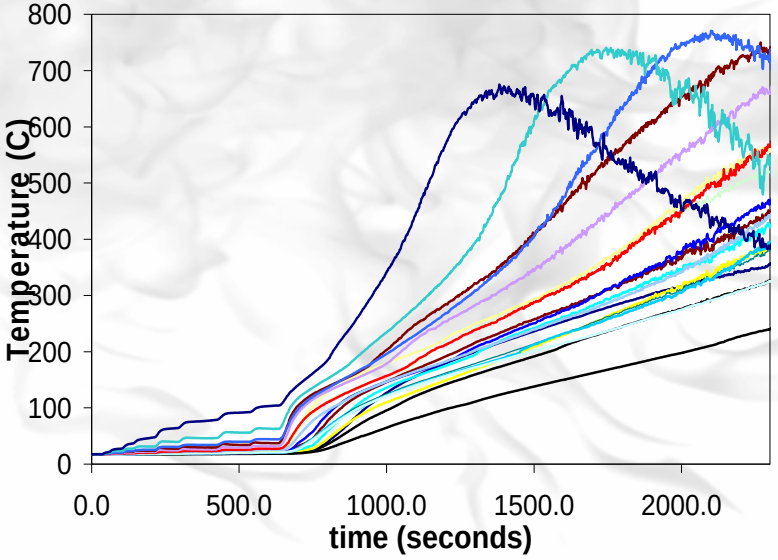
Actual state
(reality)

Modelling

Measurements

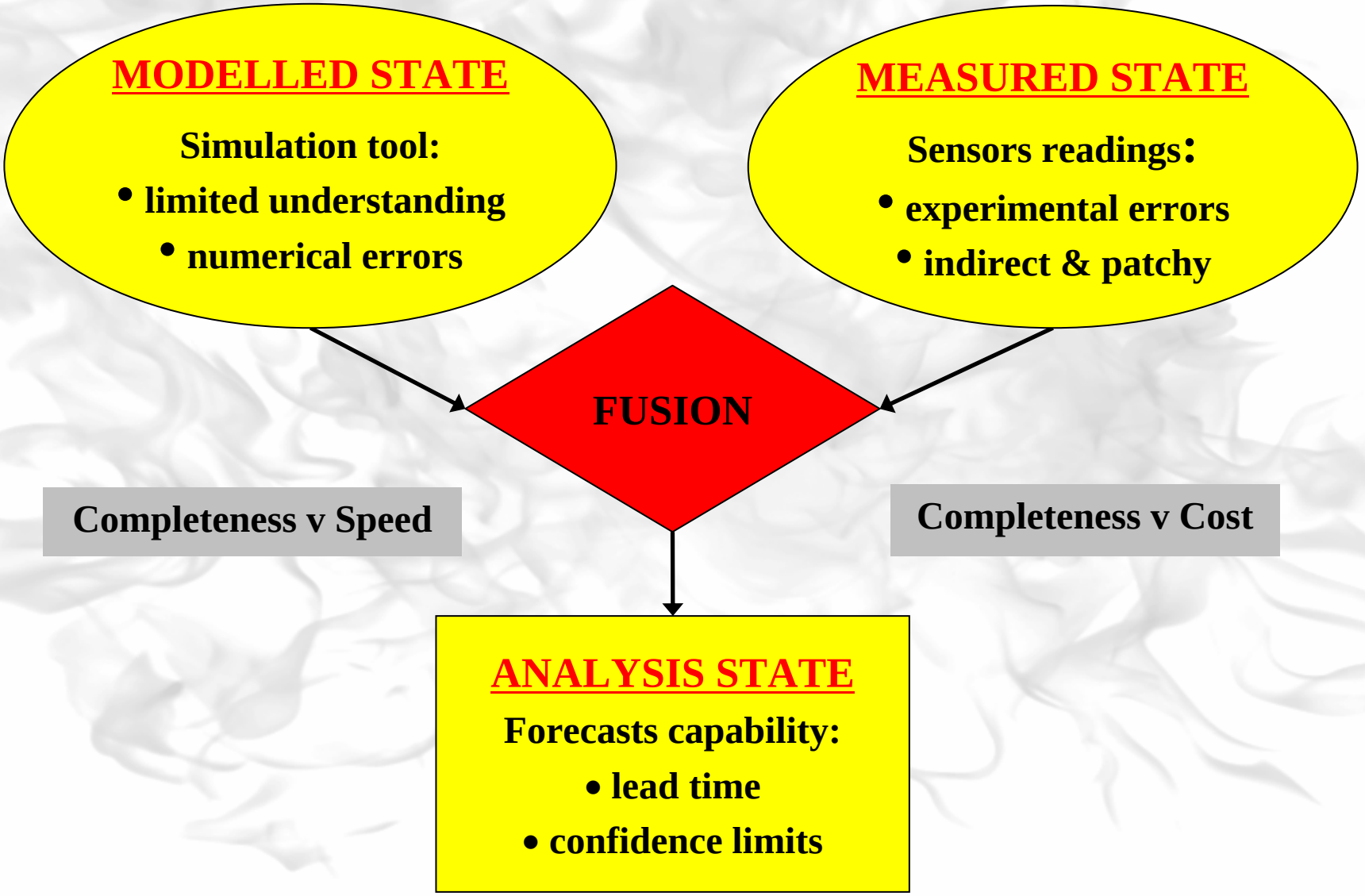


Model state



Observed state
(sensor data)

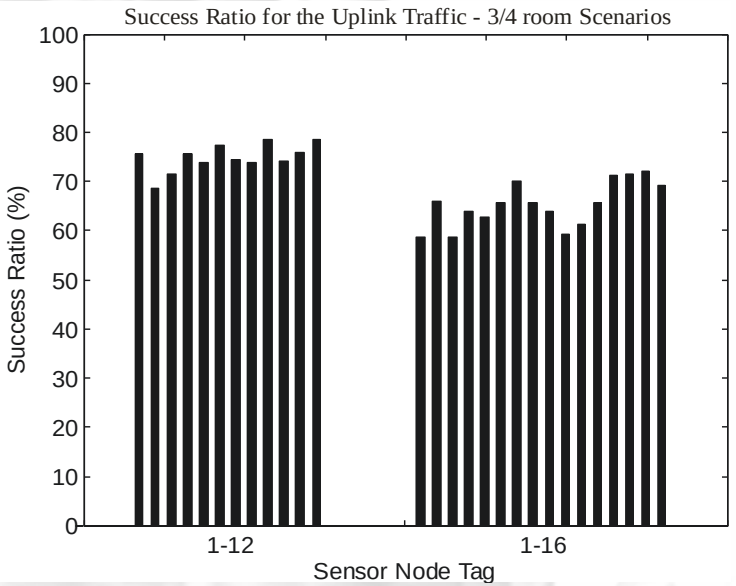
Data assimilation

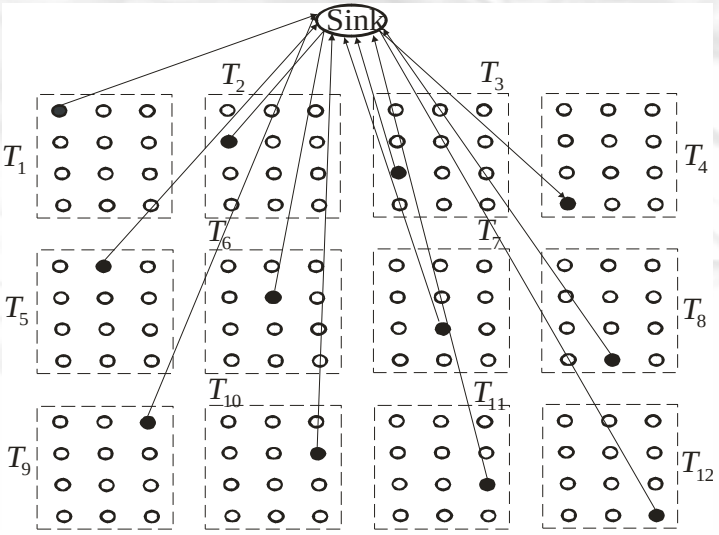


Sensor networks

- **System requires**
  - Large numbers of sensors
    - Large buildings
  - Frequent updates
    - Early detection

  => Significant burden on communication protocols
- **Wireless networks**
  - Redundancies
  - Self-organising



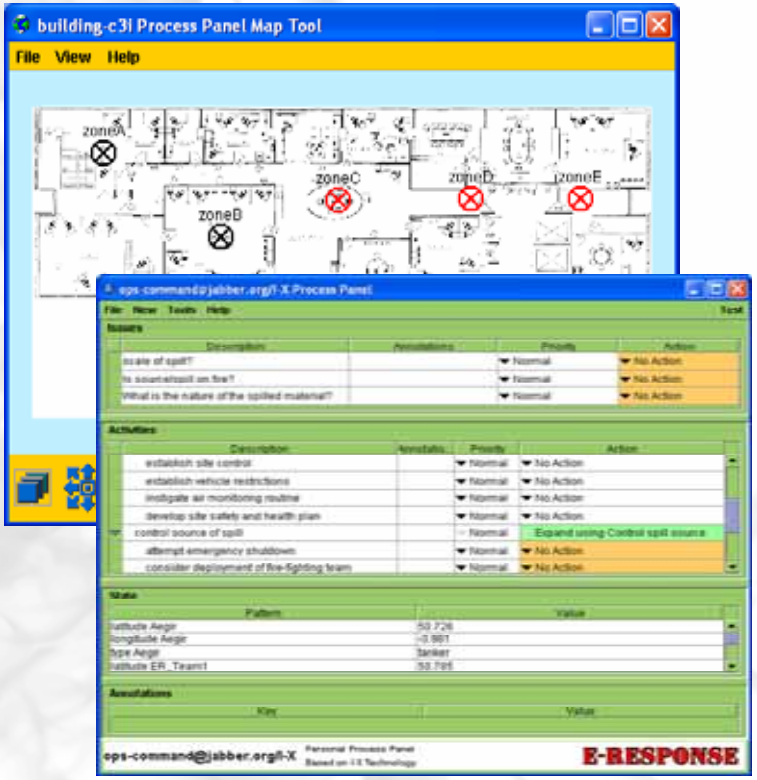


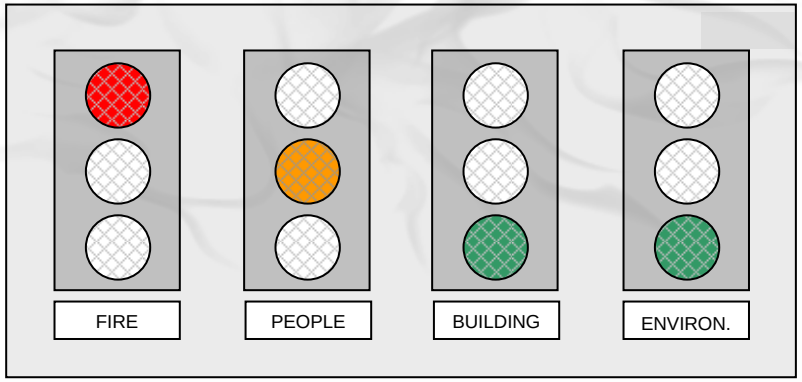
Dalmarnock experience

- **Large volumes of data logged**
  - 25GB of results
    - Dominated by video records
    - Data storage and access via grid
- **Instrumentation development**
  - Wireless sensors
    - Data reduction
    - Attenuation

Command and control

- **Scope**
  - Automated responses
  - Human decision makers
  - C3I (Command, control, communications & intelligence)
- **Draws upon AI concepts**
  - Knowledge-based
  - Planning techniques
  - Requires support layers
    - Abstract raw data
    - Interpret simulation results





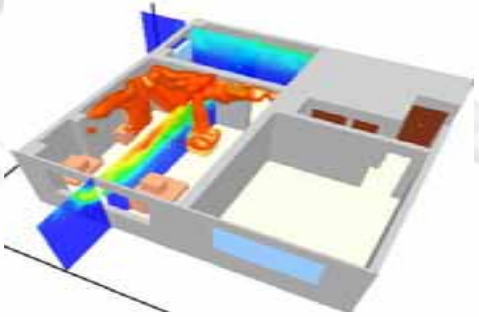
Dalmarnock experience

- **Control**
  - Fire Test Two “controlled fire”
    - Early intervention successful
    - Assist fire fighting

- **Command**
  - Human decision-makers quickly overwhelmed
    - Understanding current conditions
    - Making predictions
  - Assists assessment of information provision to end user

Conclusions

- **FireGrid provides a strategy**
  - Equipping emergency responders
- **Dalmarnock experience**
  - Sensor-linked simulation tools
  - Integrated models
  - Grid enablement
  - Intelligent decision-making



Technology integrations