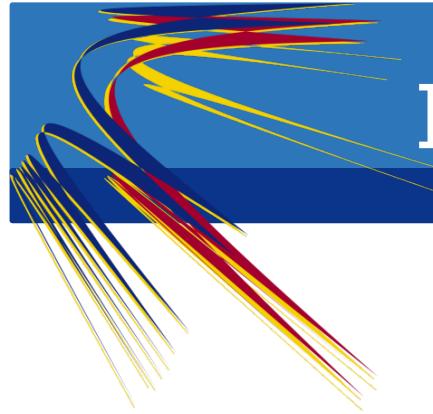


horizon
DIGITAL ECONOMY RESEARCH

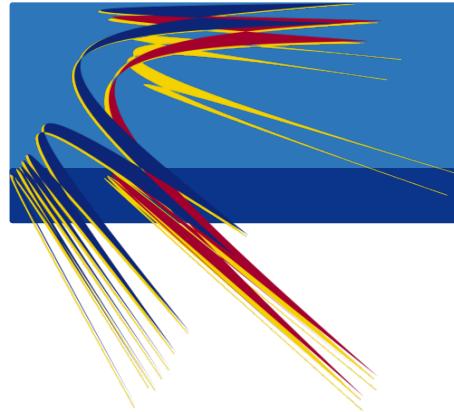
Working with interventions



Intervention

Technology introduced to interrupt established behaviour

- Results in new behaviour
- New behaviour may be good or bad (in either case will inform future designs)



New capabilities & features

Adding new value to existing technology
Adding technology to existing objects

N91

NOKIA



Snap





Finezzo



SSO

Volluto/Origin



Volluto

Cappuccino

Latte

Caffe

Crema

Espresso

Long

Double

Short

Americano

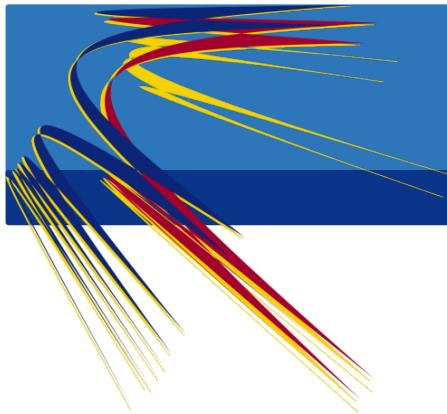
Macchiato

Latte Macchiato

Latte Lungo

Latte Cremoso

Latte Lungo Cremoso



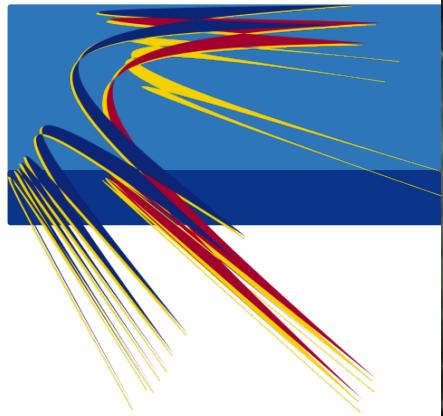
New places

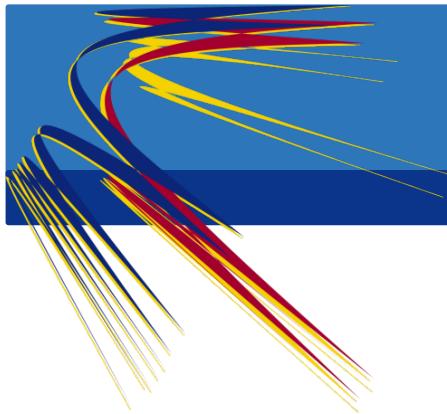
Public vs. personal
Open vs. private



A screenshot of a website titled "Metropolitans Storytelling Workshop". The page features a large image of three women in traditional-style dresses standing next to a large, textured object. The text on the page discusses the workshop's focus on oral tradition and its connection to the present. Logos for "The National Lottery", "Caterpillar", and "The Royal Society" are visible. The URL in the address bar is "http://metropolitans.org.uk/2010/06/zipang".

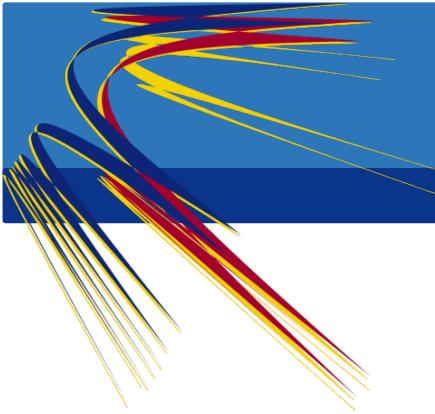




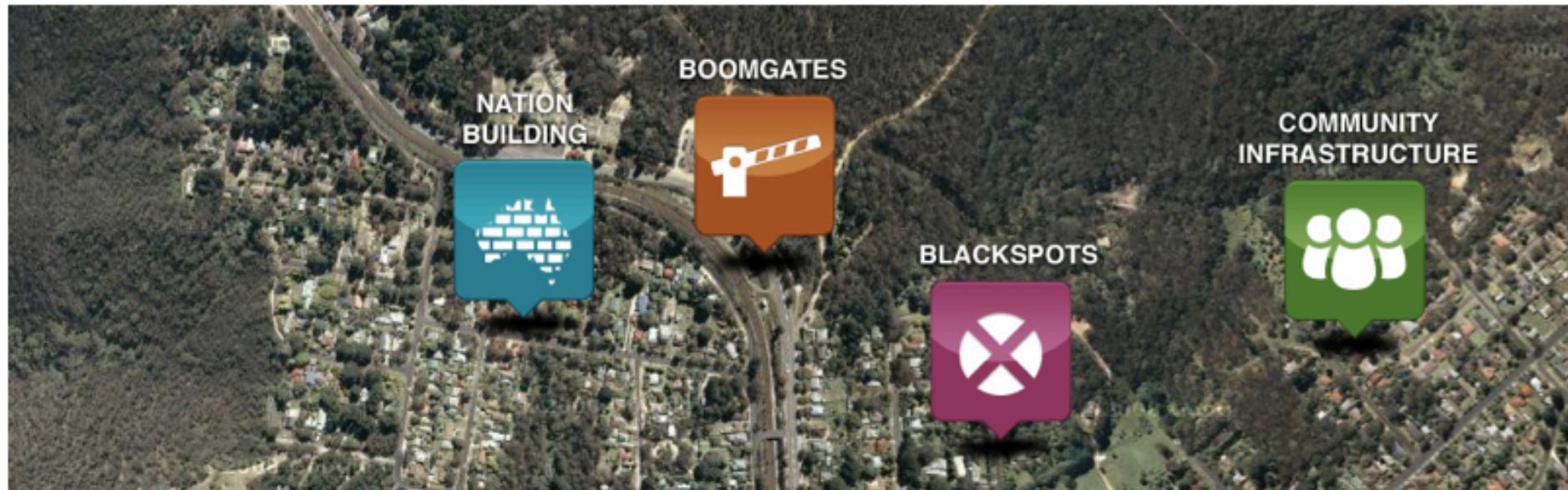


New combinations

Physical integration
Service integration
Data integration



getstimulated



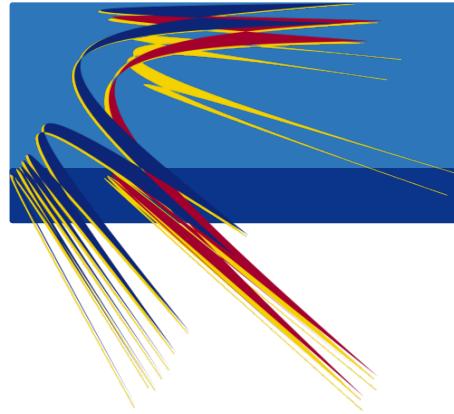
The Australian Government is spending
6.4 billion dollars of your money.

Enter your address to see how funding is spent in your area:

GO

e.g. 197 Macquarie Street Sydney





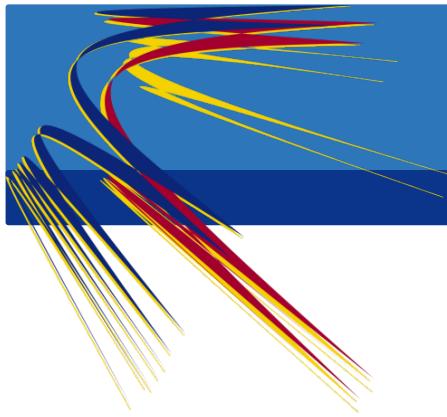
horizon
DIGITAL ECONOMY RESEARCH

User-centred development through interventions



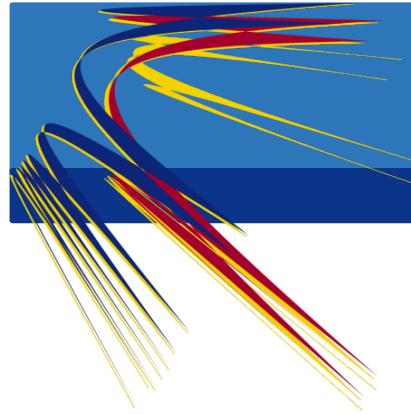
Development

- Rapid prototyping
 - Simple prototypes
 - Not robust
 - Not fully-functional
 - Tested by potential end-users
- Rapid integration of user feedback
 - Rich and qualitative

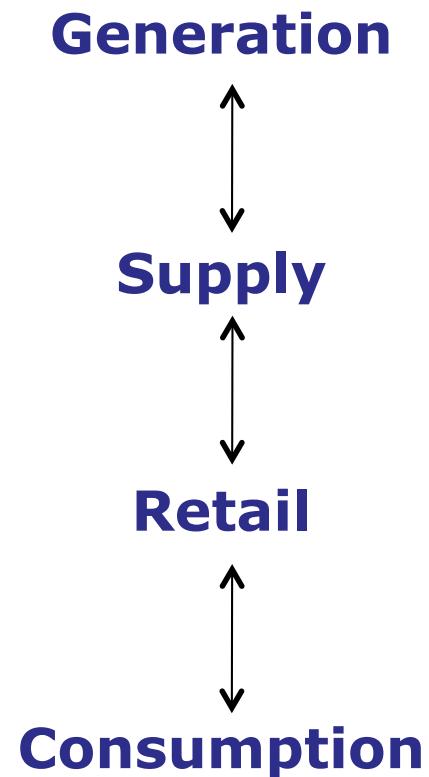


horizon
DIGITAL ECONOMY RESEARCH

C-Aware application(s)

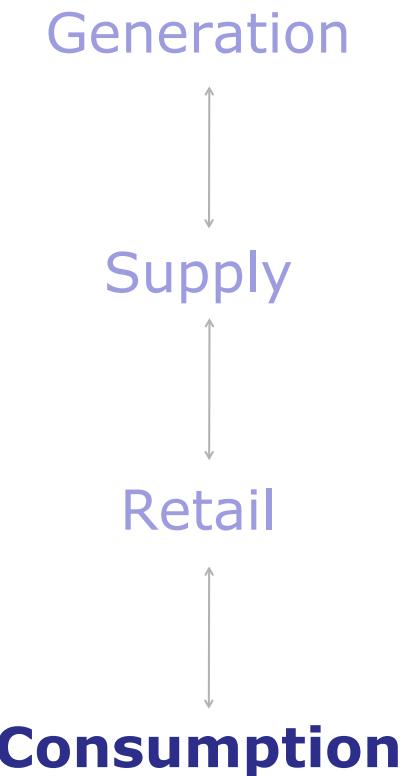


Application domain





Application domain





Application domain

Consumption

Travel
Workplace
Home



Applications

Cross-cultural workplace

Horizon vs. China Mobile research



Applications

Cross-cultural workplace

Horizon vs. China Mobile research

Cross-cultural student living

University of Nottingham UK vs. China student halls

Public/private transport

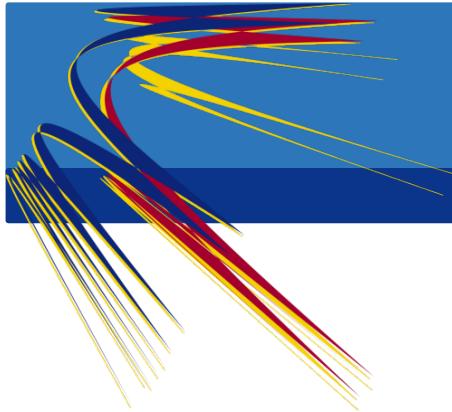
Smart logistics in Nottingham

Personal energy profile

Complete view of personal consumption footprint

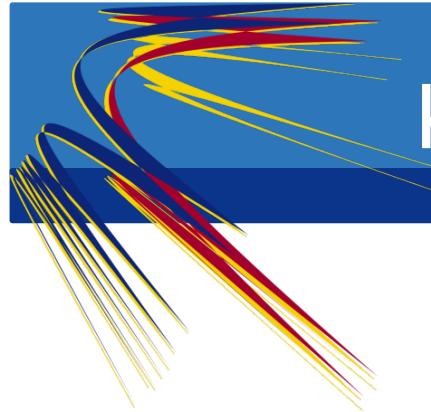
Built environment auditing

Ningbo construction and maintenance data consortium



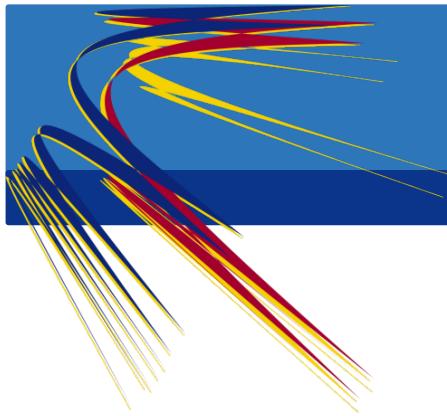
Cross-cultural workplace

Revealing emissions from workplace energy use



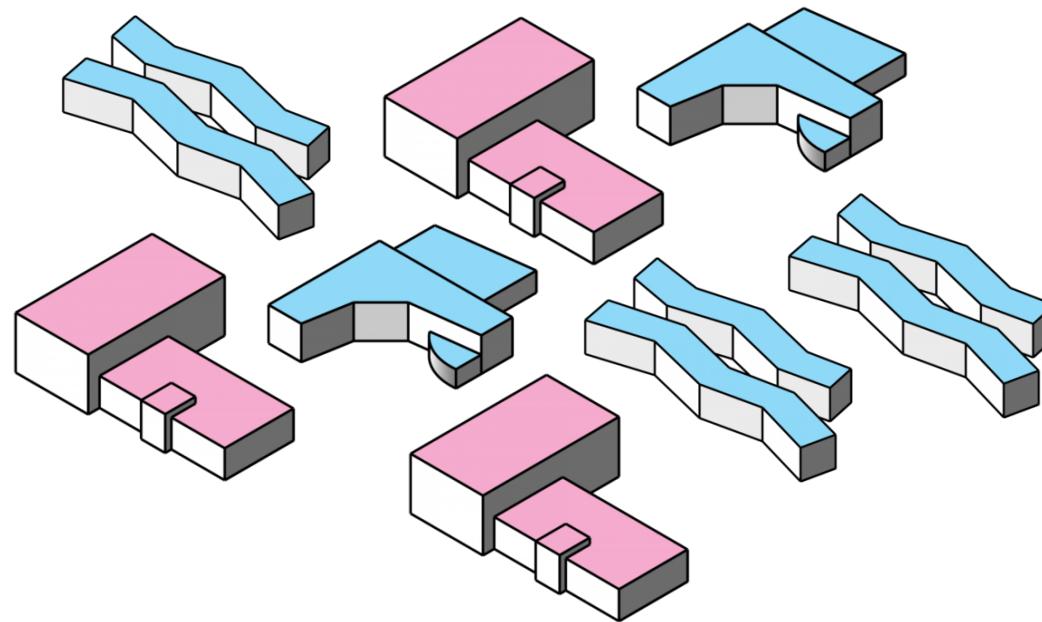
Key points

- Infrastructure for monitoring and control (**generic**)
 - Using low-cost infrastructure (M2M?) for sensing/control
 - Maintaining system state in web-based data store (personal container?)
- 3 user interfaces (**specific**)
 - Using 3 types of device
 - For 3 types of end-user
- Field trial work-plan



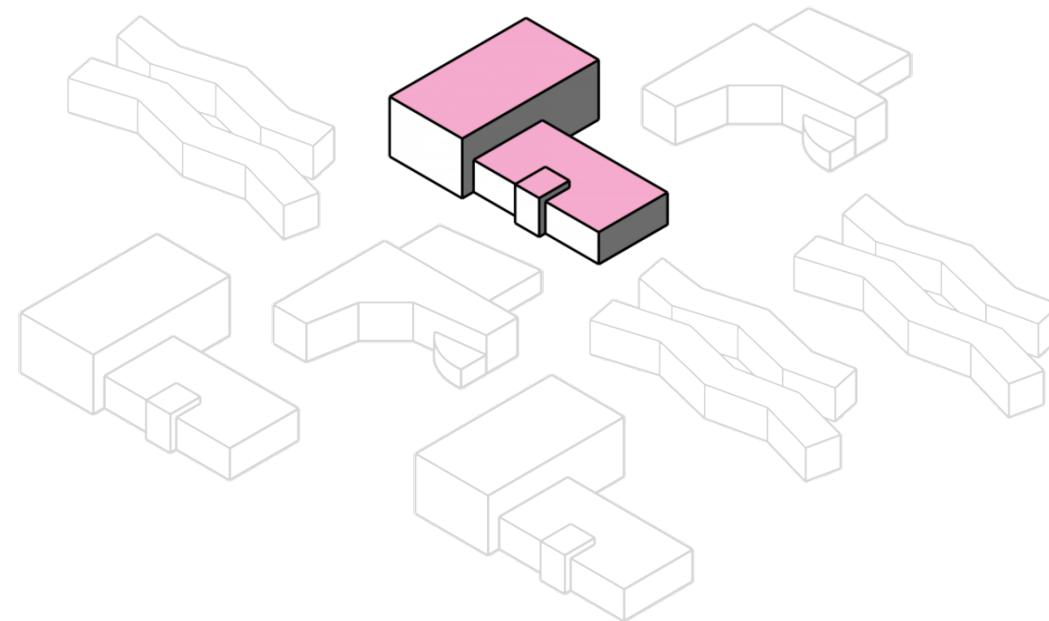
horizon
DIGITAL ECONOMY RESEARCH

Monitoring



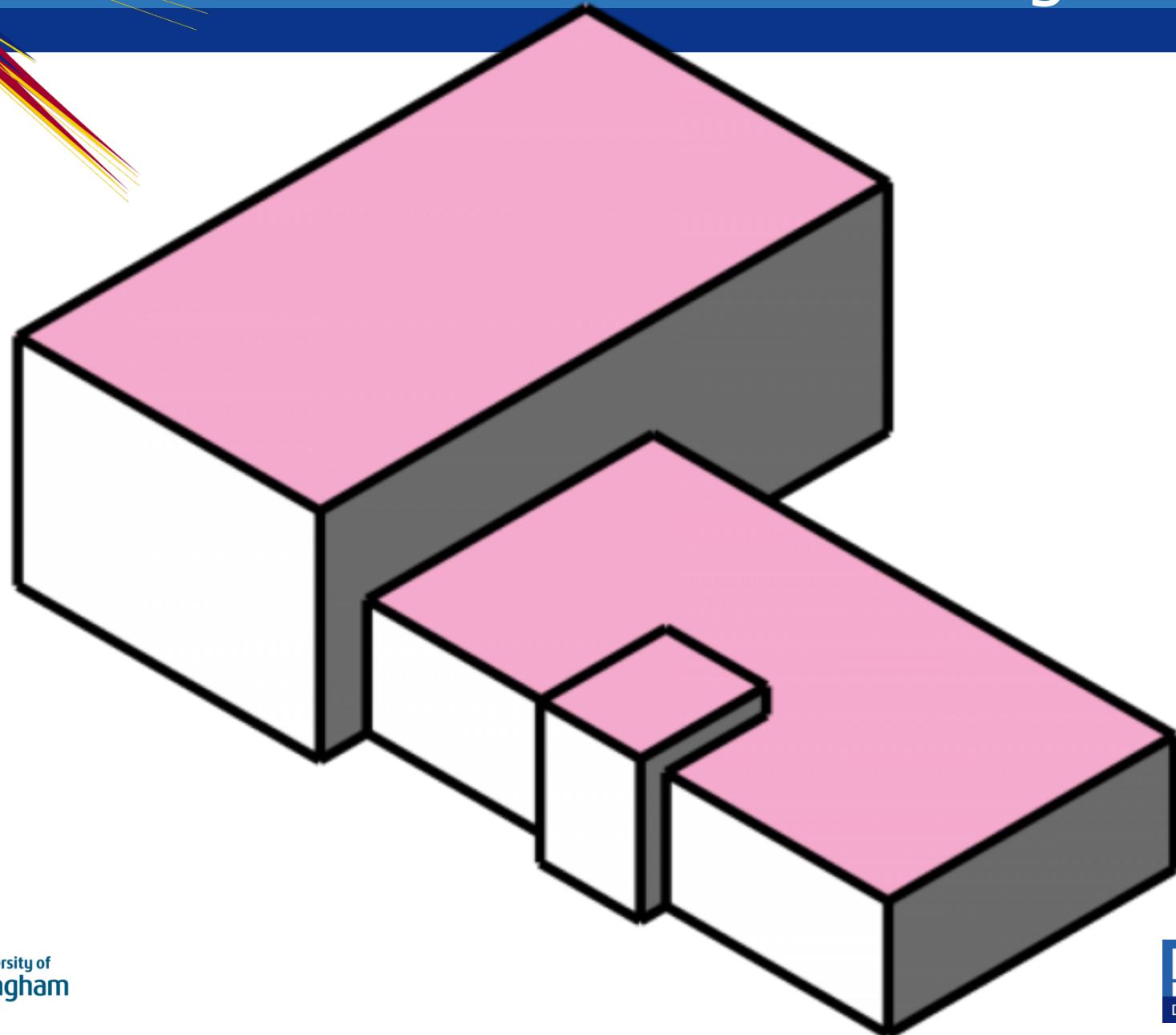


Architecture - monitoring

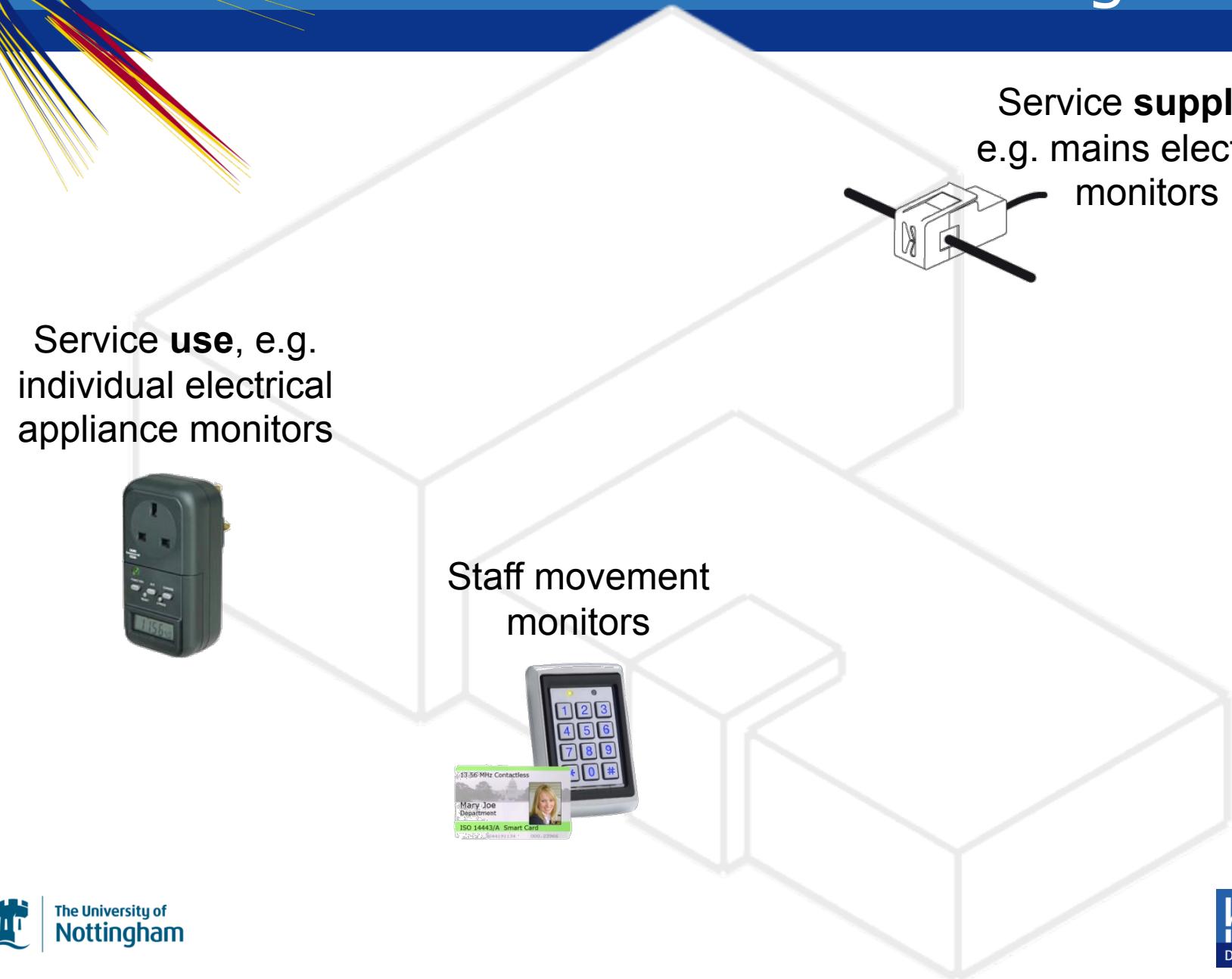




Architecture - monitoring



Architecture - monitoring



Architecture - monitoring

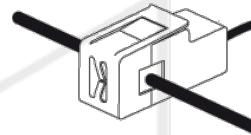
Service **use**, e.g.
individual electrical
appliance monitors



Staff movement
monitors

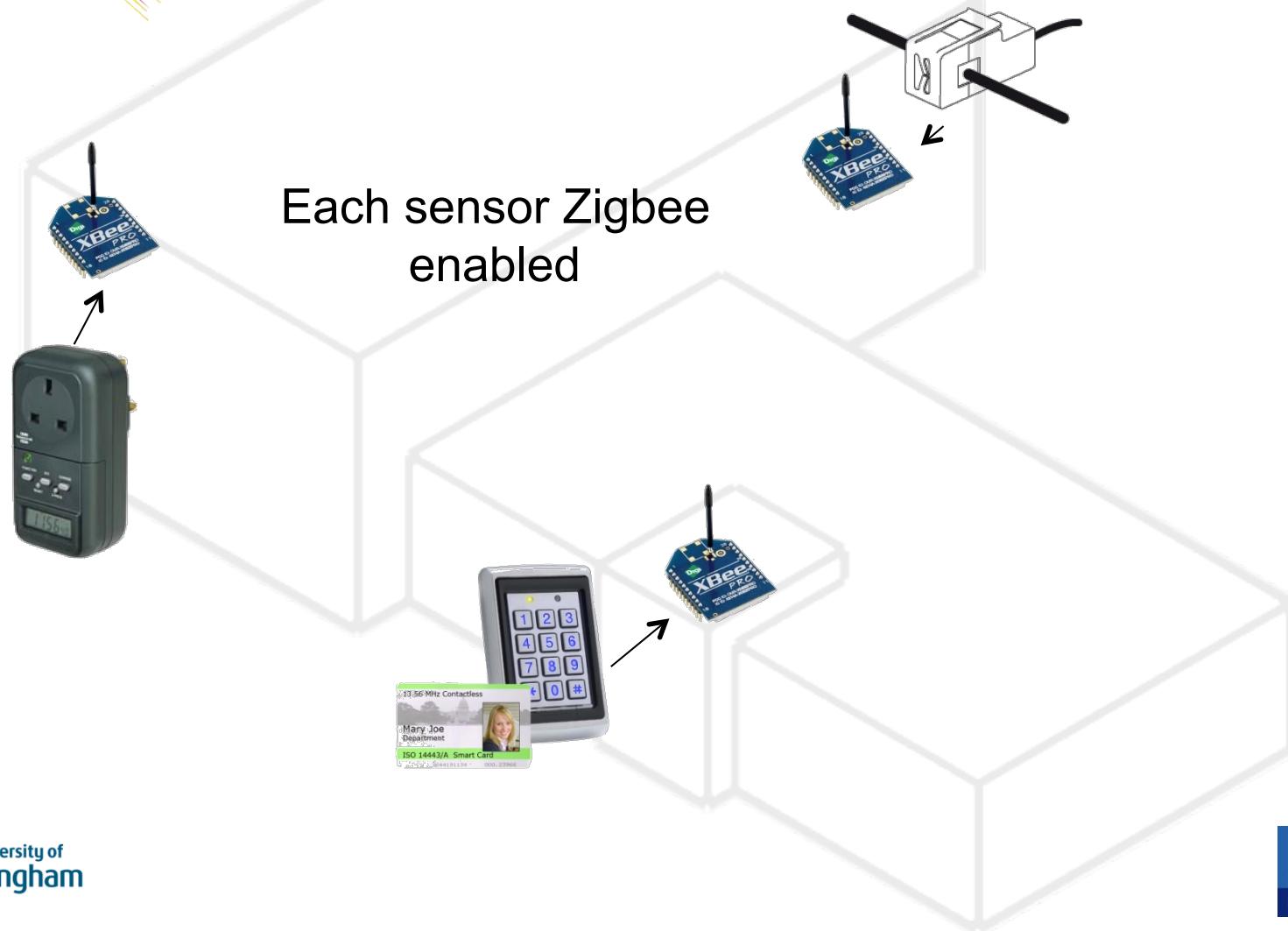


Service **supplies**,
e.g. mains electricity
monitors



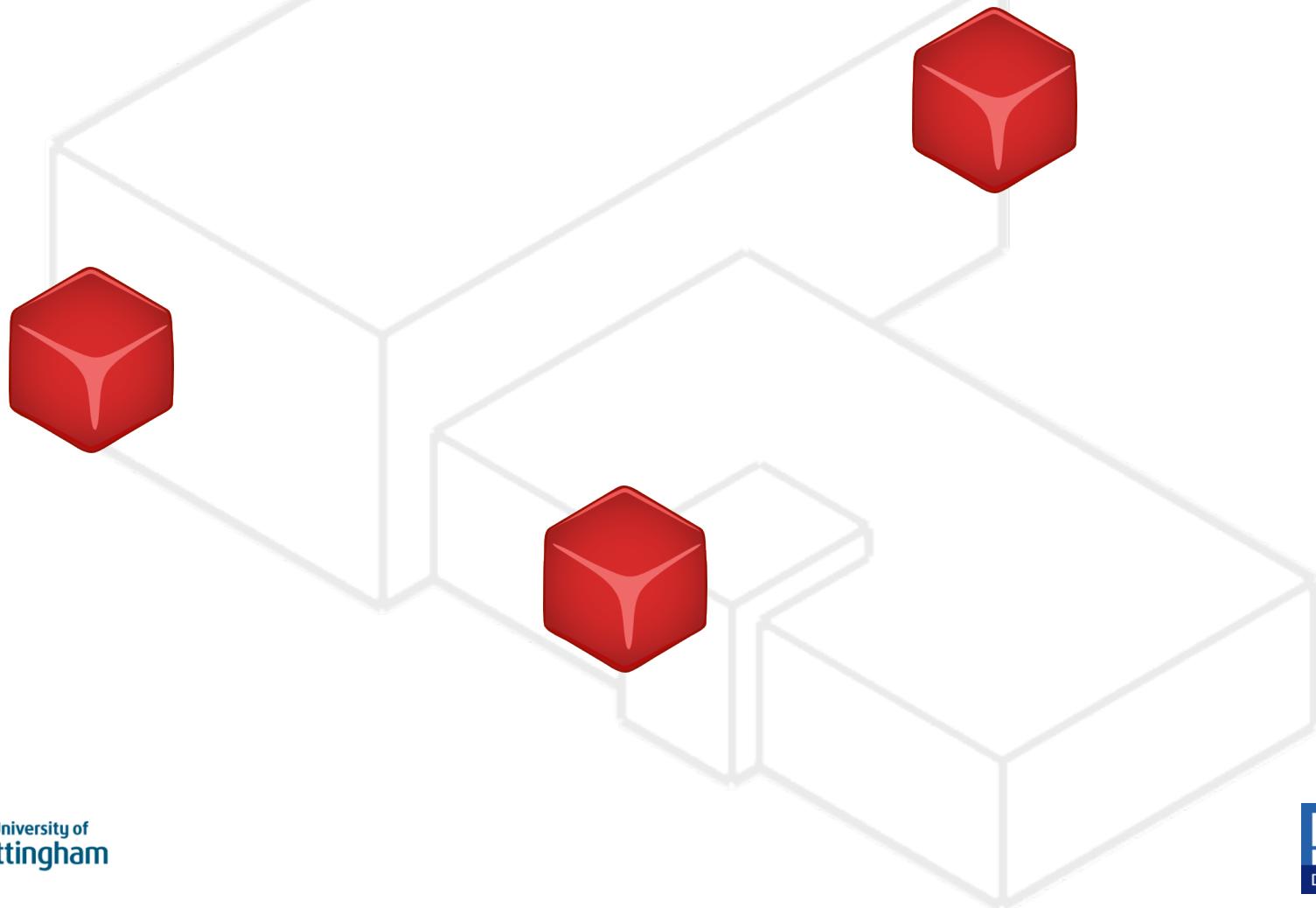
We can consider a range of sources of emissions (different utilities, e.g. electricity, gas, water), and who/what is responsible for those emissions (e.g. number/type of staff, number/type of appliances, current processes)

Architecture - monitoring

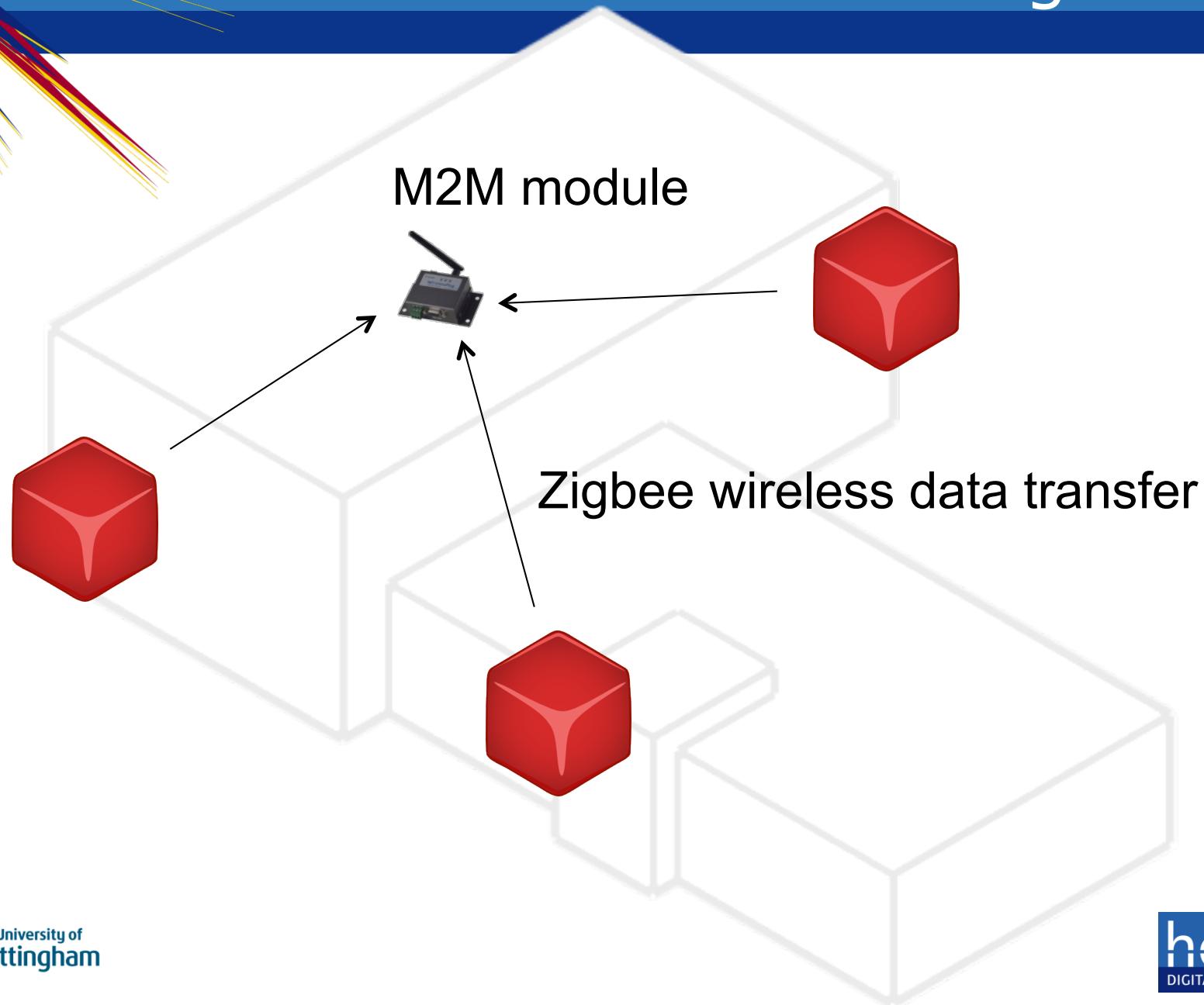




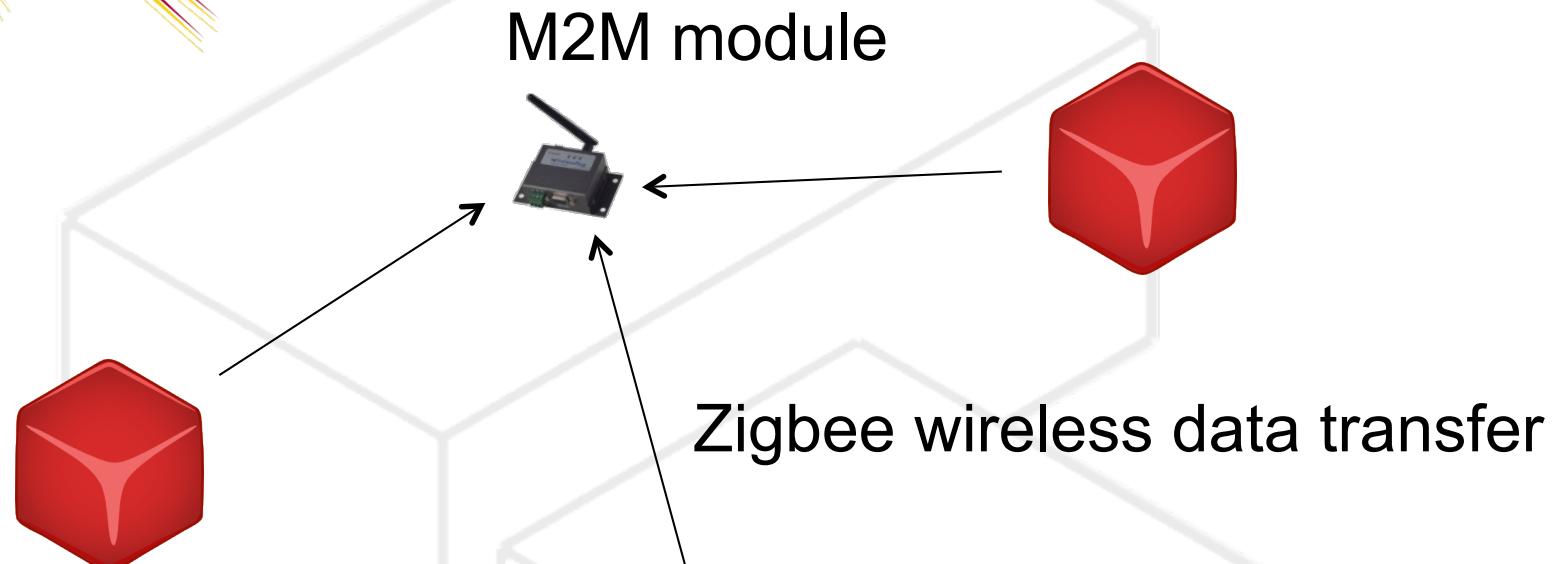
Architecture - monitoring



Architecture - monitoring



Architecture - monitoring

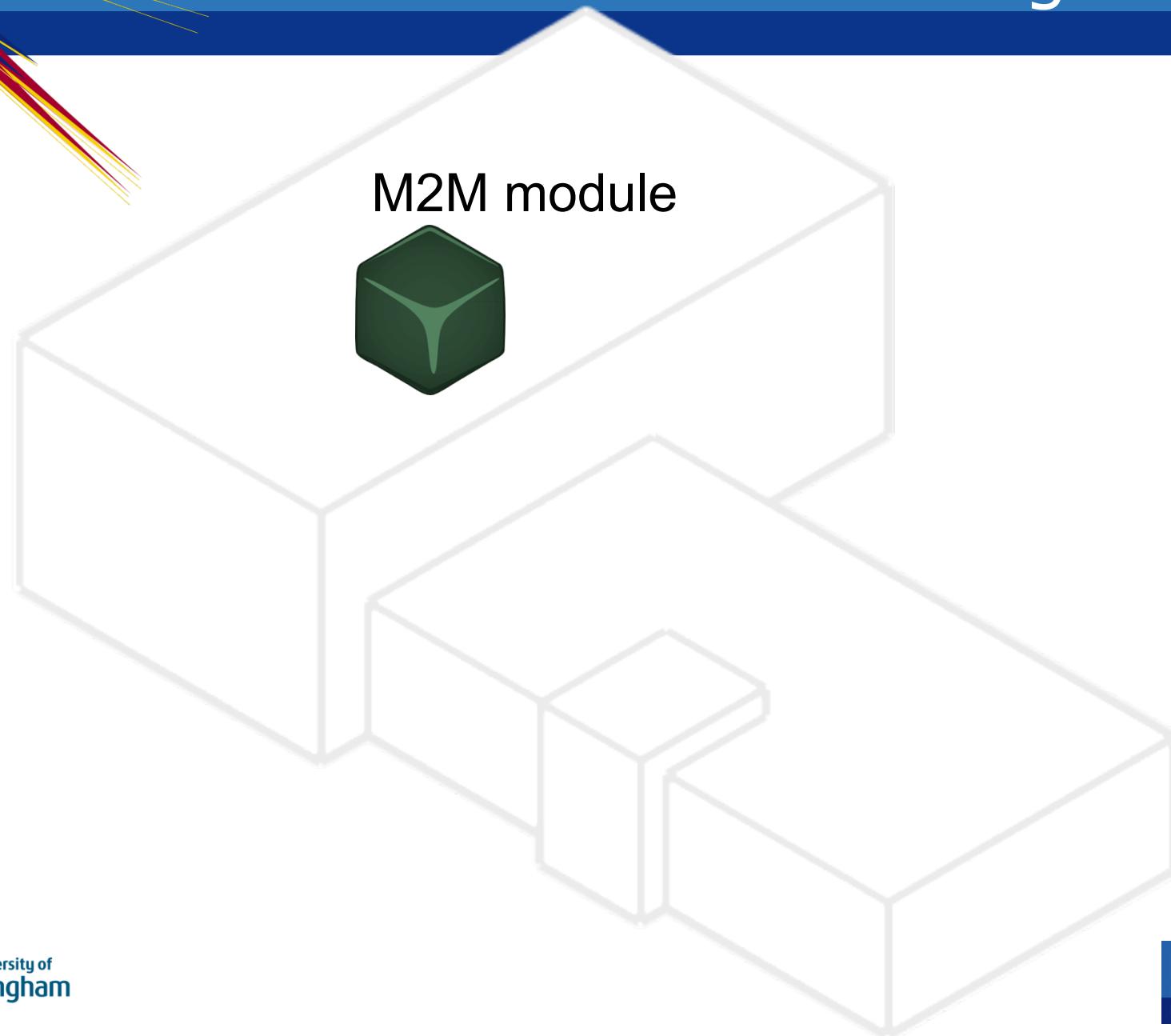


When does this occur?

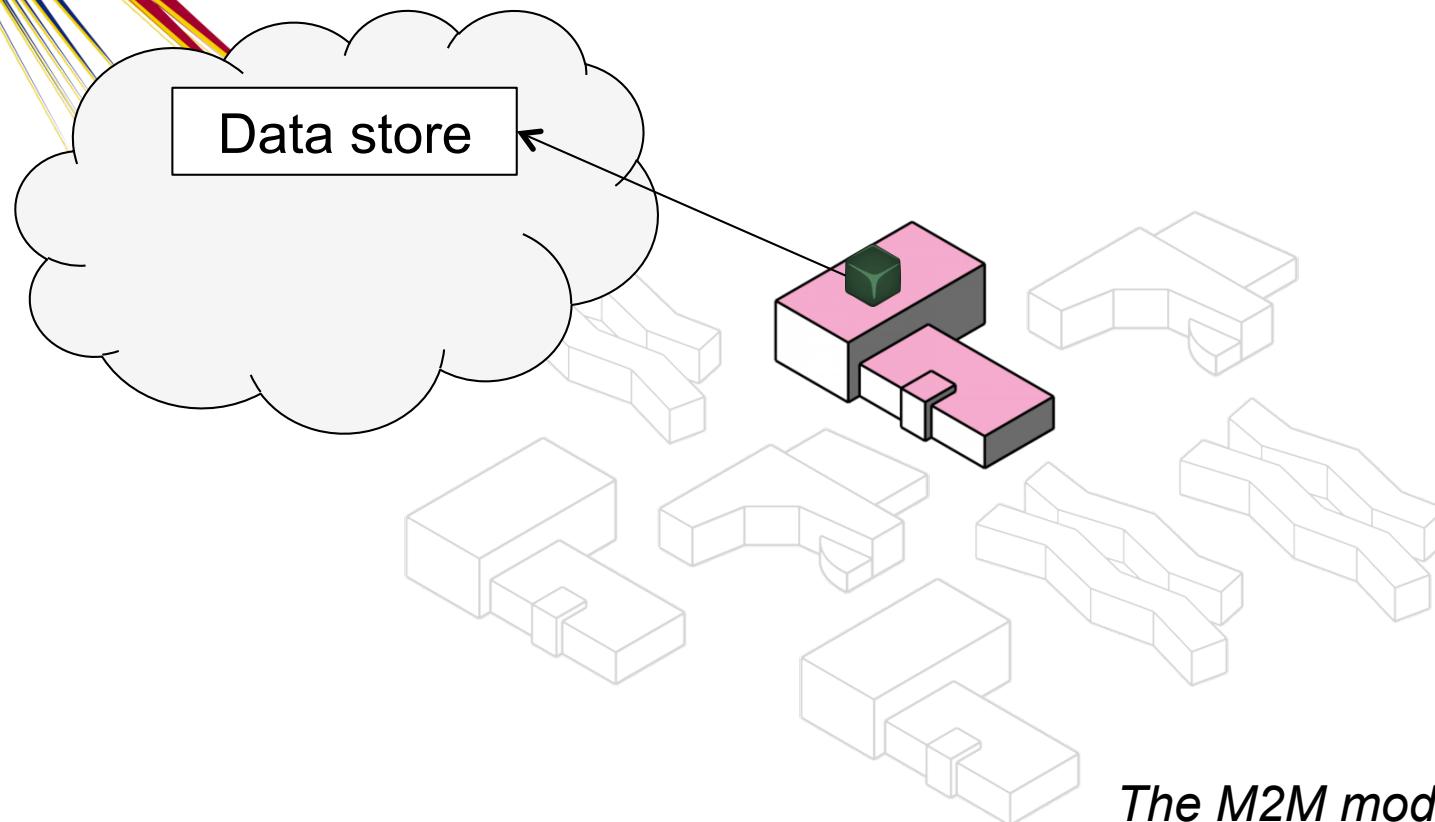
*Regularly (e.g. once per minute)
and/or triggered by events (e.g.
when door is opened)?*



Architecture - monitoring



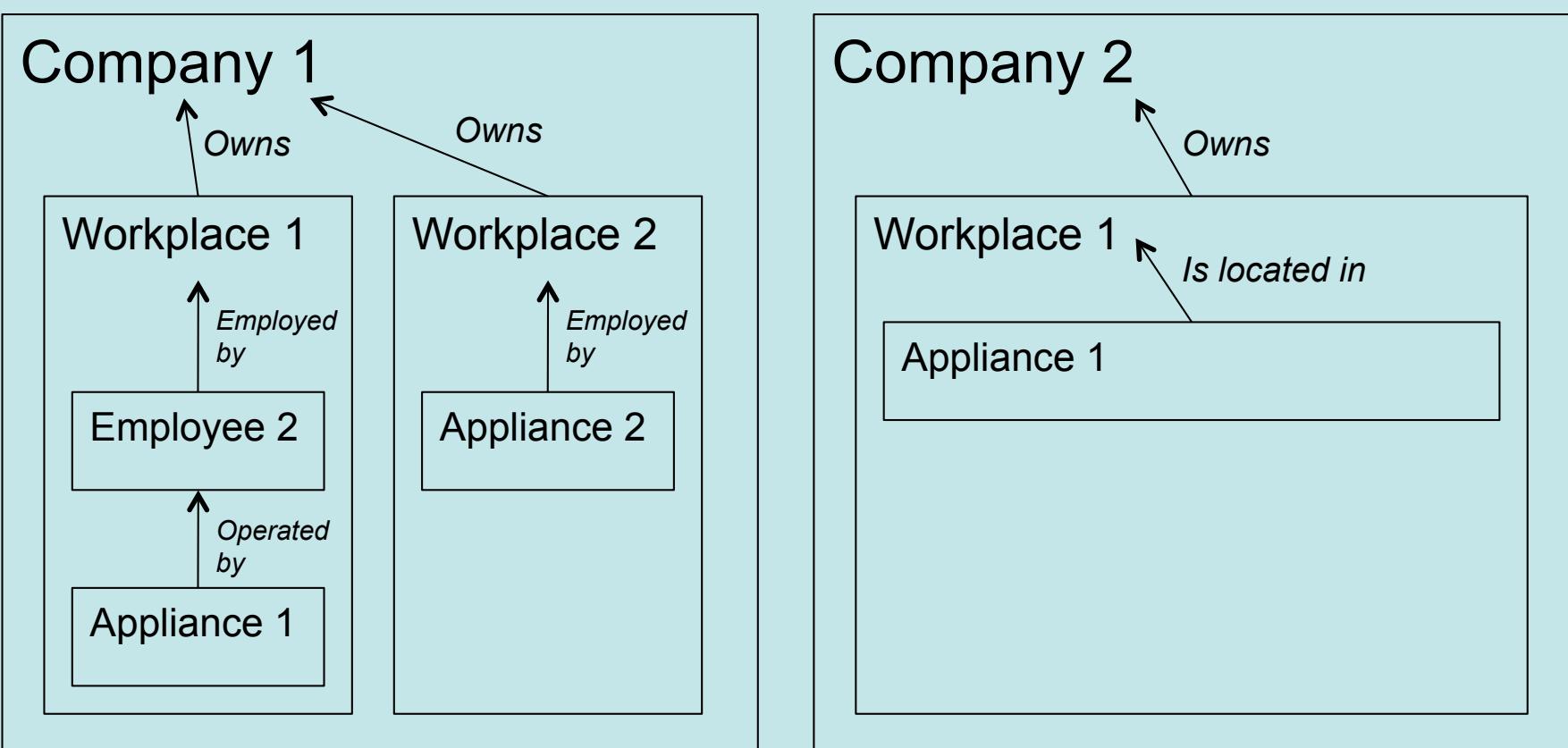
Architecture - monitoring



The M2M module passes the data from the various sensors – via mobile phone network – to an online data store

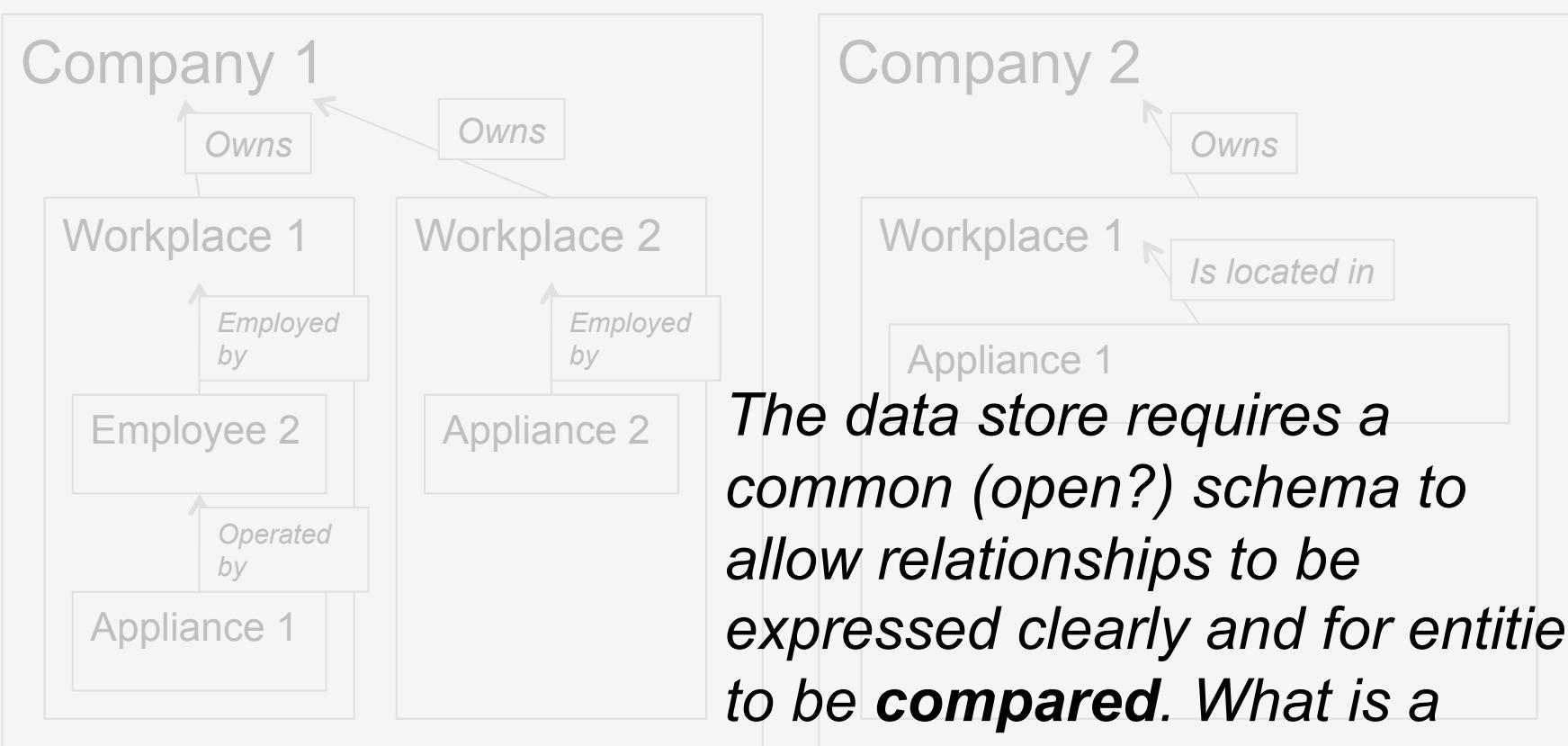
Architecture - monitoring

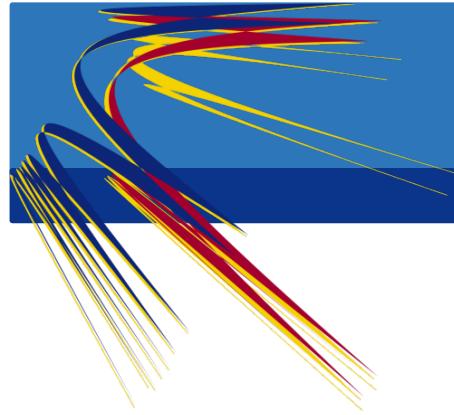
Data Store



Architecture - monitoring

Data Store

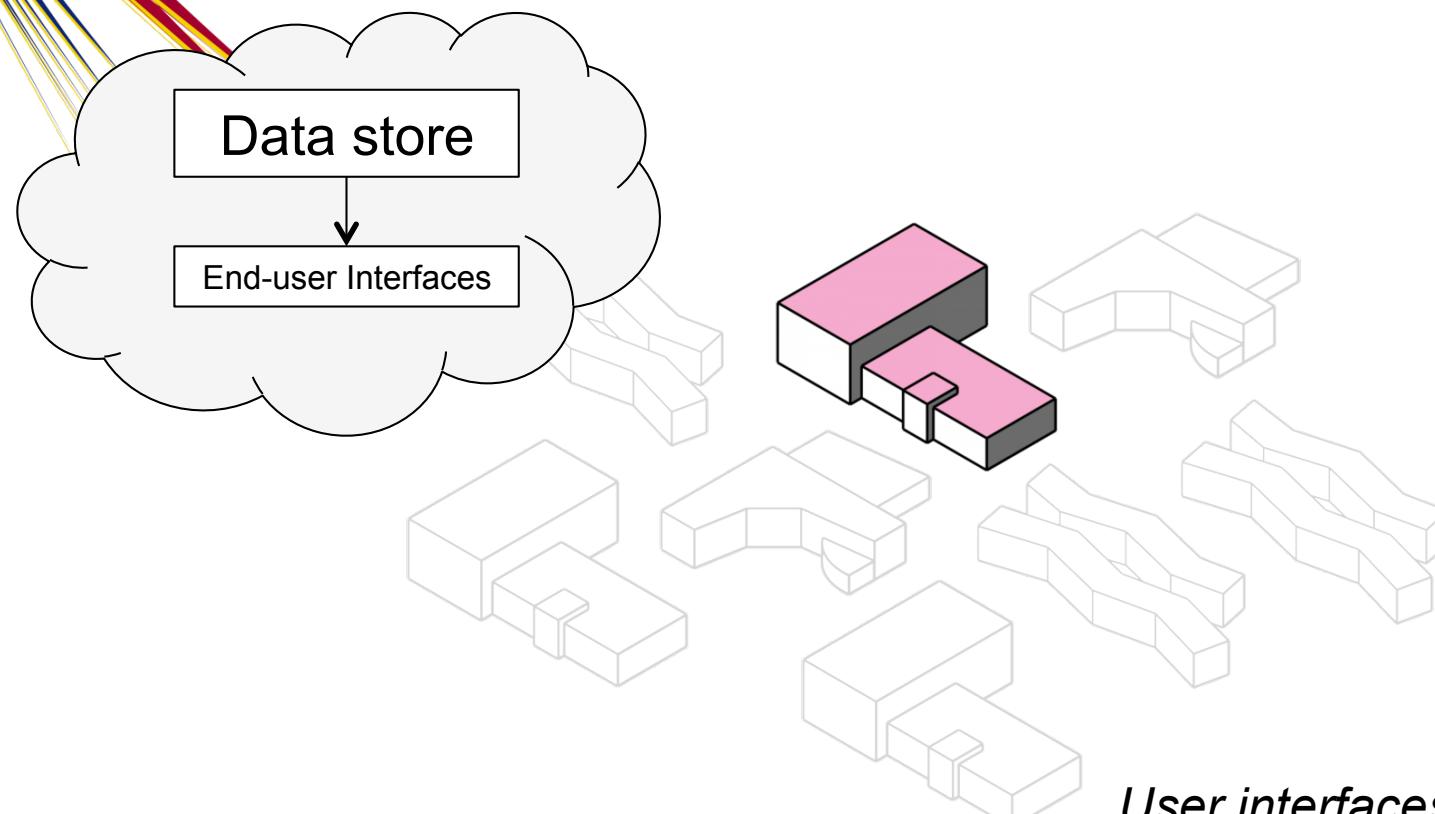




User Interfaces

Presentation and Control

Architecture - presentation



User interfaces are driven by the data from the data store



Architecture - presentation

User Interfaces

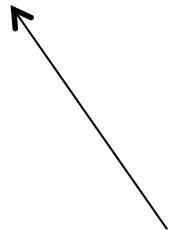
- Who are the potential end users?
 - Staff/tenants of a workplace
 - Managers of a workplace
 - Maintenance
 - Service suppliers (e.g. national grid)
 - Service retailers



Architecture - presentation

User Interfaces

- Who are the potential end users?
 - Staff/tenants of a workplace
 - Managers of a workplace
 - Maintenance
 - Service suppliers (e.g. national grid)
 - Service retailers



*These are considered in
other Horizon projects (e.g.
Desimax)*



Architecture - presentation

User Interfaces

- Who are the end users?
 - Staff/tenants of a workplace
 - Managers of a workplace
 - Maintenance
 - Service suppliers (e.g. national grid)
 - Service retailers

The field-trial in C-Aware focuses on these





Architecture - presentation

User Interfaces

- Who are the end users?
 - Staff/tenants of a workplace
 - Managers of a workplace
 - Maintenance
- There are 3 interesting interfaces that could be designed for these users, each with different characteristics

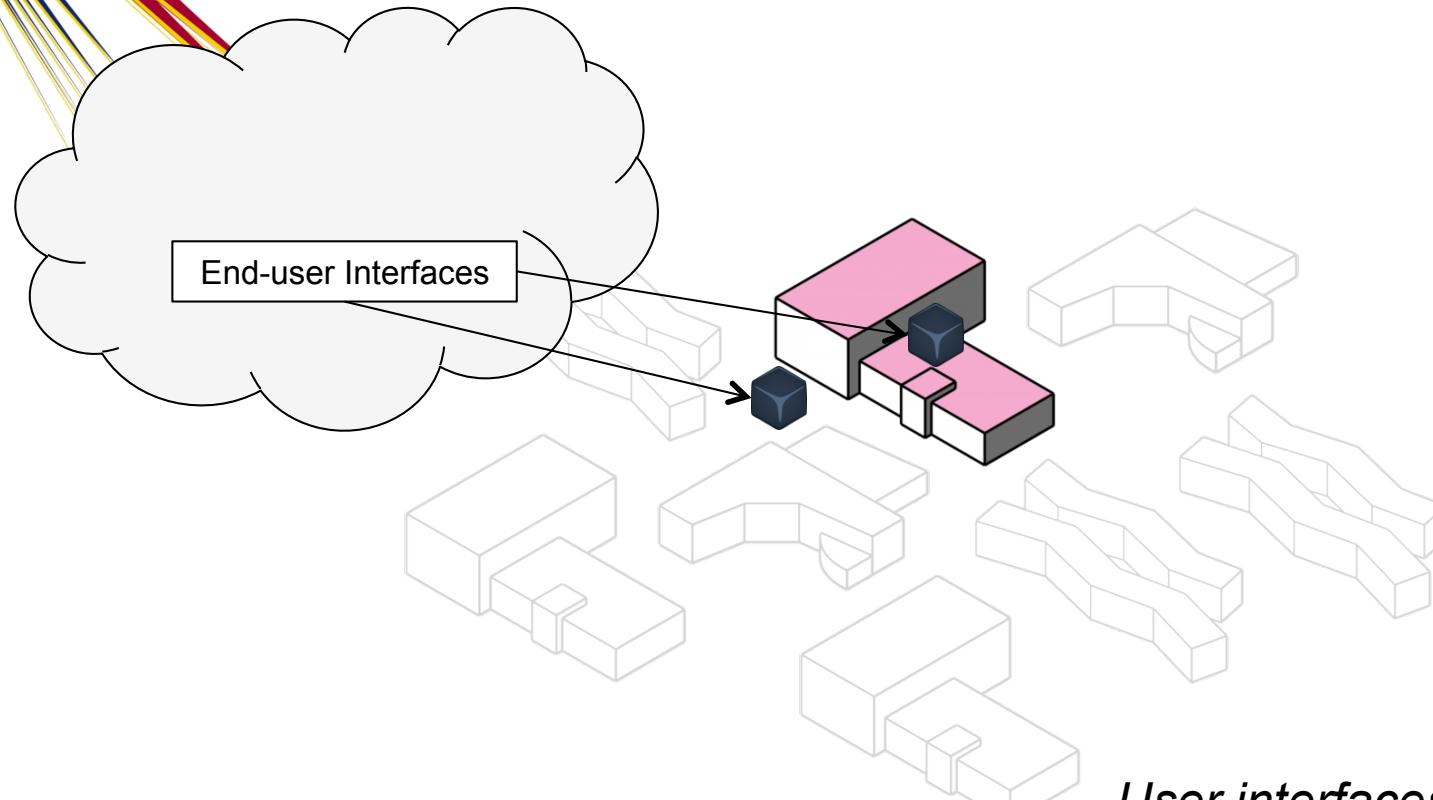


Architecture - presentation

User Interfaces

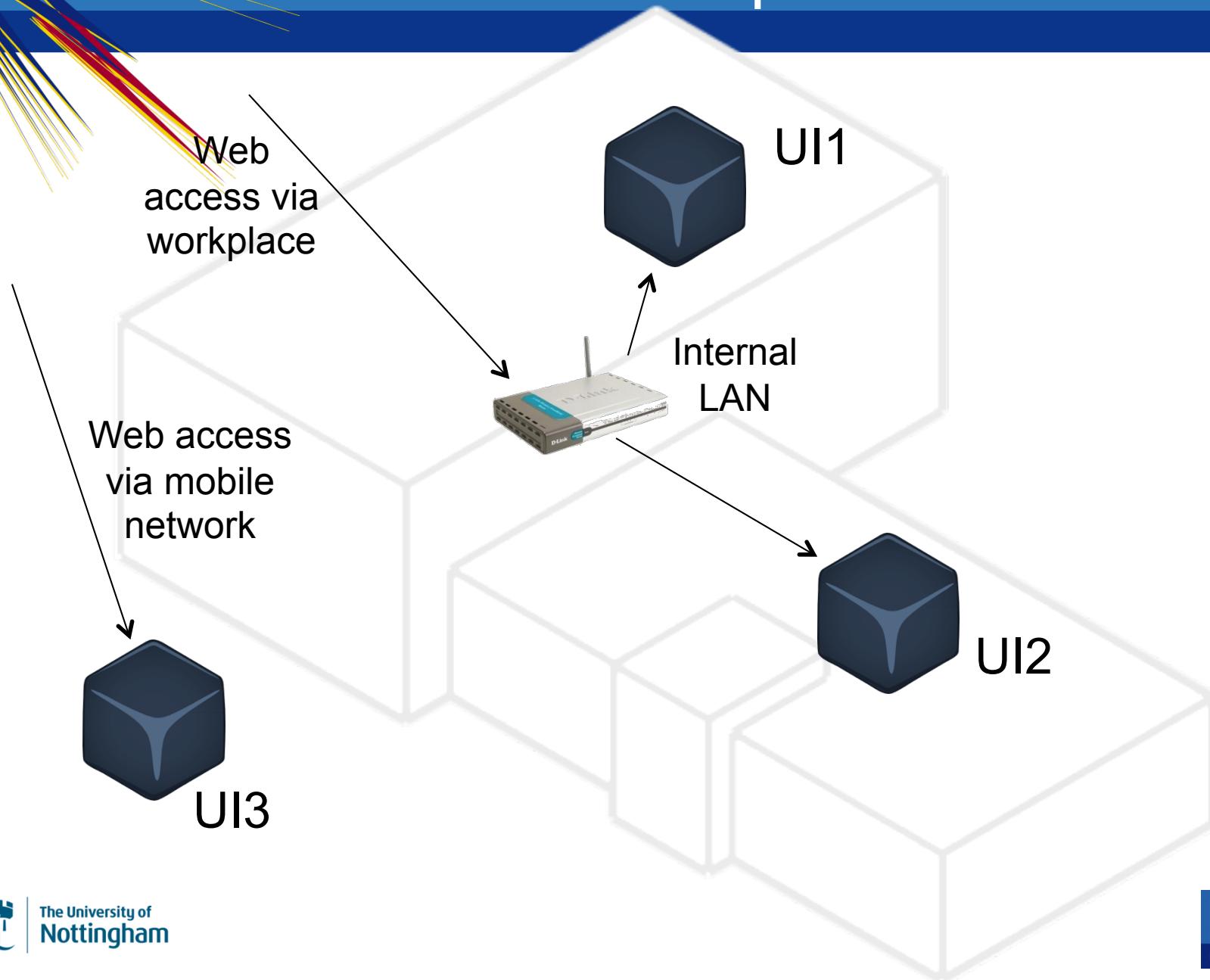
- Who are the end users?
 - Staff/tenants of a workplace – *UI 1: Public display*
 - Managers of a workplace – *UI2: Private desktop display*
 - Maintenance – *UI3: Personal mobile display*
- There are 3 interesting interfaces that could be designed for these users, each with different characteristics

Architecture - presentation



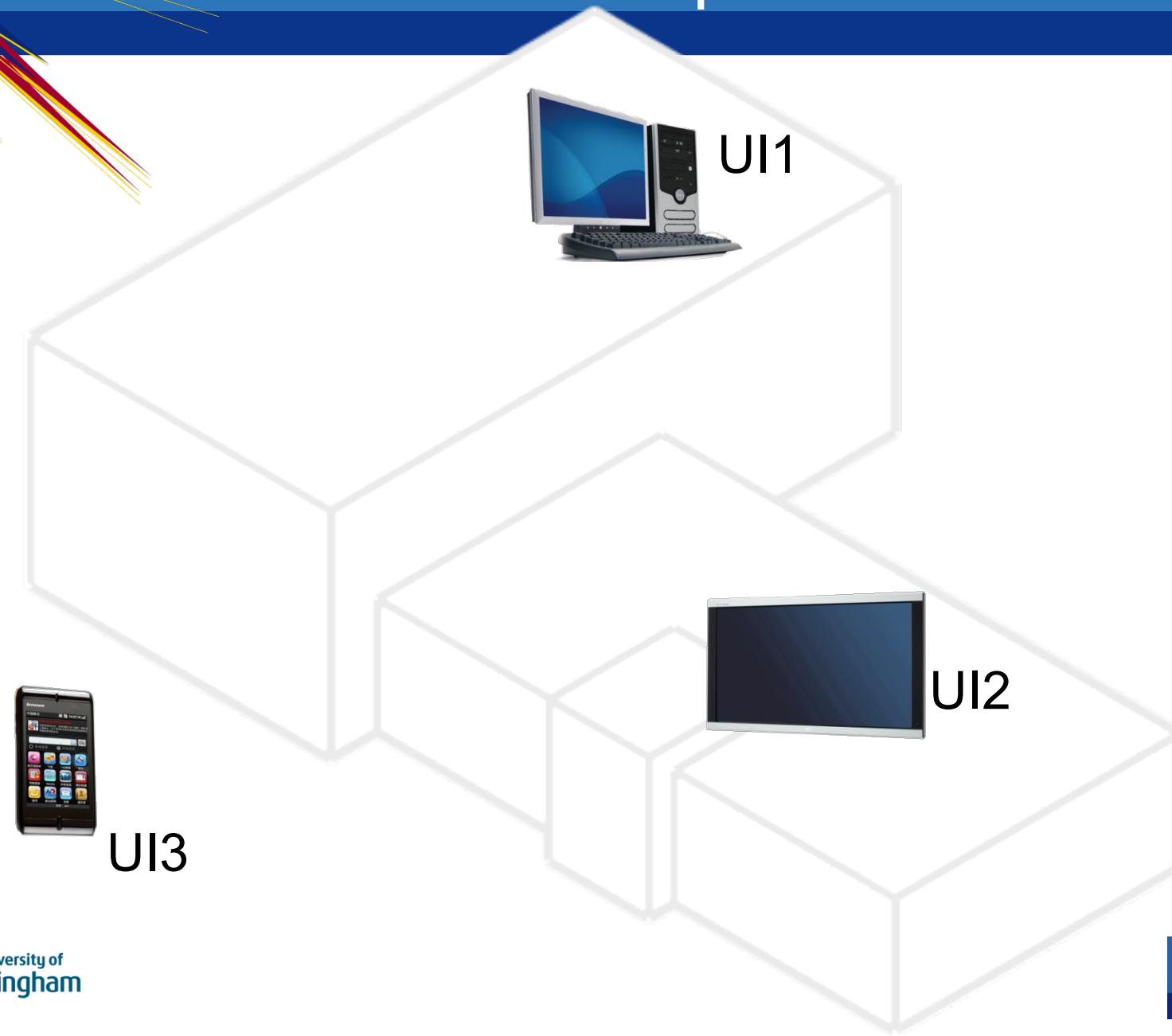
User interfaces are accessed by displays with web access

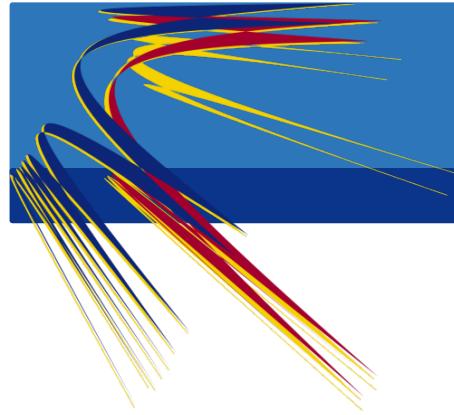
Architecture - presentation





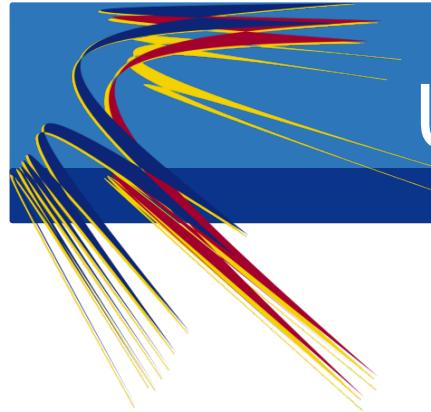
Architecture - presentation





User Interface 1

Public display for presenting data to employees

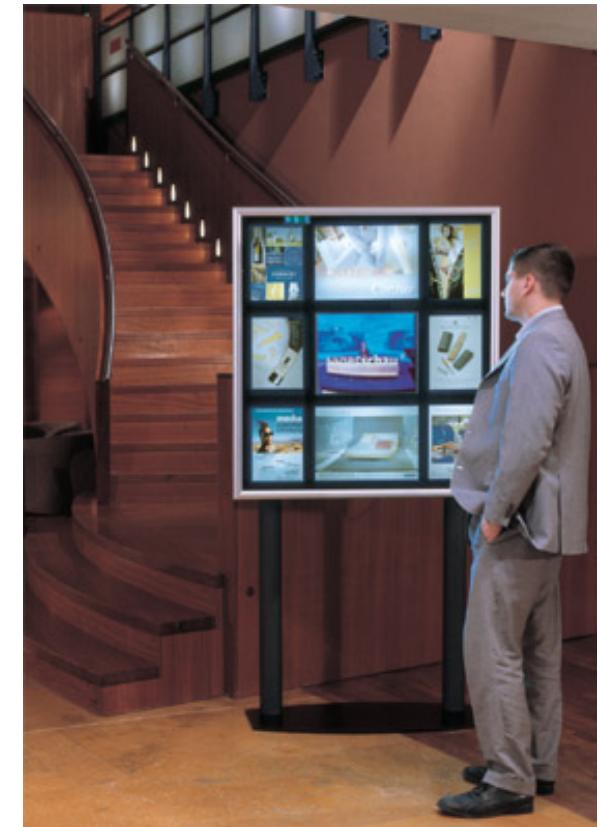


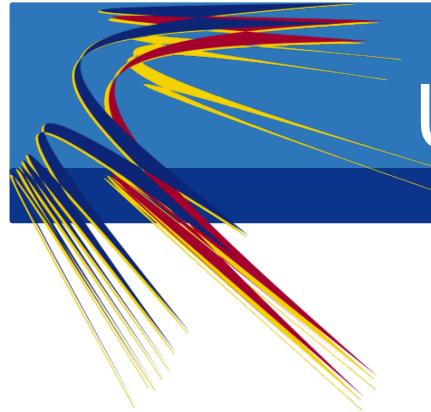
User interfaces

UI1: Public display for employees

Employees can be motivated to improve their working habits to reduce the emissions of the workplace

- Each workplace will have a public display (or a number of identical displays?). The public display should show:
 - Progress of the workplace towards its goal(s)
 - The contribution of each team to the progress of the workplace
 - Comparison with progress of a competing workplace



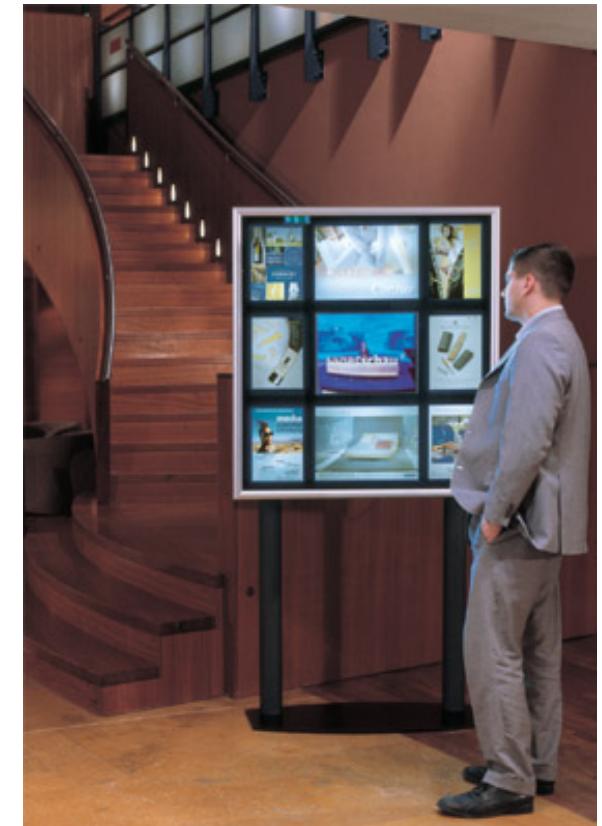


User interfaces

UI1: Public display for employees

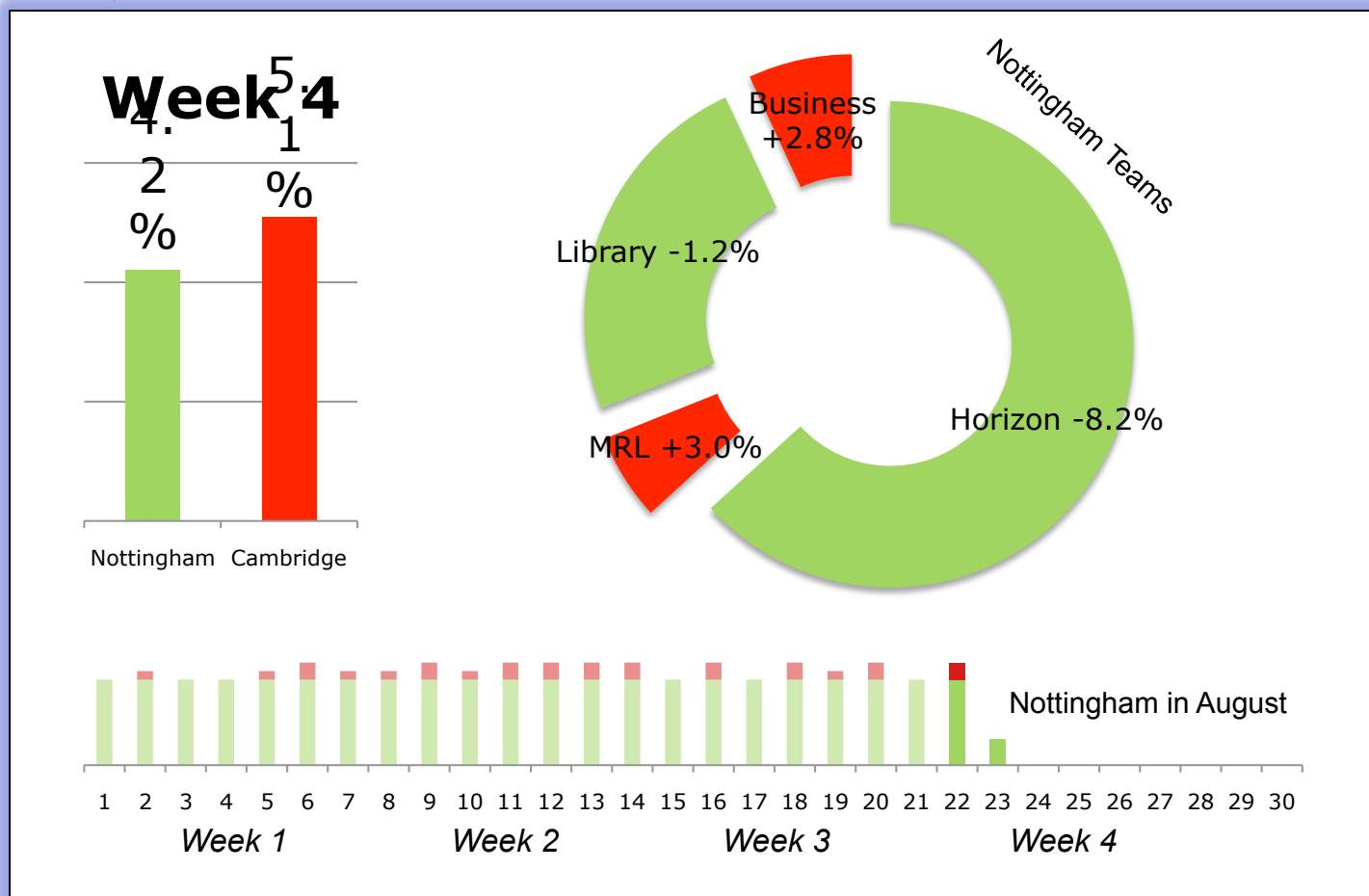
Employees can be motivated to improve their working habits to reduce the emissions of the workplace

- Each workplace will have a public display (or a number of identical displays?). The public display should show:
 - Progress of the workplace towards its goal(s)
 - The contribution of each team to the progress of the workplace
 - Comparison with progress of a competing workplace
- Similar workplaces will compete to reduce emissions; within a workplace, employees will be split into teams to compete to contribute the highest reductions
- The display also conveys a positive image to visitors



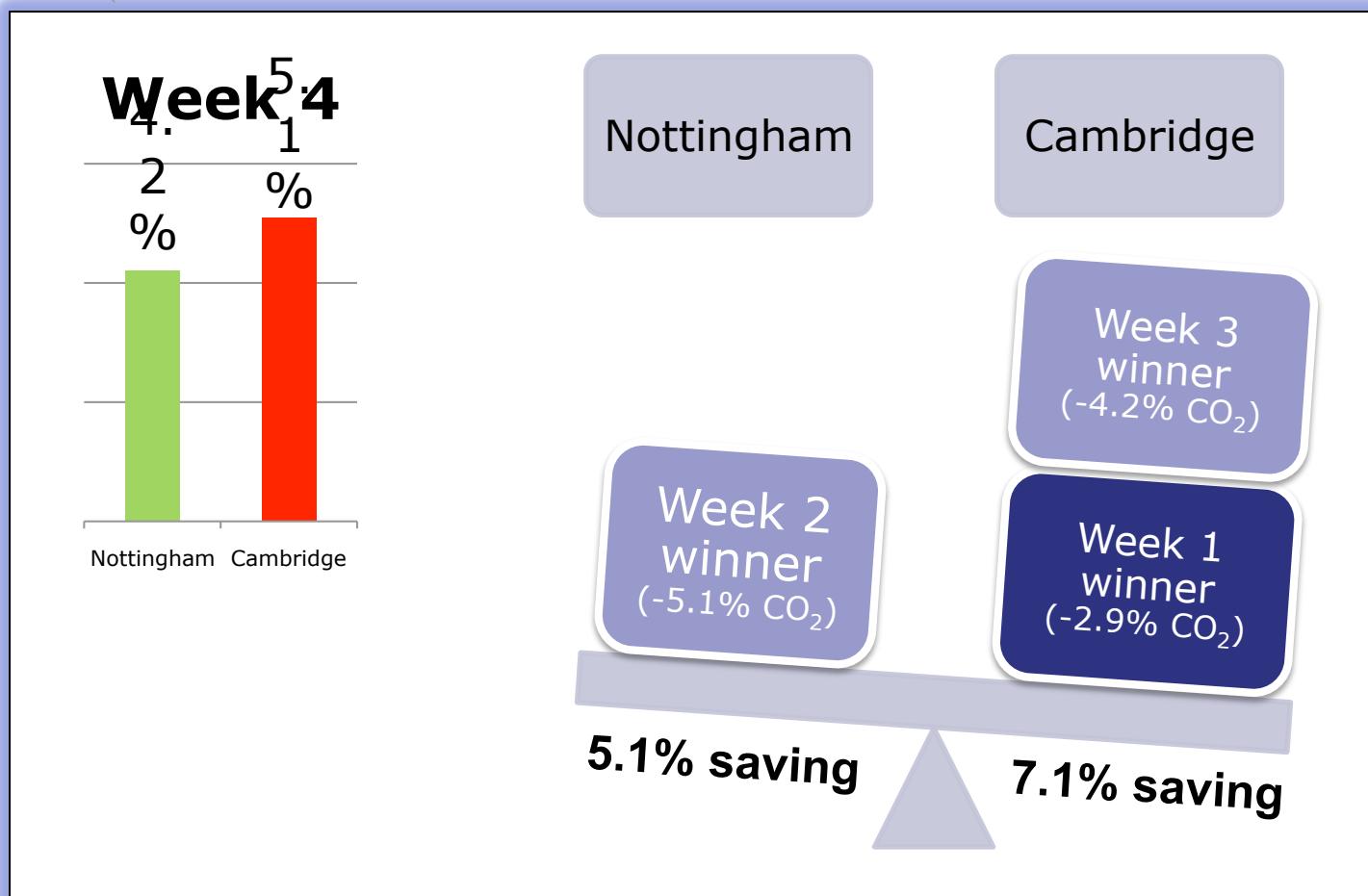
User interfaces

Examples



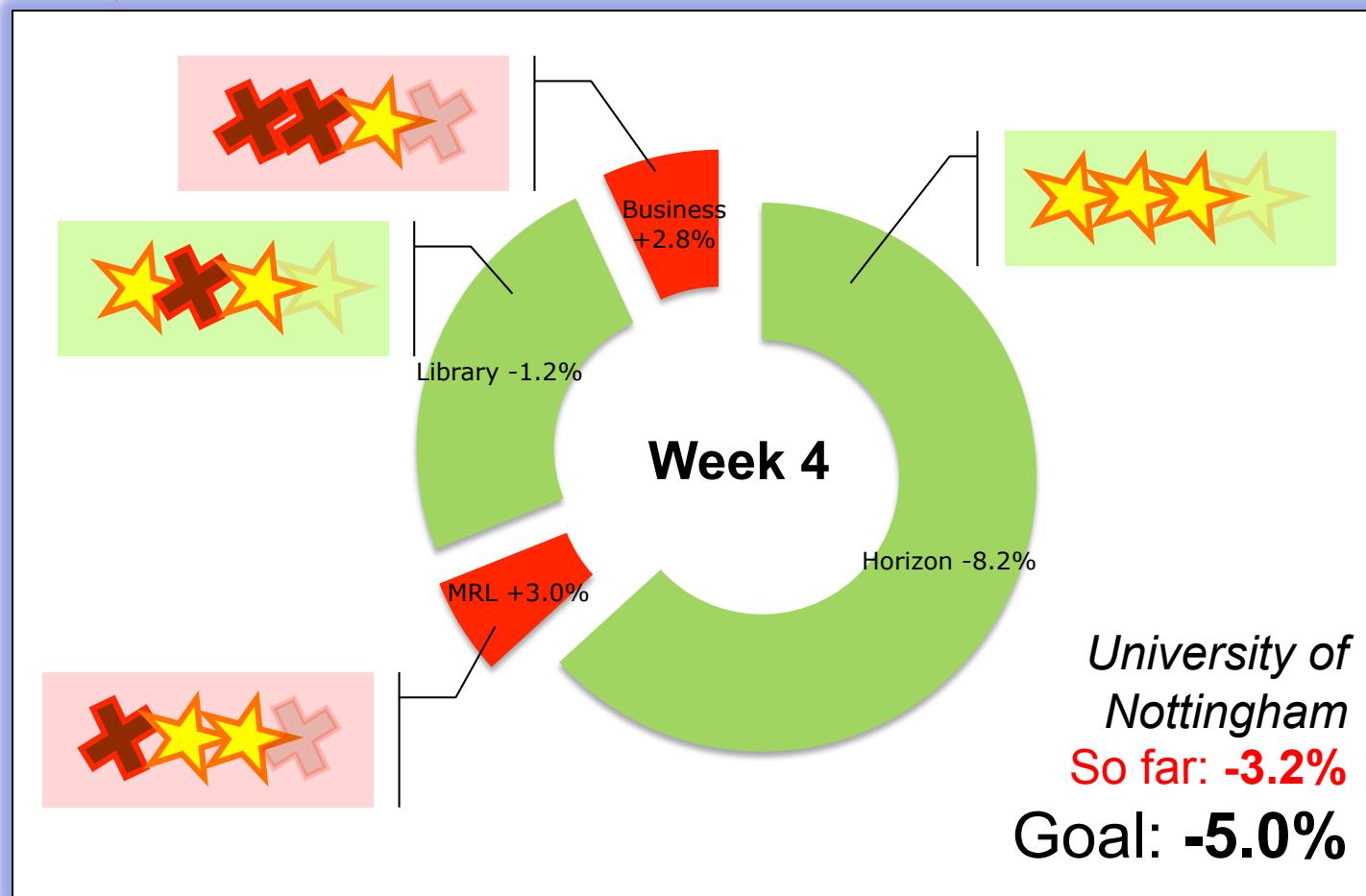
User interfaces

Examples



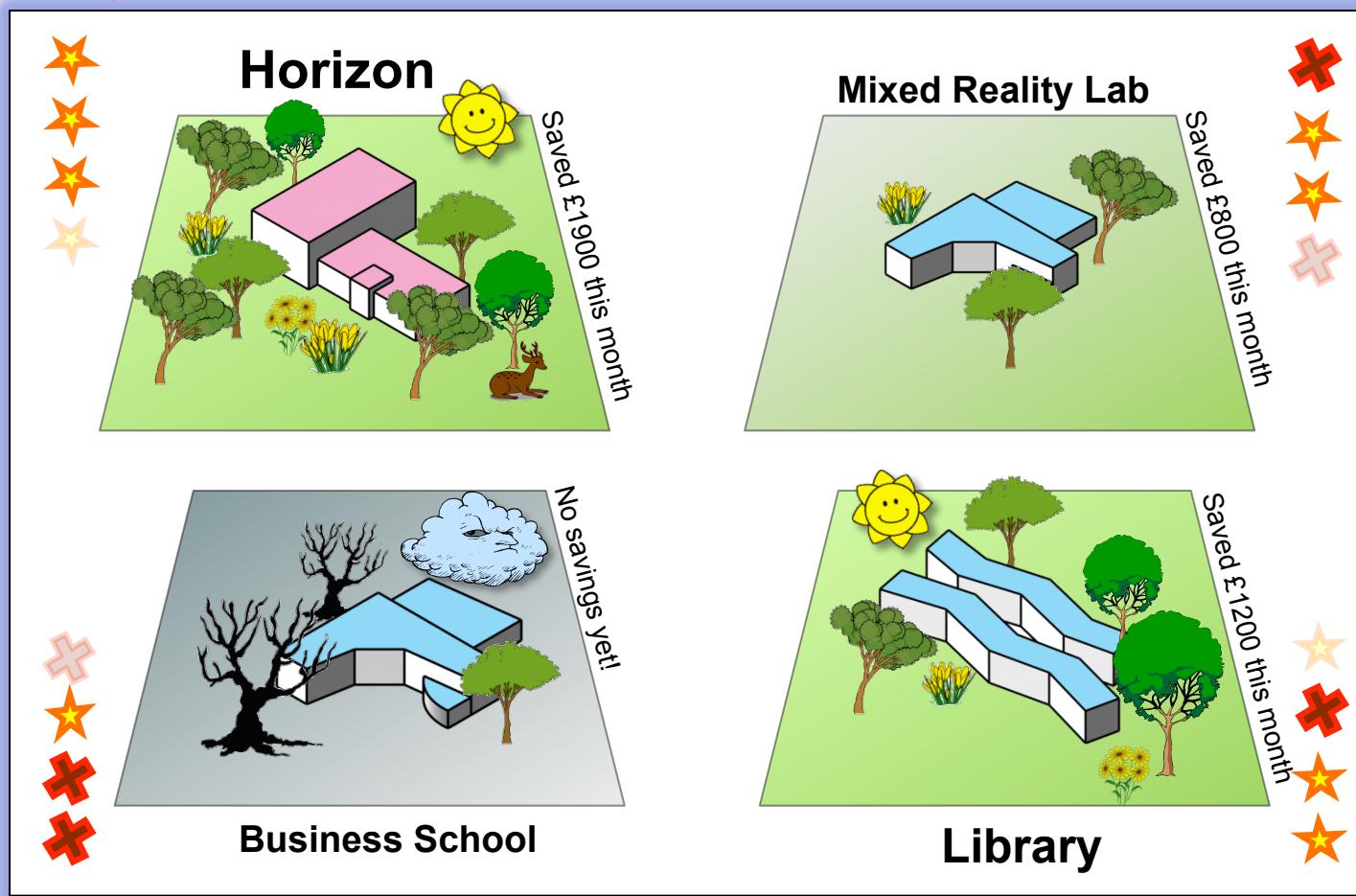
User interfaces

Examples



User interfaces

Examples

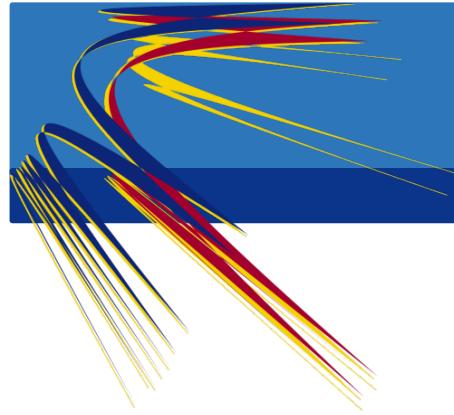




User interfaces

Issues

- **Dynamic to maintain interest**
 - UI1 must react to changes quickly, always reflecting new information in order to maintain the interest of the employees
- **Responsibility – reliably link action to emission to avoid incorrect public blame**
 - Emission data must be reliably linked to the correct employees/teams within a workplace (we should not incorrectly 'blame' employees)
- **Teams, not individuals – avoid individual accountability and build team relationships**
 - Encouraging team competition within a workplace rather than individual competition is usually more effective as this builds relationships between employees and encourages widespread change in habits, rather than individual changes in habits
 - Progress towards goals by teams should be displayed publicly, but contributions by individual employees should not be shown publicly, so that competition within teams/personal embarrassment does not occur
- **Clear goals set by management – collective, achievable goals**
 - Within a workplace, teams should compete to contribute to collective goals, not just to beat each other
 - Goals should be set by the owners/management of a workplace, and advice should be given on methods for improvement
 - Goals should be set/adjusted regularly to maintain engagement of employees
- **Rewards – competition is a reward**
 - Employees of the winning team should consider enjoyment of the competition as the reward
 - Rewards for reaching a collective goal may be given to all employees; providing additional rewards to the winning team may discourage competition or encourage over-competition



User Interface 2

Private desktop display for presenting data to
managers of a workplace



User interfaces

UI2: Private desktop display for managers of a workplace

Managers of the workplace can see which employees/appliances contribute to the emissions of the workplace, and monitor the effects of changes they make to the workplace

- UI2 will allow managers to determine what behaviours are causing emissions (discover particular staff, appliances or processes that need to be changed)





User interfaces

UI2: Private desktop display for managers of a workplace

Managers of the workplace can see which employees/appliances contribute to the emissions of the workplace, and monitor the effects of changes they make to the workplace

- UI2 will allow managers to determine what behaviours are causing emissions (discover particular staff, appliances or processes that need to be changed)
- UI2 will also allow managers to assess the impact of any changes they make to staff/ appliances (compare emissions before and after a change)





User interfaces

UI2: Private desktop display for managers of a workplace

Managers of the workplace can see which employees/appliances contribute to the emissions of the workplace, and monitor the effects of changes they make to the workplace

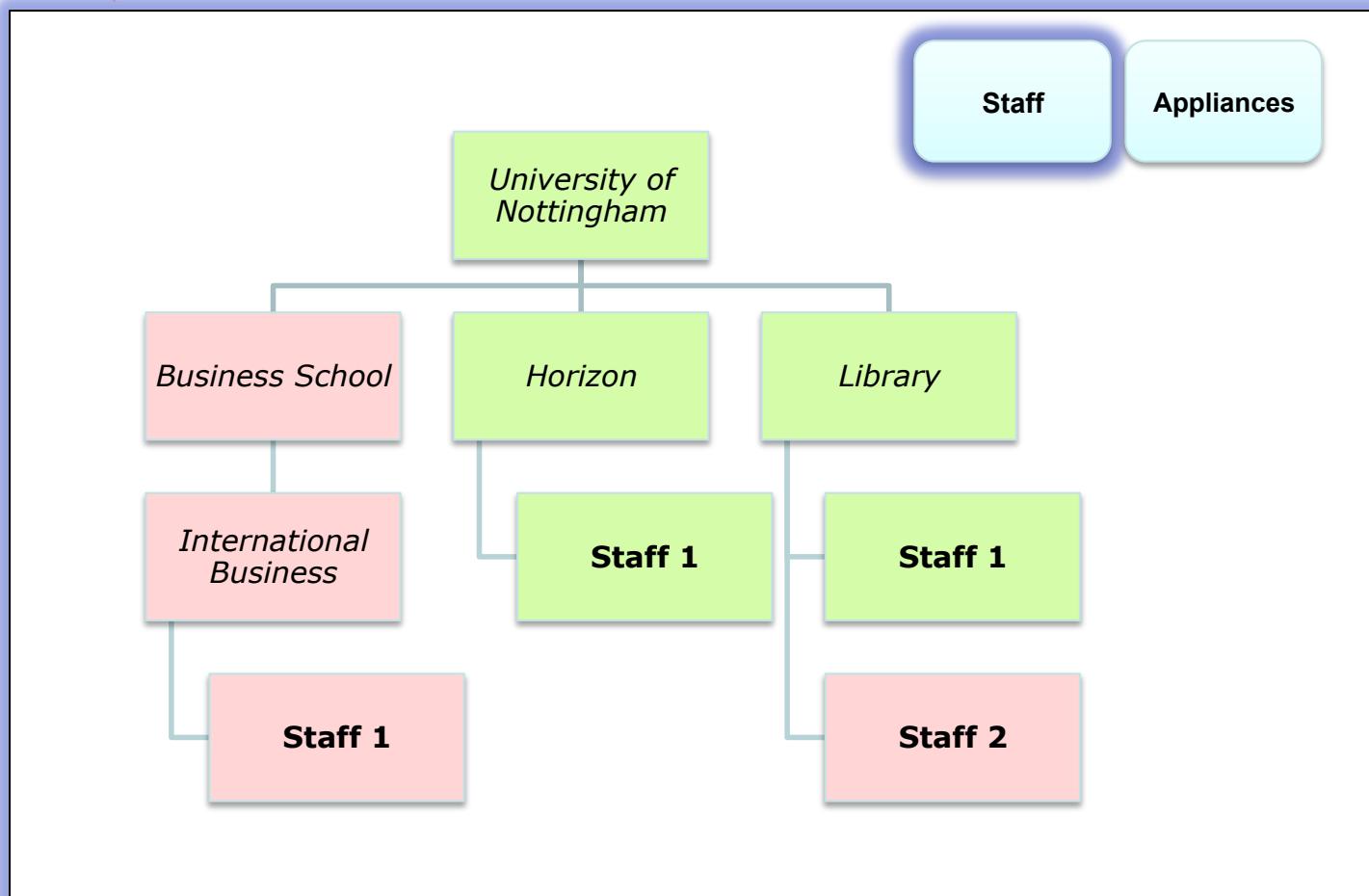
- UI2 will allow managers to determine what behaviours are causing emissions (discover particular staff, appliances or processes that need to be changed)
- UI2 will also allow managers to assess the impact of any changes they make to staff/ appliances (compare emissions before and after a change)
- UI2 should also allow managers to make comparisons between their workplace and other workplaces so that they can set goals





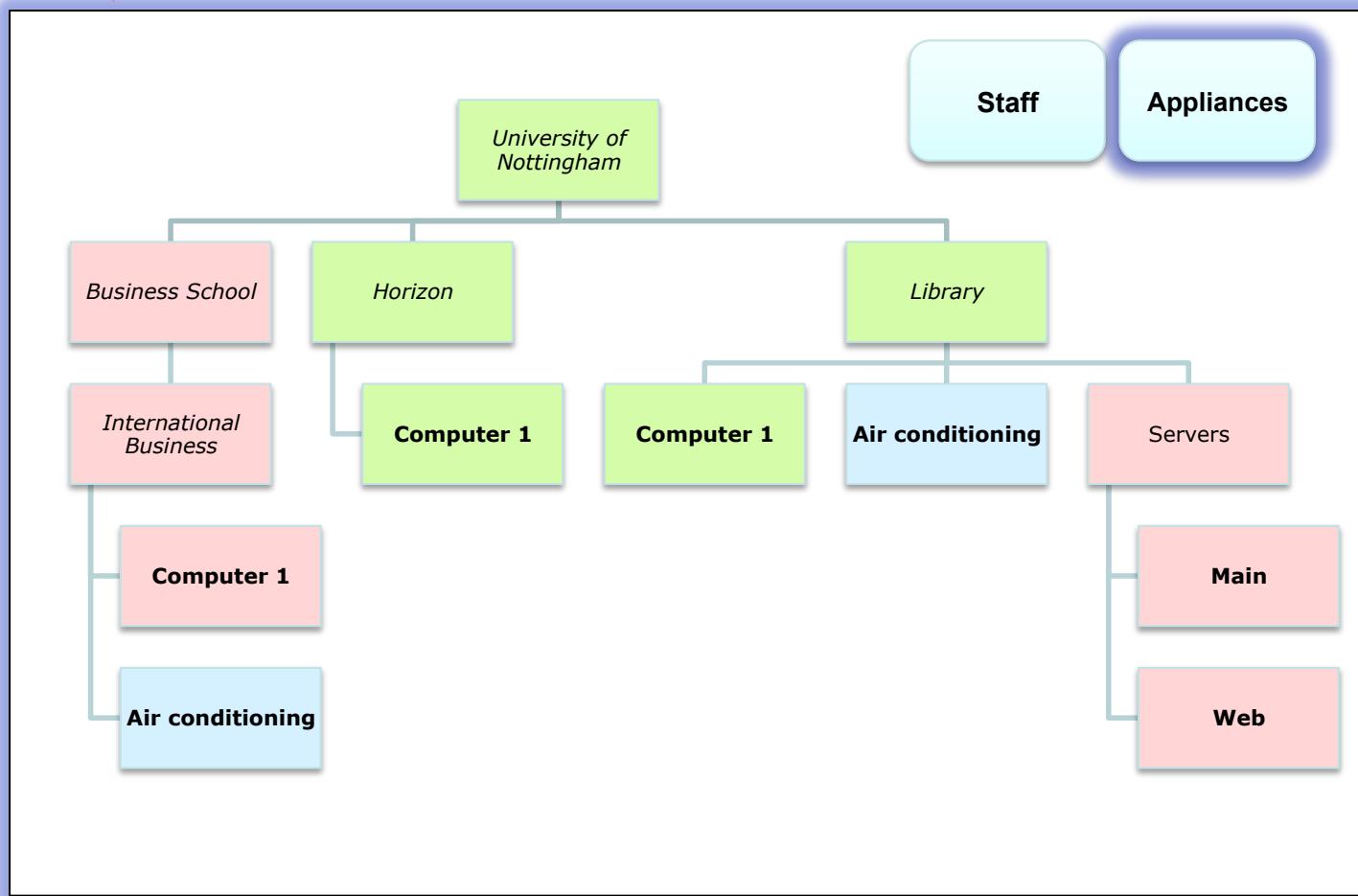
User interfaces

Examples



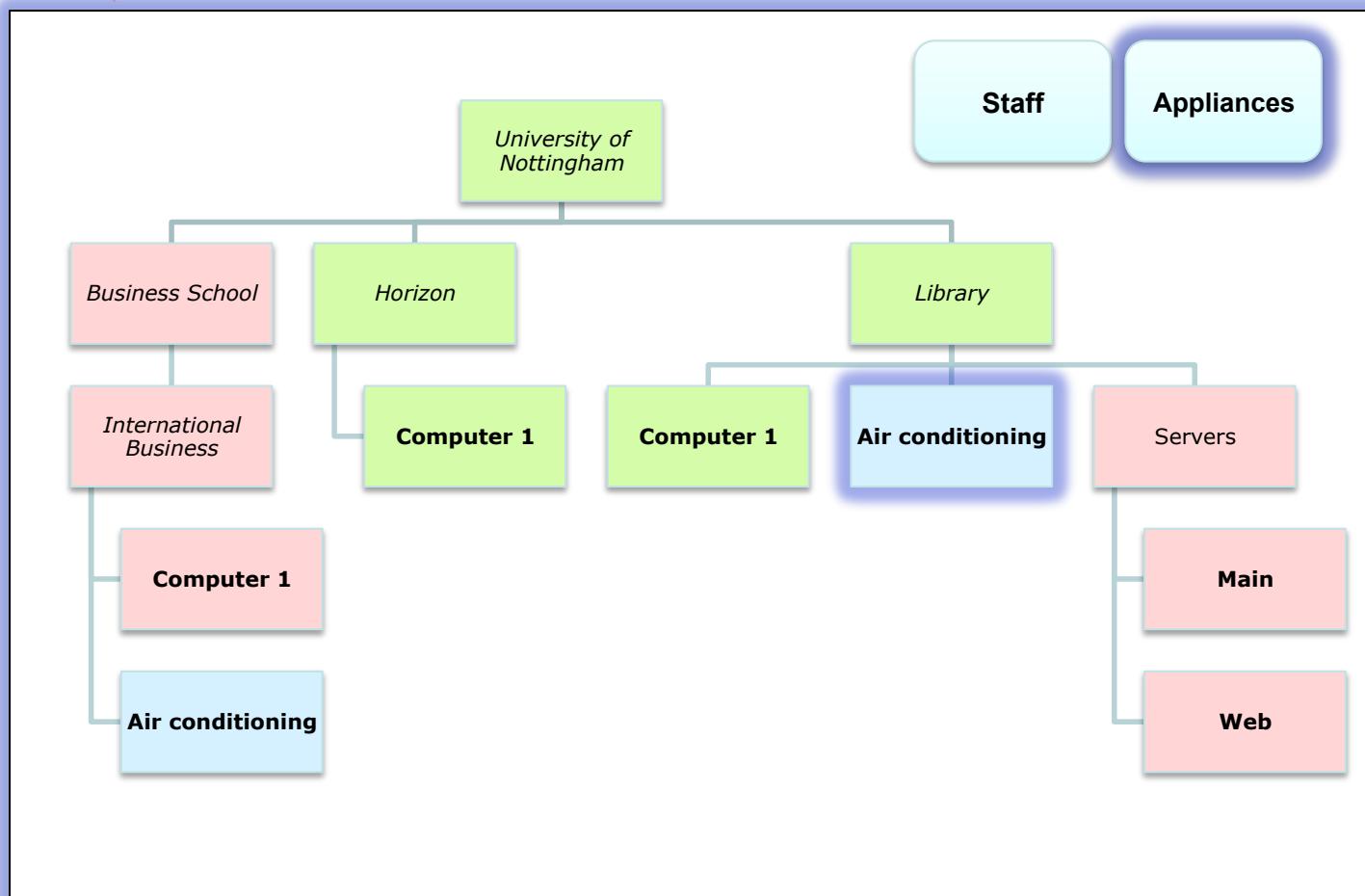
User interfaces

Examples



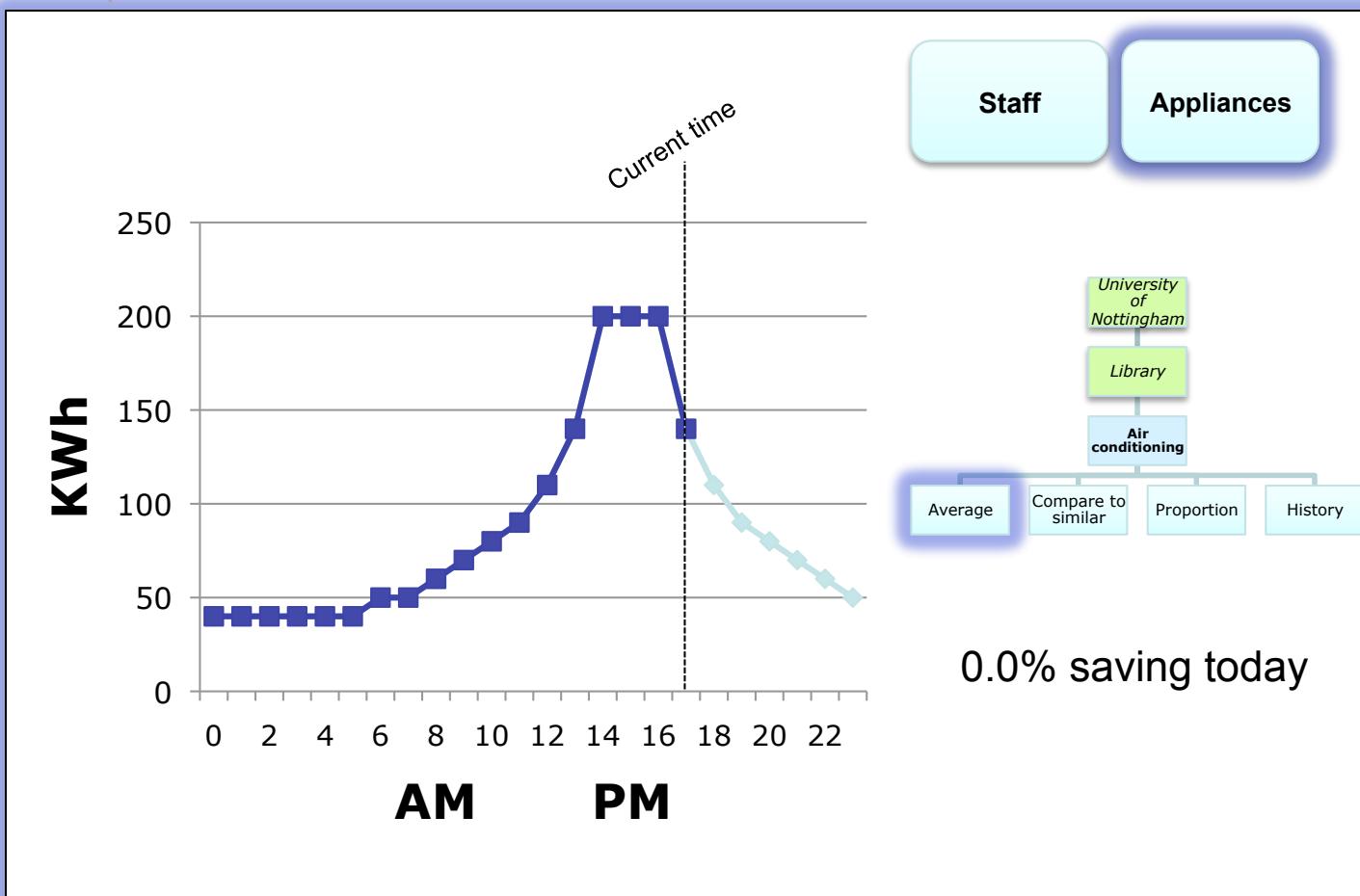
User interfaces

Examples



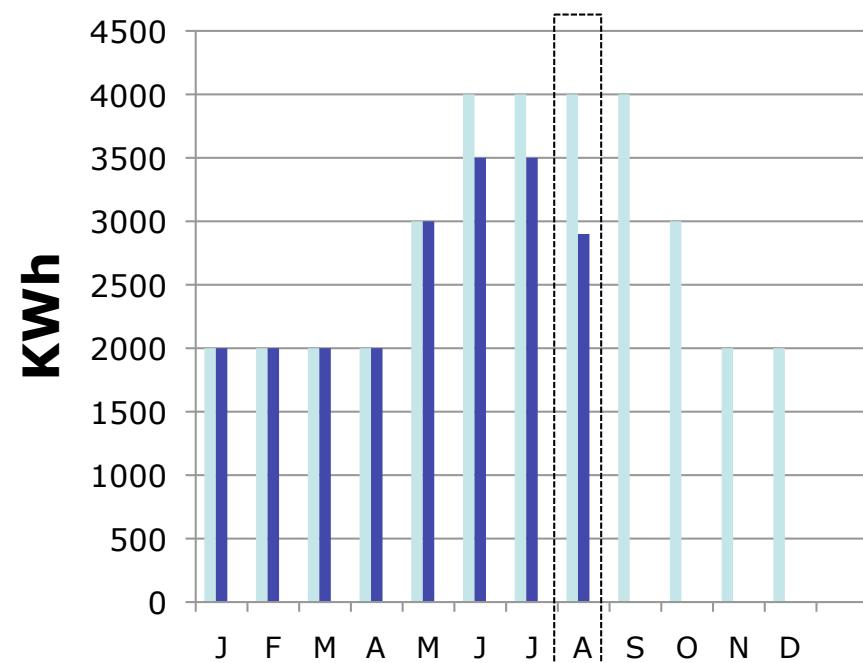
User interfaces

Examples



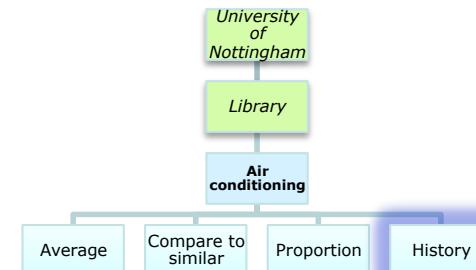
User interfaces

Examples



Staff

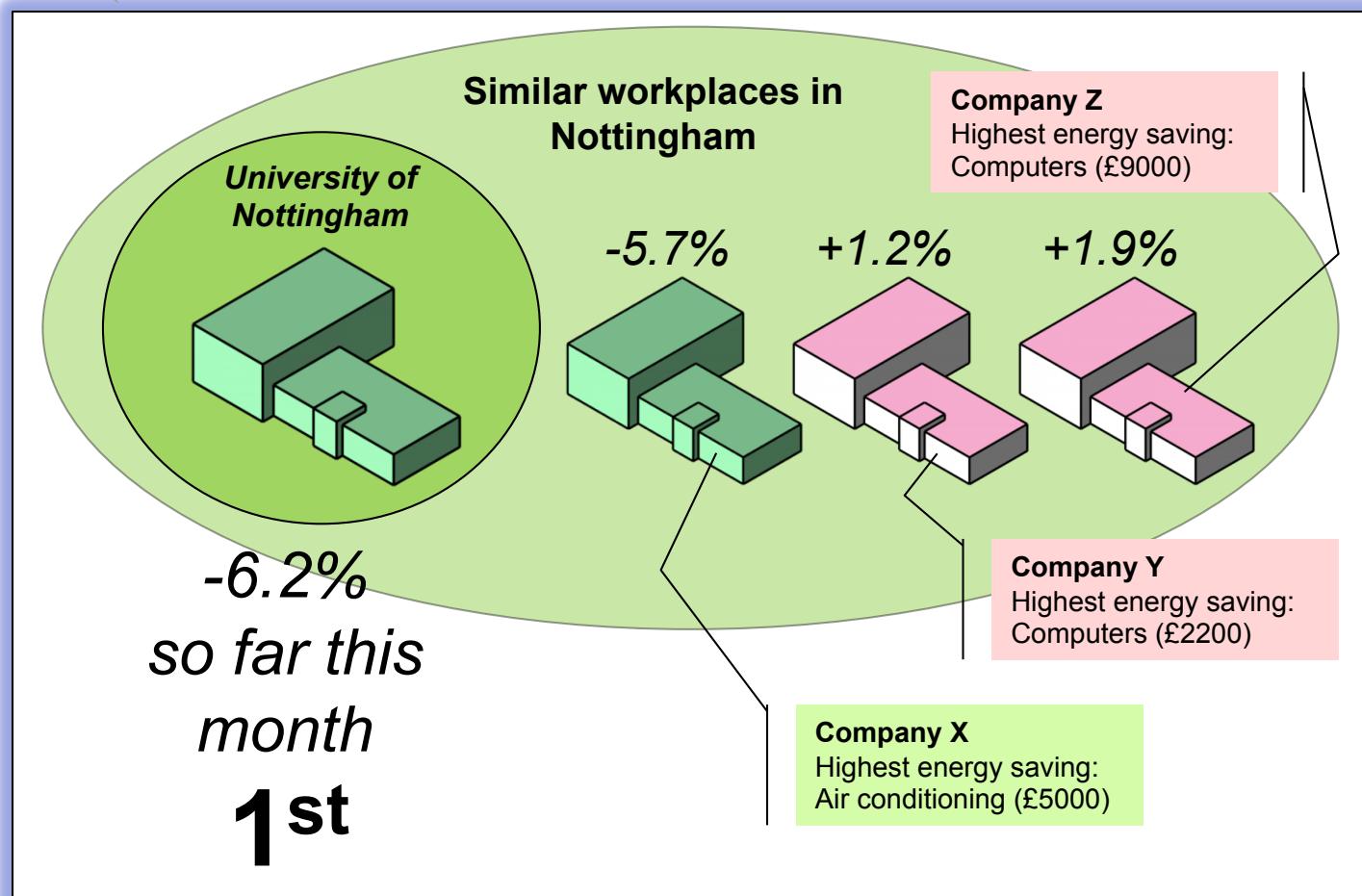
Appliances



10% saving this year
 (£9000)

User interfaces

Examples



User interfaces

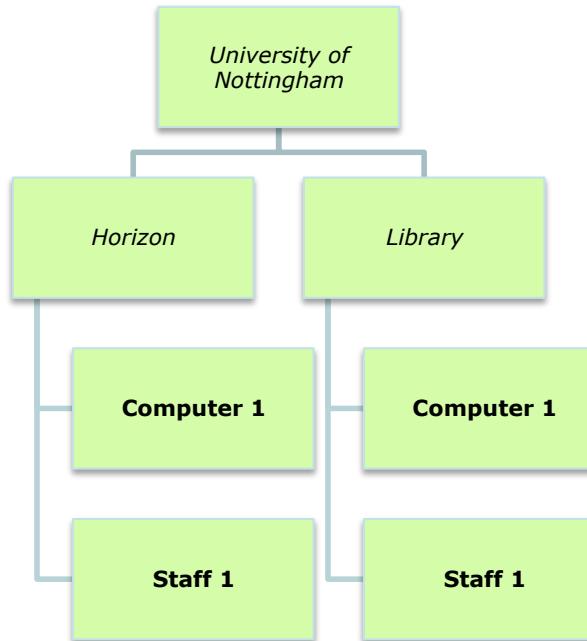
Examples

Progress for August

Total saving 5.0%
So far: **6.2%**

Current saving
£11000

Best progress



User interfaces

Examples

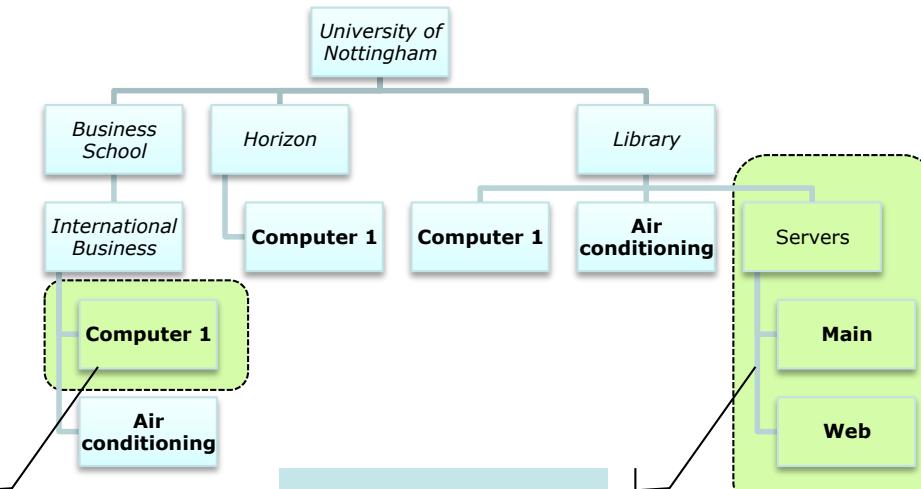
Goal for September

Total saving 7.0%

Potential saving
£15000

Reduced operating hours
Potential saving: £300

Key targets

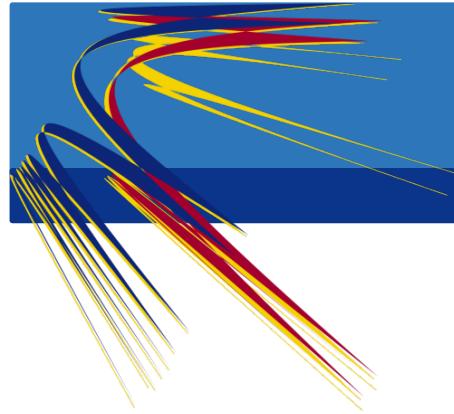




User interfaces

Issues

- ***Cost vs. emissions – policy makers motivated by cost***
 - Managers will probably be motivated by the costs of energy use rather than emissions of energy use, therefore UI1 will need to emphasise the link between energy use and both costs and emissions
- ***Responsibility – reliable reporting if UI makes individuals accountable***
 - As with UI1, this interface would require emission data to be reliably linked to the correct employees/appliances within a workplace, particularly if managers are going to make changes based on data presented by the interface; the interface should not suggest a change unless it is highly likely to make a positive impact
- ***Levels of information & privacy – reflect responsibility of individual managers***
 - To preserve privacy UI1 only revealed team data; UI2 should allow data to be viewed at different levels of detail, allowing the manager to view the emissions of the entire workplace (and compare to other workplaces), emissions of teams (and compare to other teams), and emissions of individual employees and appliances
 - The amount of information should correspond to the information already available to a particular manager, e.g. if a manager only has responsibility for one team then they should not be able to view information about employees in other teams. For this reason, the interface must be restricted such that only specific managers can view it (by personal authentication)
 - Information about other workplaces must be anonymised so that a manager cannot find out about the structure/processes of a competing workplace
- ***Goal setting – link to the public display***
 - UI2 should allow the managers to set the goals that are shown in UI1; UI2 must allow the manager to assess the changes in emissions caused by setting goals – this will allow a manager to determine which changes to make permanent (enforcing changes made by a good team across the whole workplace), and which changes to reverse



User Interface 3

Personal mobile display for presenting data to
maintenance staff and providing control

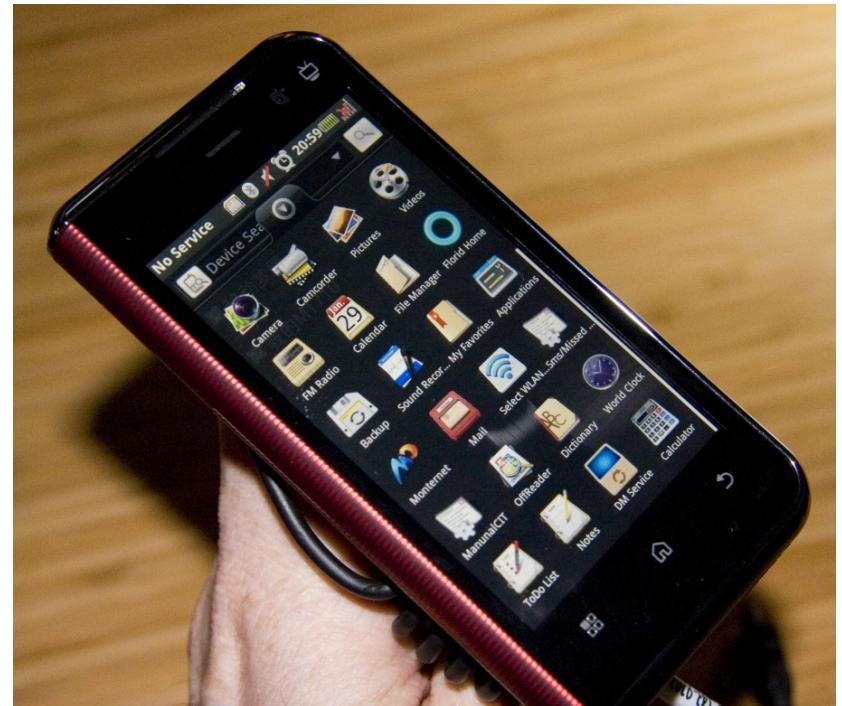


User interfaces

UI3: Personal mobile display for maintenance

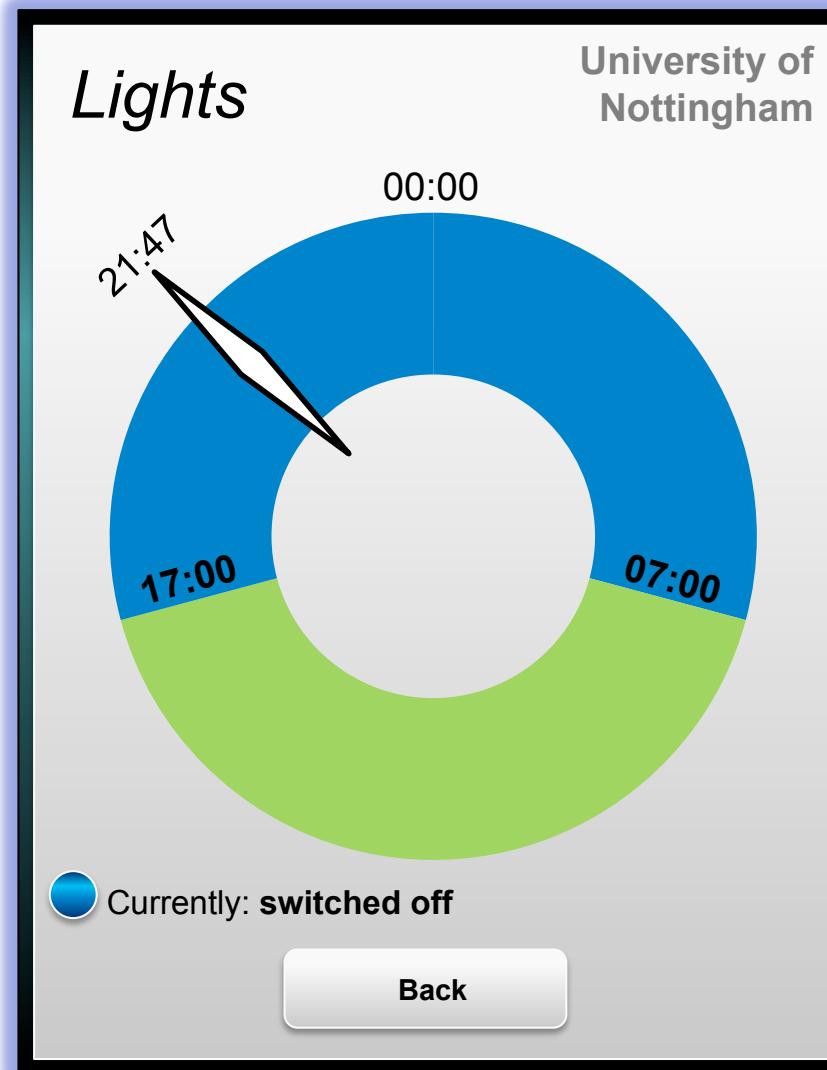
UI3 will allow the user to compare the current status of appliances in the workplace to the "expected" status of the appliances, to determine whether an appliance is potentially faulty/ requires maintenance

- The mobile UI can be accessed inside or outside the workplace
- The UI will allow an external maintenance company to monitor many workplaces simultaneously, comparing the effectiveness of appliances in different environments (giving evidence for recommendations to be made to managers for changes to workplaces)





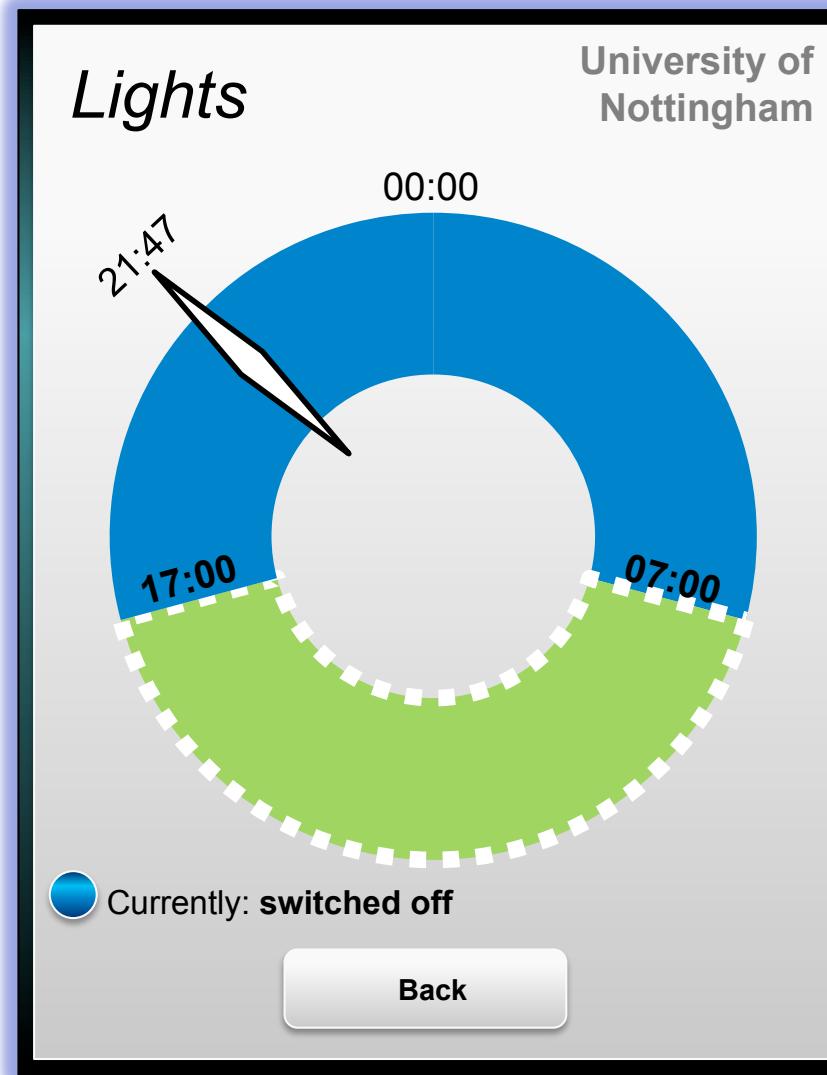
User interfaces



Examples



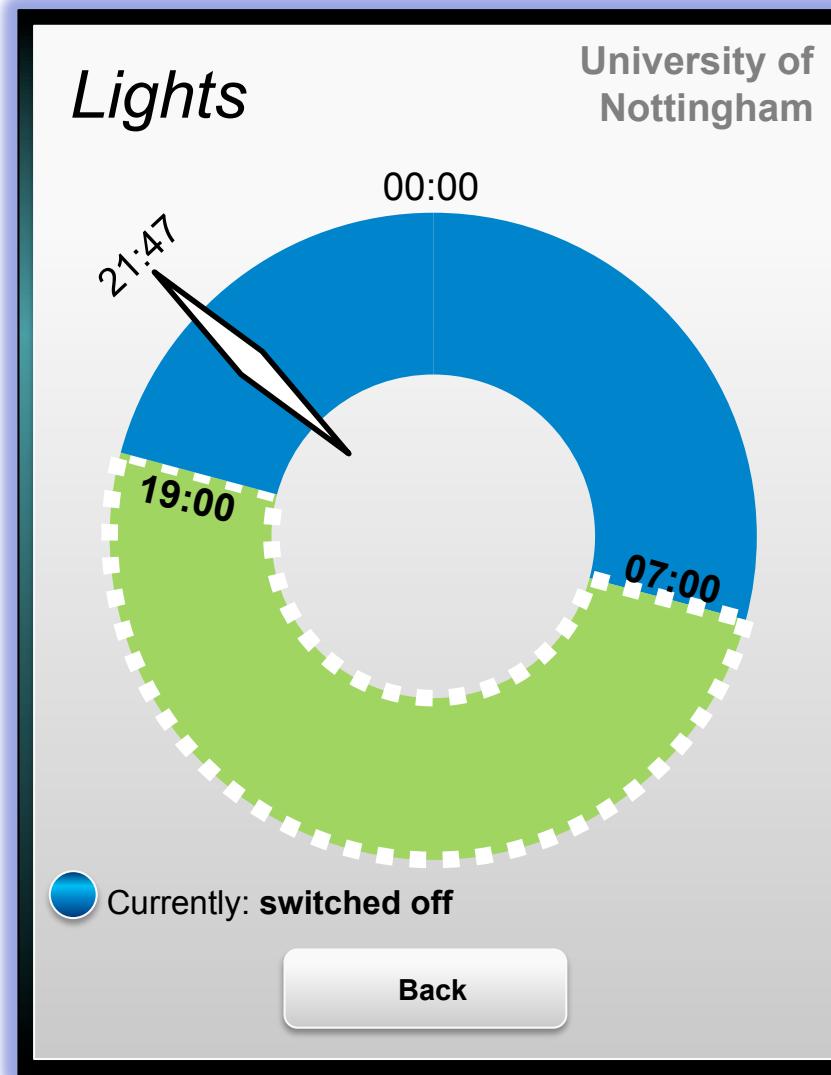
User interfaces



Examples



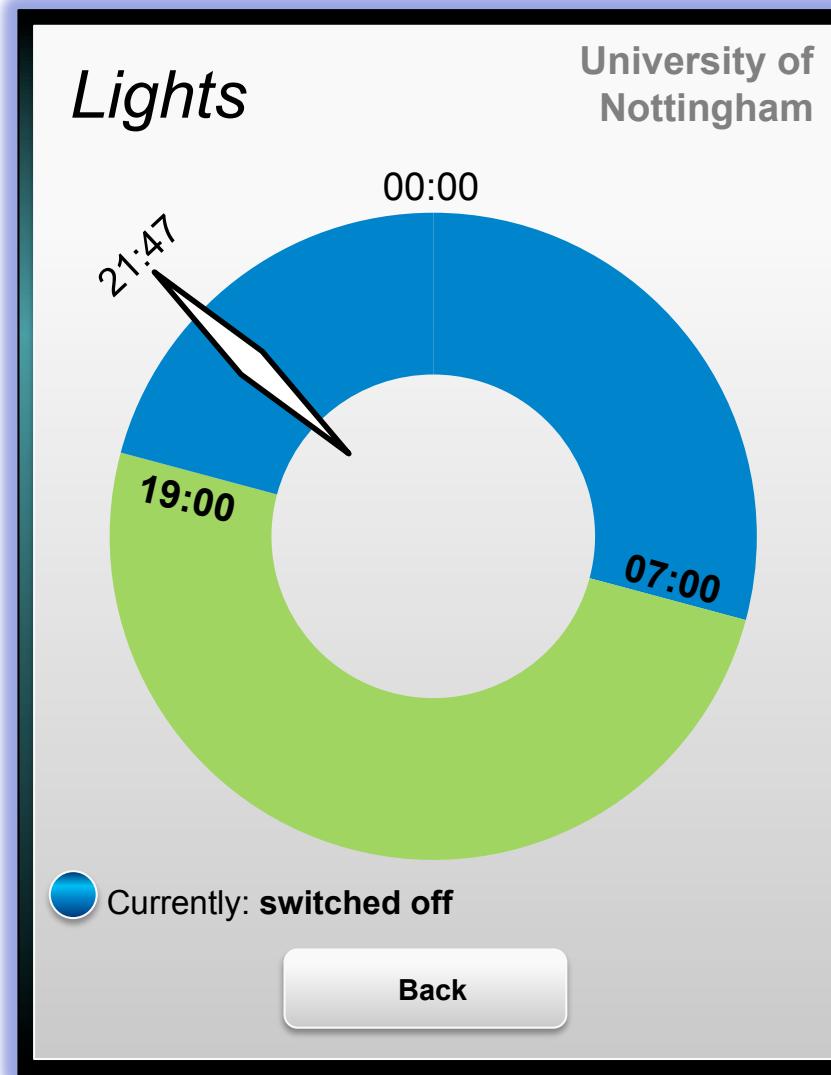
User interfaces



Examples



User interfaces



Examples



User interfaces

A screenshot of a mobile application interface. At the top, a white rounded rectangle contains the text "All clients". Below this, there is a list of items, each preceded by a small circular icon. The visible items are:

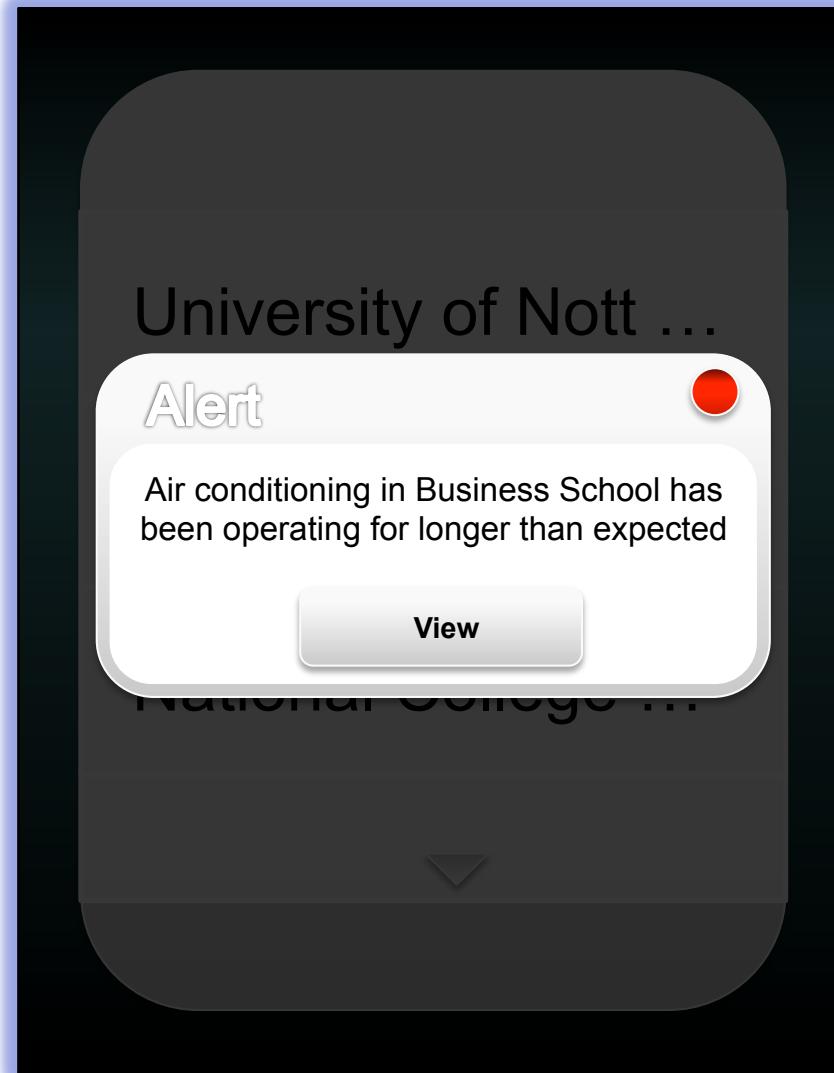
- University of Nott ...
- City Hospital
- National College ...

At the bottom of the list is a light gray button with a downward-pointing arrow in the center.

Examples



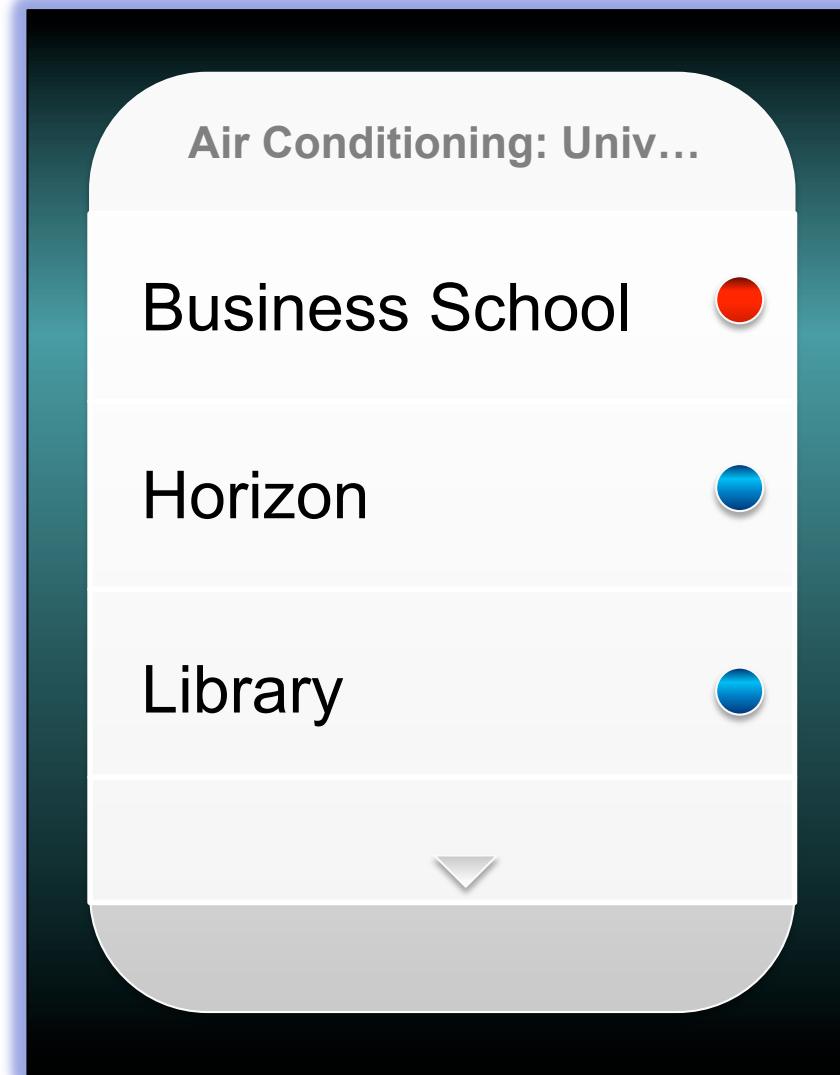
User interfaces



Examples



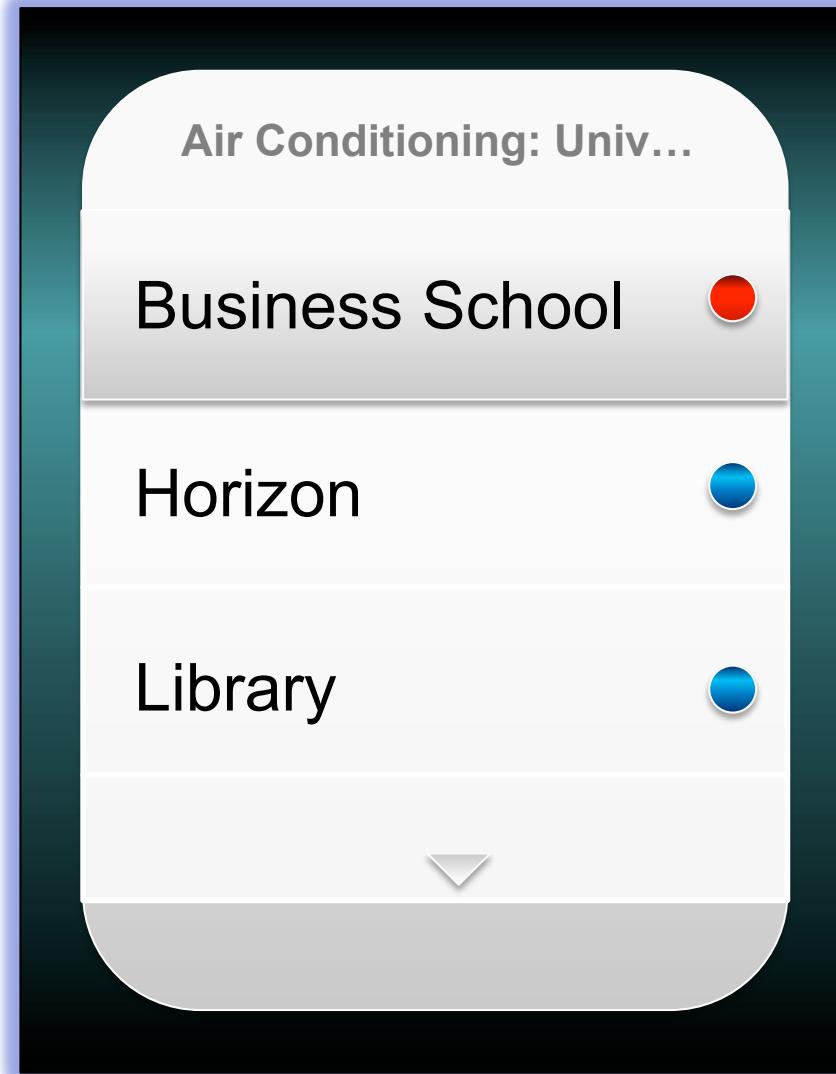
User interfaces



Examples



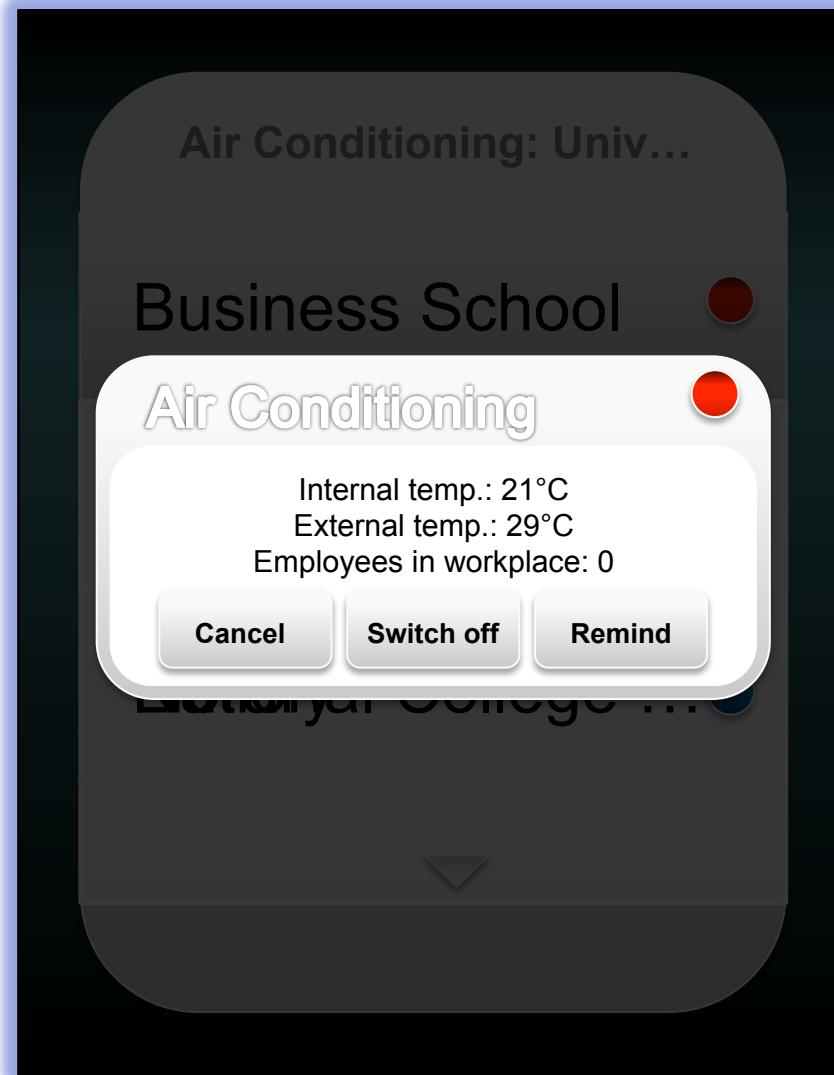
User interfaces



Examples



User interfaces



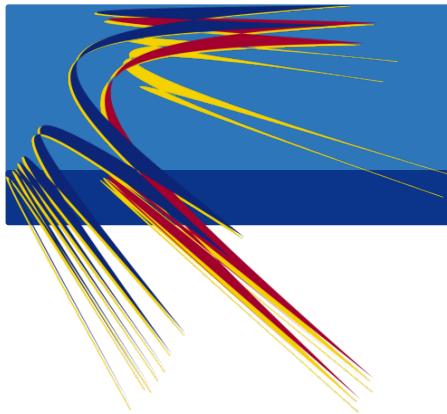
Examples



User interfaces

Issues

- ***Authentication – security back-door***
 - If UI3 can be used to control appliances remotely, we must ensure that only authorised personnel can use the interface
- ***Accountability – responsibility for remote changes must be clear***
 - If decisions to visit a workplace for maintenance are based on data provided by the interface, this data must be accurate
 - The effects of controlling appliances via the interface must be made clear to the user, so that the user does not negatively affect the workplace
 - A history of interactions with the workplace through UI3 must be kept so that the managers of the workplace can see what maintenance has been carried out

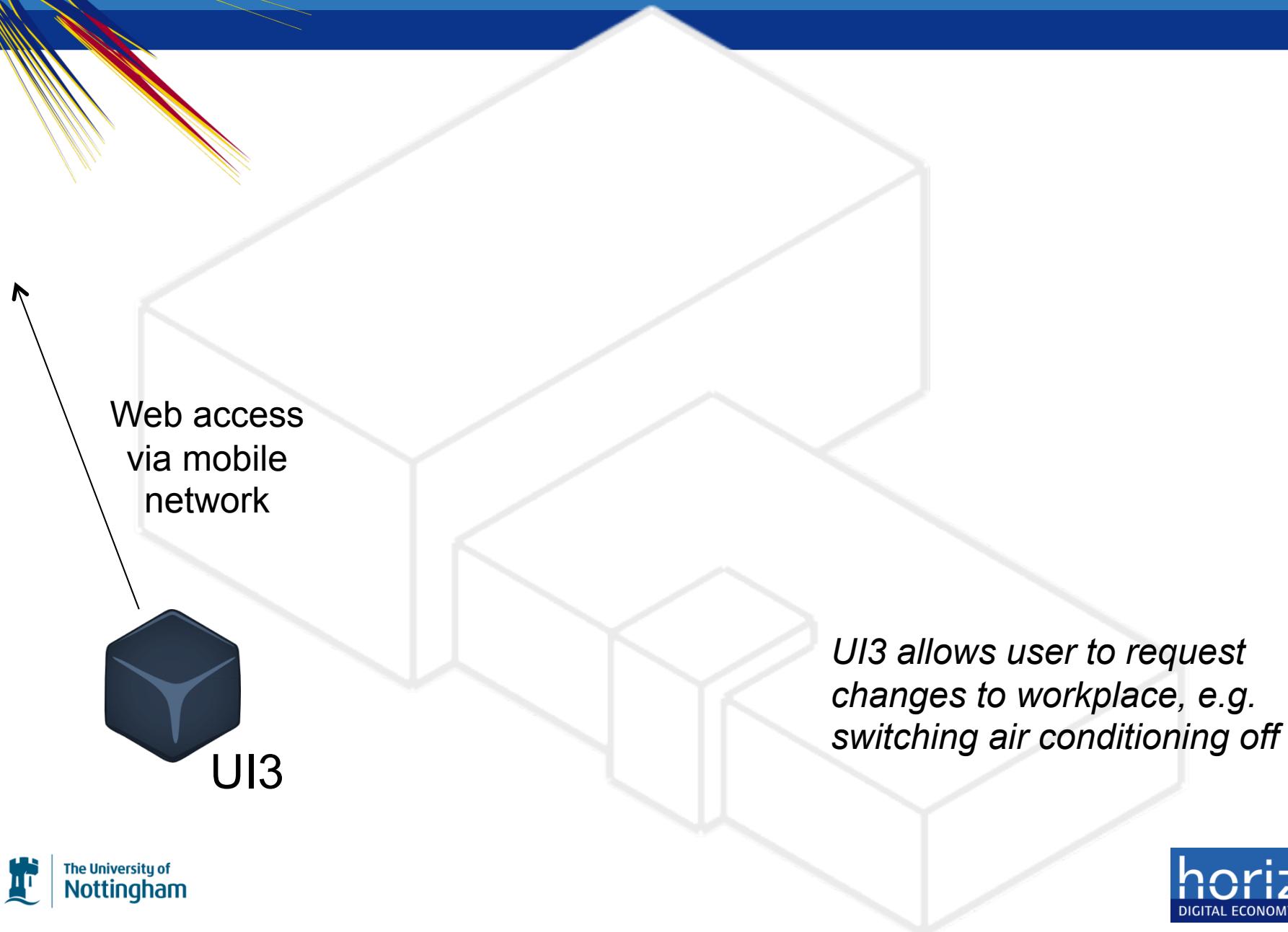


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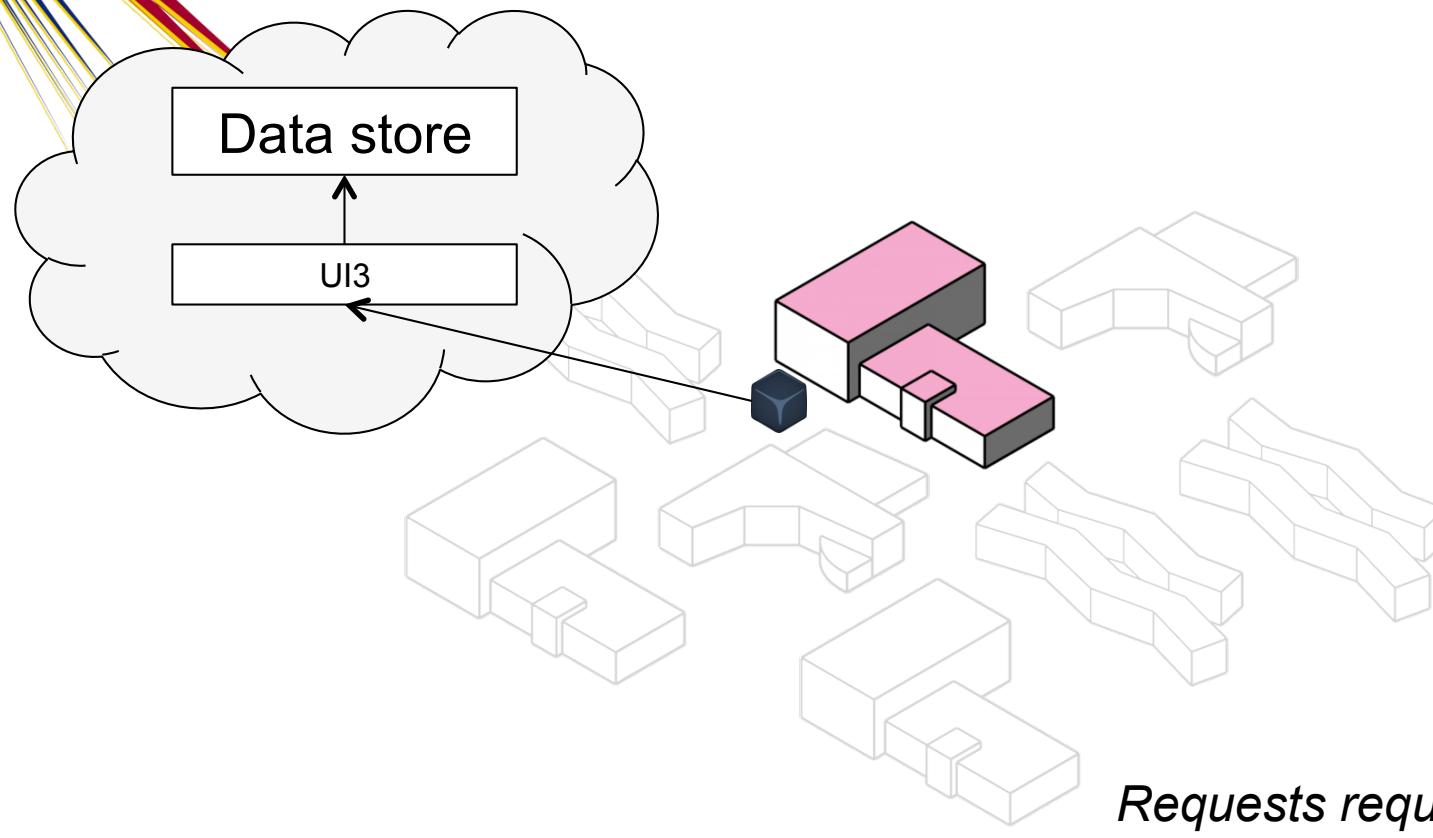
User Interface 3: control



Architecture - control



Architecture - control



Architecture - control

Data Store

Company 1

Workplace 1

Workplace 2

Entries in the data store for appliances will contain settings for operation (e.g. time to switch on/off) as well as emissions data; UI3 will modify the settings

Company 2

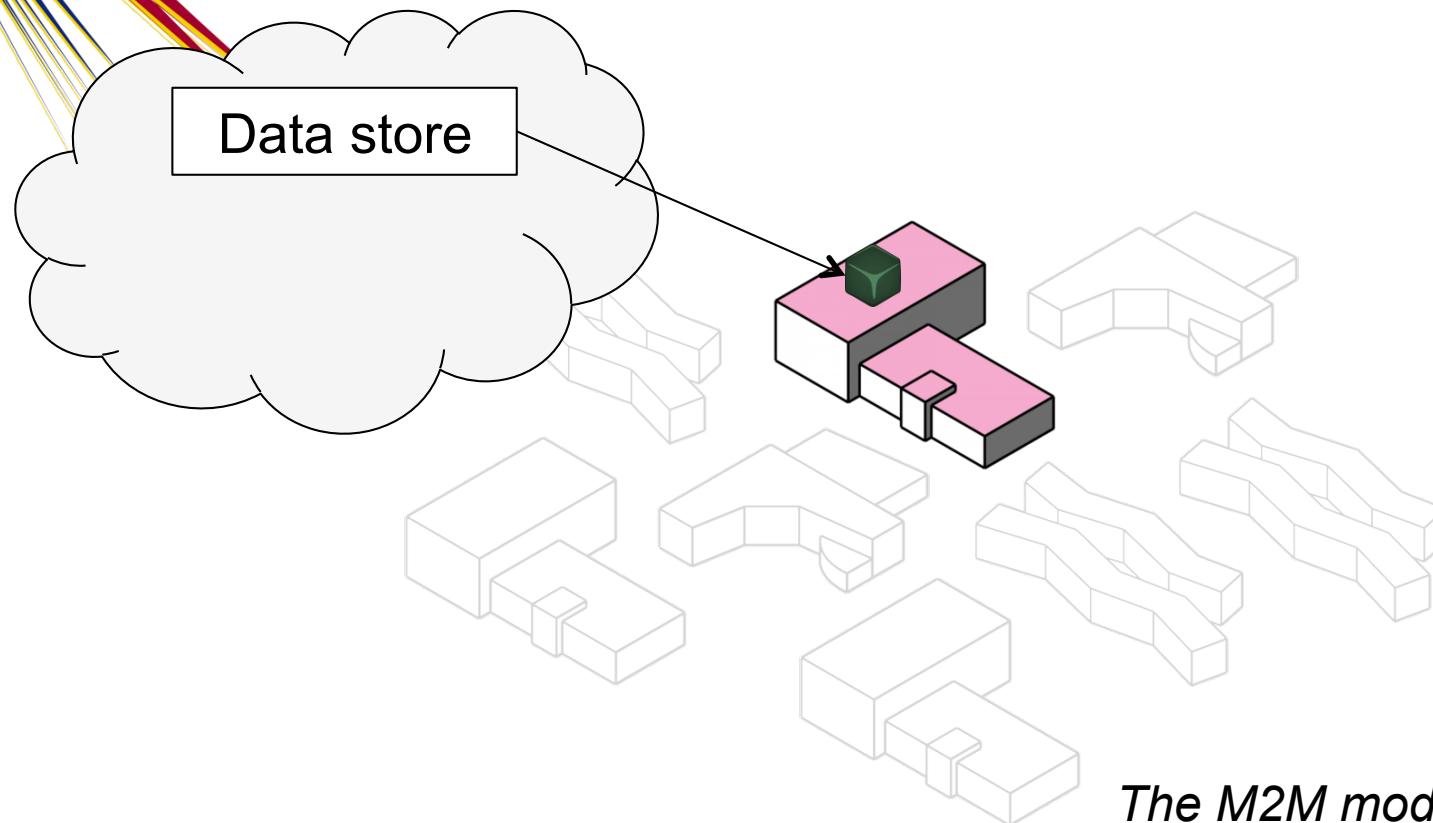
Workplace 1

Appliance 1

Settings

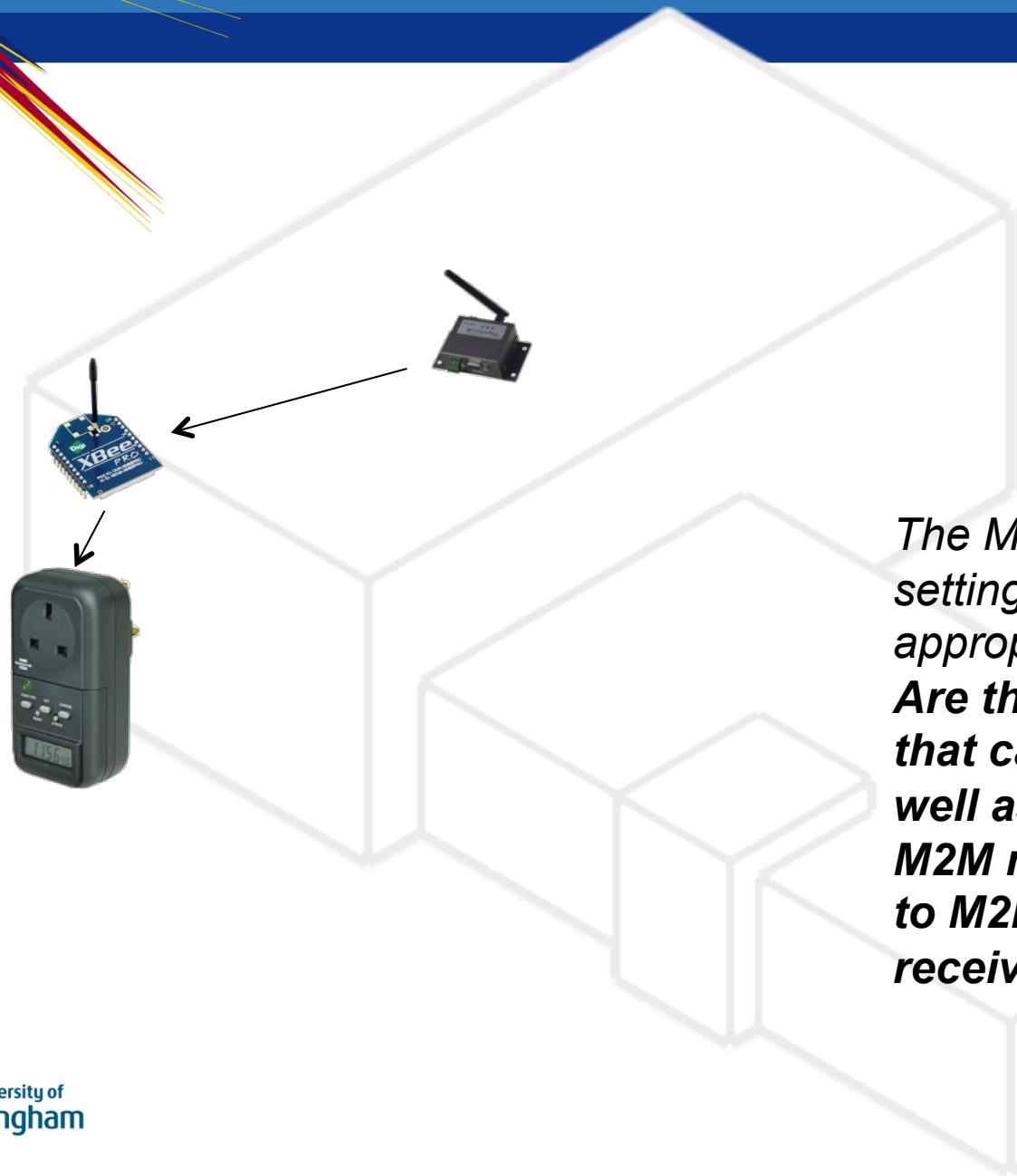
Emission data

Architecture - control



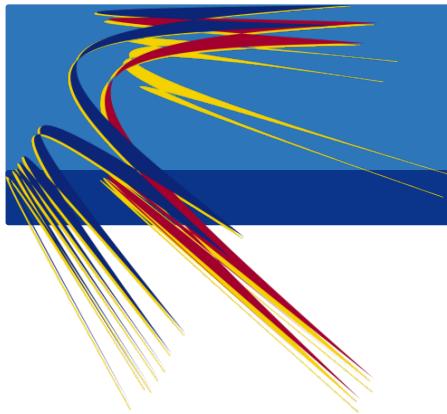
The M2M module requests changes to appliance settings

Architecture - control



The M2M module passes settings changes back to the appropriate appliance

Are there any M2M sensors that can control appliances as well as monitor them? Can M2M modules send data back to M2M sensors as well as receiving data?



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Field trial plan



Work plan

- **Phase 1 – Testing monitoring architecture**
 - Review of existing monitoring infrastructures
 - Consultation with University of Nottingham ETC (<http://www.nottingham.ac.uk/etc/>) and Estates (<http://www.nottingham.ac.uk/estate/>) regarding current monitoring capabilities of University of Nottingham and local workplaces
 - Acquiring suitable sensors and sensor hub (e.g. M2M module) – check compatibility/portability with China
 - Deploying and testing sensor infrastructure in test site (Horizon Research)
- *Currently ongoing*



Work plan

- **Phase 2 – Testing data store for monitoring**
 - Developing schema for data store
 - Deploying data store on suitable web platform
 - Linking sensor infrastructure to data store and testing scalability of data store for long-term monitoring
- *Currently ongoing*



Work plan

- **Phase 3 – Prototype (monitoring) user interfaces**
 - Review of existing user interfaces for Carbon emission awareness
 - Rapid iteration of prototypes based on paper prototyping and short test deployments at local sites (student halls of residence at University of Nottingham, Horizon Research)
 - Internationalise interfaces
 - *Currently ongoing*



Work plan

- **Phase 4 – Test control architecture**
 - Acquire and integrate suitable control hardware with monitoring hardware
 - Modify data store to support control
 - Test control functionality (reliability and response speed)



Work plan

- **Phase 5 – Prototype enhanced UI3**
 - Modify UI3 to enable control functionality
 - Rapid iteration of UI3 prototype in consultation with various potential end-users



Work plan

- **Phase 6 – Formal field trials**
 - Determine observation/data capture method + sites
 - Installation of monitoring/control infrastructure + UI devices on sites
 - Pre-trial interviews/focus groups with users
 - Trial
 - Post-trial interviews/focus groups with users



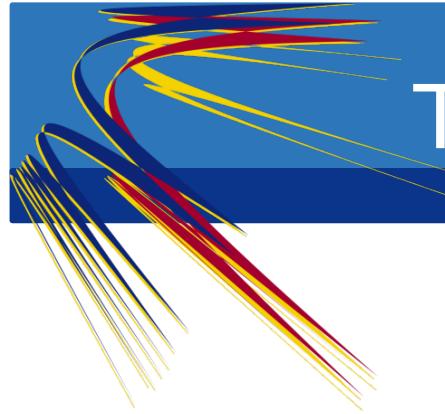
Work plan

- **Phase 7 - Analysis**
 - Data sessions/workshop with stakeholders
 - Dissemination of results
 - Plan for follow-on proposals



Work plan

Phase	Months							
	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24
1		Impl. monitoring						
2		Impl. data store						
3			Prototype UIs					
4				Impl. control				
5					Impl. monitoring			
6						Field trial		
7							Analysis	



Test/trial sites

Interesting workplace comparisons

1. Similar workplaces in **different** organisations
 - China Mobile Innovation building vs. Horizon Research office
 - Are employees/managers motivated by this competition?
 - Do they understand the comparison?
2. Similar workplaces within the **same** organisation
 - University of Nottingham: Horizon Research office vs. Mixed Reality Lab office
 - Employees regularly visit the opposite workplace and socialise with employees from the opposite workplace – how does this affect the motivation?