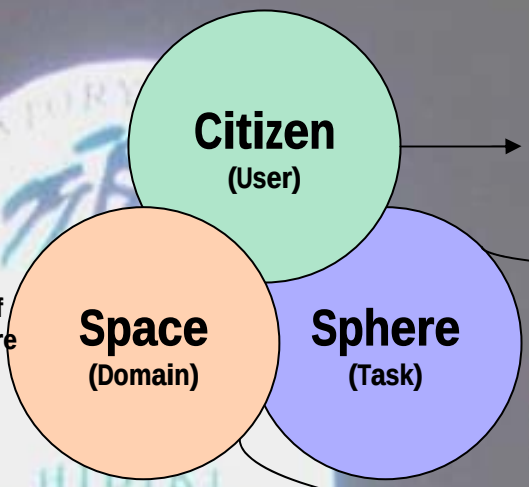
# Extending Traditional HCI Design Approaches for Pervasive Computing

Vassilis Kostakos & Eamonn O'Neill
Department of Computer Science, University of Bath

## What this is about

**Pervasive and ubiquitous systems are computer systems that are present everywhere. A truly pervasive system will offer assistance to its users constantly, in any location and for any task. These kinds of systems are nothing like the traditional, static, screen-keyboard-and-mouse systems. We now have to deal with a multitude of unknown situations and locations where the pervasive system may be used, and the interaction requirements now become very dynamic and fluid.**




### Citizens vs Users

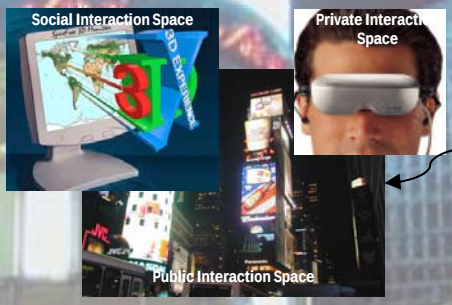
Imagine a pervasive system that covers the whole of the UK, or even Europe. Such large-scale pervasive systems can be usefully viewed as a public service. We may know little or nothing about the particular *users* of a publicly available, large-scale pervasive system. But there are a number of things we can know about *citizens*. Such information may include citizenship rights, how citizens view public systems, (e.g. broadcast television, public transport etc), and what types of access to public systems citizens prefer or require. All these can help in the design of pervasive systems.

### Information Spheres

How can designers possibly account for any arbitrary activity that any particular user may wish to perform using a public pervasive system? Our proposed top-down approach attempts to define activities abstractly and to offer support in reasoning about and designing from these abstractions. Just like pools of information, information spheres are conceptual entities that contain certain types of information. There are 3 types of spheres: tthe *public* sphere (contains public domain information), the *private* sphere (contains private information for each citizen), and the *social* sphere which contains non-private information which is not made public due to social restrictions or physical constraints.

## How to design pervasive systems

**We have extended the traditional Human-Computer Interaction (HCI) design foci of User-Task-Domain to take into account the social issues that systems of such societal scale raise.**




### Spaces

With such a multitude of locations being covered by a pervasive system, each one with its own peculiar characteristics, how can we design a system that will take into account all these different domains? In the third element of our framework, we propose a top-down approach that categorises all possible spaces into three main groups: *public spaces* (they belong to the community), *social spaces* (neither private nor public) and *private spaces* (owned and controlled by an individual).

We make a further distinction between these spaces created by our physical environment and the *interaction spaces* created by artefacts including computing and communications devices. The essence of our approach to pervasive computing is the effective integration of spaces (physical location + social dimensions) created by the built environment with interaction spaces created by computing resources distributed in that environment.

## Using our design tool

**The design tool and process described here may be used to examine existing settings and artefacts or to evaluate envisioned designs and proposed artefacts. In either case, using the design tool will help the designer to decide which devices and technologies are suitable for delivering which pieces of information to particular citizens in particular settings.**


### The relationships diagram

The design tool produced by our framework is presented in the form of a diagram. There are four columns in this diagram. The first two columns represent spaces and interaction spaces, which combine to form the spaces element of our framework. The third column represents the spheres element, while the rightmost column represents the citizen element of our framework. Each of the first three columns has three rows or points, which reflect the classification we have used throughout the description of our framework: *private, social,* and *public*. The citizen column consists of only two points: *one* and *many*. These represent the presence of one person or more than one person, either within a space or an interaction space. The dotted lines indicate connectors where the designer of a pervasive system must be particularly careful, where conflicts are likely to arise between the demands and affordances of the different elements of our framework and where particular activities or information access may not be supportable in particular settings by the available technologies.

❶ Generate a list of artefacts (locations, information, technologies), and create a checklist for each artefact.
❷ Combine the checklists of artefacts which are related in the real world.
❸ Validate the checklist for each artefact by creating an instance of the relationships diagram.
❹ Propose solutions

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| Artefact | Space | | | Int. Space | | | Sphere | | | Citizen | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pr | S | P | Pr | S | P | Pr | S | P | 1 | M |
| Telephone Directory | | | | | | | | ✓ | | | ✓ |
| A4 telephone lists | | | | | | ✓ | | | | | ✓ |
| Waiting room | | | ✓ | | | | | | | | ✓ |
| Reception | | ✓ | | | | | | | | | ✓ |

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| Artefact | Space | | | Int. Space | | | Sphere | | | Citizen | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pr | S | P | Pr | S | P | Pr | S | P | 1 | M |
| Telephone Directory | | | ✓ | | | ✓ | | ✓ | | | ✓ |
| A4 telephone lists | | | ✓ | | | ✓ | | ✓ | | | ✓ |
| Waiting room | | | ✓ | | | ✓ | | ✓ | | | ✓ |
| Reception | | ✓ | | | | | | | | | ✓ |

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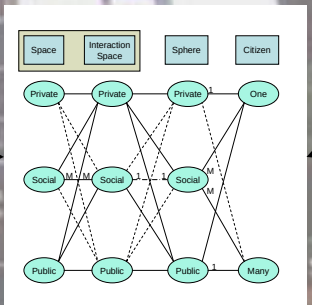


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- **Manipulate interaction spaces (change the technology that is used)**
- **Relocate artefacts (relocate technology)**
- **Re-establish links between information and technology (what information to deliver using which technology).**

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Presented at PREP2004, 5-7 April 2004,
University of Hertfordshire, UK