Cityware: urban design and pervasive systems

The Bartlett Faculty of the Built Environment, UCL
Bath and North East Somerset Council
HP Labs, Bristol
IBM Ease of Use
Imperial College London
Nokia Insight & Foresight
University of Bath
Vodafone Group R&D

- **Themes of the project**
- **Understanding the city as a system**
- **Space syntax methods**
  - **Gatecounts and static snapshots**
- **Architectural space & interaction space**
- **Analysing wireless interaction spaces**
  - **Bluetooth patterns of presence and naming practices**
- **Evolving the deployment**
  - **From Bluetooth scanning to context aware service discovery**
- **Contacts and posts**

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- **Designing space**
  - theoretical understanding of urban space augmented by pervasive technologies, and their impact on emergent forms of communication, socialisation and culture and on local people's and visitors' use of and relationship with architectural and interaction space
  - extend and develop space syntax theory to take account of pervasive technologies to inform analyses of privacy and context
  - investigate how to get from the contextual information revealed by analysis of people's movements and activities in urban space to representations of context that can be used in developing pervasive systems

- **Security, privacy & trust**
  - threat analysis for services in urban environments, including hosted services and peer-to-peer interactions in social or public spaces
  - trust analysis: a deepening of our understanding of user requirements, perceptions and reasoning about trust- and risk-related issues in urban social and public spaces
  - techniques for securing users against the threats identified in activity 1 integrated with the urban lifestyle factors identified in activity 2 will lead to new security protocols and to design implications for spaces, architectural features, devices, and physical tokens of services

- **Context awareness & service discovery**
  - personal context servers that run on wireless devices carried by users, and manage their personal context
  - techniques for the formation, management and interoperation of ad hoc groups of personal context servers, including techniques for sharing and anonymising context information and delegating context management
  - techniques to incorporate uncertainty into context values and define functions to compute over uncertain context values
  - context-based discovery services that can dynamically discover, tailor and build services

- **User engagement**
  - understanding the physical, psychological and social impacts of pervasive systems on the lifestyles and behaviours of residents of and visitors to urban environments
  - short-term interventions to evaluate particular aspects of technical development, including evaluations of the use of particular applications
  - evaluating the impact of pervasive technologies beyond short-term intervention experiences and towards an understanding of their long-term everyday urban use through longitudinal studies of user behaviour over the lifetime of the project

- **Understanding the city as a system**
  - its physical and digital forms and their relationships with people's behaviours in the city
- **Development, use and refinement of methods**
  - observing, recording, modelling, analysing
- **Space syntax already has methods**
  - address the physical form of the city and its relationships with people's behaviours
  - can we "digitally augment" these methods to take account of the digital form of the city?
- **Ubicomp 2006**

- ## Gatecounts
  - used to establish flows of people at sampled locations within the city
  - a gate is a conceptual line across a street; gatecounts entail counting the number of people crossing the line
  - observers stand on the street and count the number of people crossing the gate in either direction

- ## Static snapshots
  - open spaces of the city considered in detail - external (e.g. a square) or internal (e.g. a café)
  - observers record people's movements in and out of the space, as well as the types of activity taking place in the space
  - understanding of how people appropriate and make use of a particular space, and how these patterns of use bring people into contact with each other
  - common observation is the use of spaces by people using mobile phones and laptop computers, & the ways that they locate themselves with respect to the surrounding urban fabric & other people

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- Architects design space
  - space within which people behave, move, encounter
  - defined by elements such as walls, doors, benches
- Interaction space
  - space within which an artefact is usable
  - defined both by the characteristics of the artefact and by the architectural space in which it is situated
    - e.g. within a public architectural space, a large display can create a public interaction space
  - can be visual (display), auditory (speakers) or wireless

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IEEE Computer, October 2006
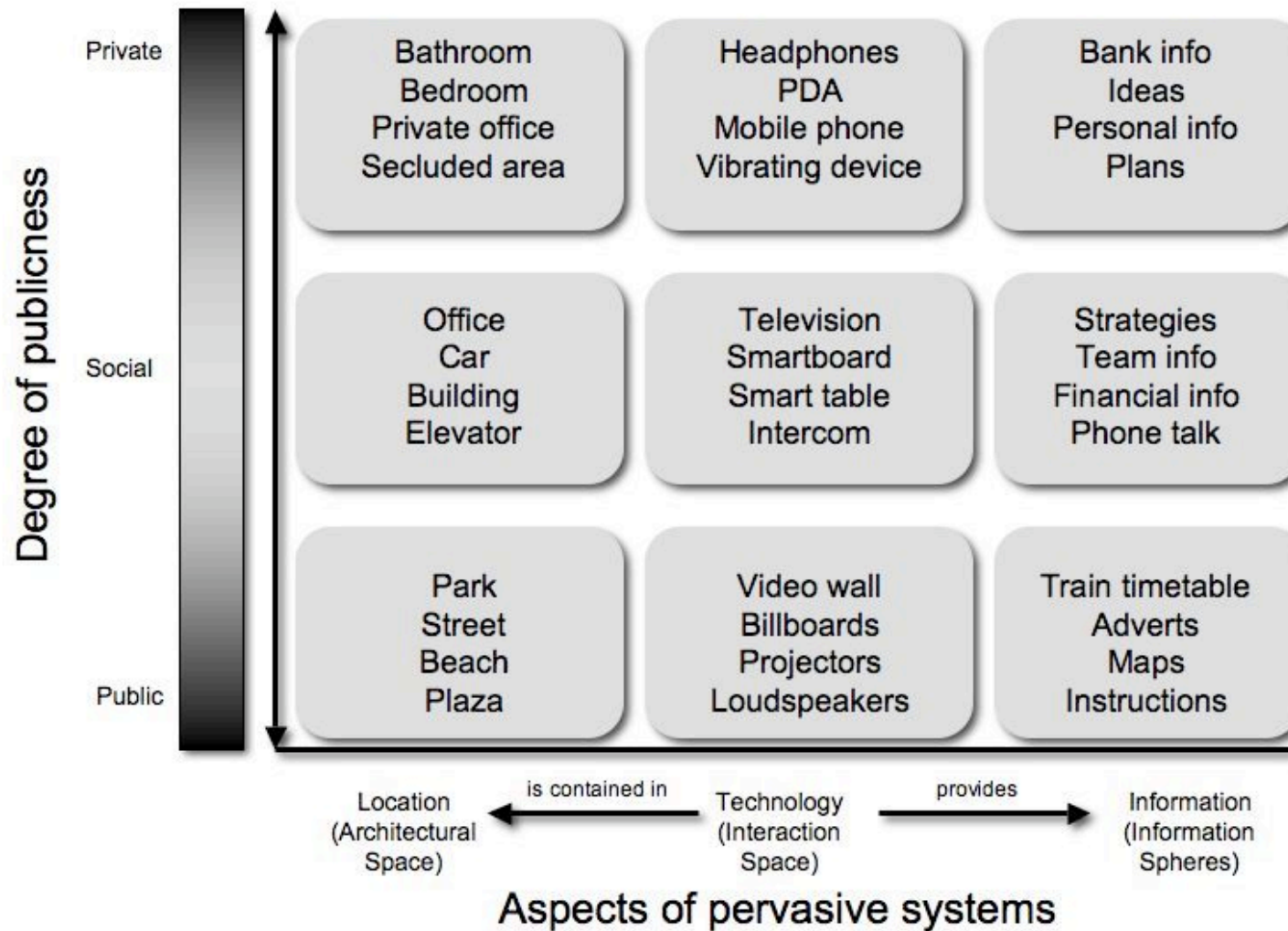
- (Partial) view of pervasive systems as networked *embedded*, *fixed* & *mobile* devices
- We can map fixed and mobile across visual, auditory and wireless to describe how humans "join" the system: the interaction spaces
- Fixed wireless interaction spaces
  - e.g. 802.11, GSM/GPRS or 3G "hotspot"/coverage
  - defined by an access point and characteristics of the environment
- Mobile wireless interaction spaces
  - e.g. Bluetooth
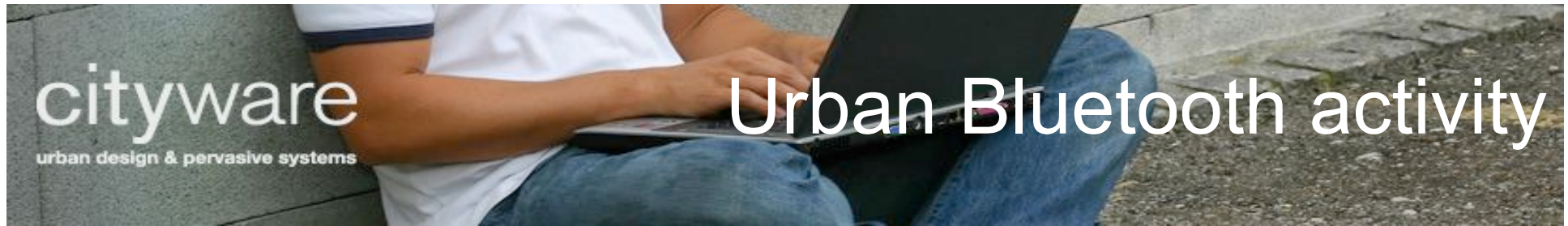
- The vast majority of Bluetooth interaction spaces are mobile
    - created by small, personal devices such as mobile phones
- In contrast to the fixed interaction spaces created by static WiFi access points, the wireless interaction spaces created by Bluetooth devices map closely to the movements of people around the city
    - which are a primary concern of space syntax
- We've extended gatecount and static snapshot methods to include observing and recording Bluetooth interaction spaces
- We have begun to uncover interesting data on patterns of presence of Bluetooth devices, and Bluetooth device naming practices

- 10 gatecounts throughout the city of Bath
  - One observer performed the manual pedestrian count while the other performed the Bluetooth count using our mobile scanners
  - 30 minutes at each location iterated over 2 days
- 2 long-term gatecounts: campus and street
  - about 7.5% of observed pedestrians had discoverable Bluetooth devices

- 2 long-term scanners in pub and café
- 30-minute observations in each
  - observers recorded people's positions, behaviours and movements through space
  - correlated these observations with the data recorded by our Bluetooth scanners
  - generating aggregate data which were unavailable using conventional space syntax methods

- Collected Bluetooth name data from 3 long-term scanning sites
  - street: 771 names
  - campus: 625 names
  - pub: 307 names
- User-defined names
  - street: 58%
  - campus: 76%
  - pub: 88%
- No intentional context data
  - further research ongoing

- From some user-defined names we infer that the user has some awareness of Bluetooth and its properties: "Clear off!!", "U Found Meee..."
- Being "Bluetooth-savvy" is a precondition for choosing names that *may* be characterised on a *self-others* spectrum, running from one extreme of simple presentation of self to another extreme of seeking an effect on other people
  - "Annie", "John K. Taylor", "Snagglepuss", "Crown Jools", "Pezza's girl", "M.C.F.C OK!", "Send me stuff", "4 a gay time call 077…"
- Bluetooth on mobile phones gives rise to a de facto rather than merely potential interaction space
  - there is little point in altering the device's name from the default unless there is an intention for either functional or social interaction
  - through her choice of name, the user defines the "feel" of that interaction space

- Install a computer with multiple dongles
- The dongles masquerade as
  - Laptop
  - Mobile phone
  - Printer
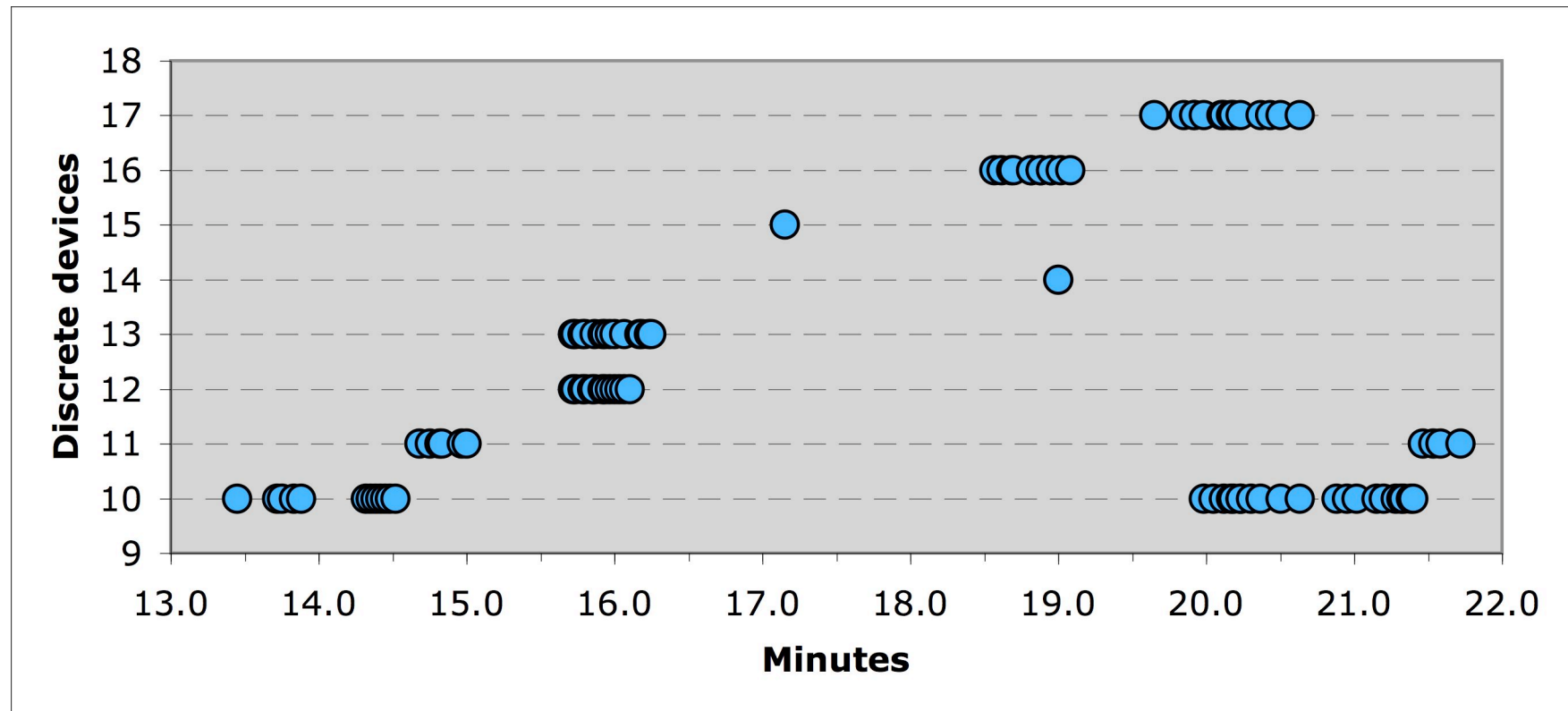- Vary names
- What gets sent to us?

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- **Research question**
  - Does the presence or absence of "local" content – e.g. a picture of the environment where the user is sitting – affect the user's susceptibility to WiFi phishing?

- **Methodology**
  - Answer the above question in circumstances where the user thinks she is in a situation carrying risk
  - Step 1 - find two configurations that are equally trustworthy outside the context (name on paper, survey)
  - Step 2 - look for different user responses between the same configurations but in situ

- Stage 1: simple Bluetooth scanning
  - baseline understanding of technology and the city
- Stage 2: "Hooked" - you and your fish in Bath
  - uses network of Bluetooth scanners
  - represents where you've been (space) and who else has been there (copresence)
- Stage 3: further levels of "Hooked"
  - offering more interactivity and context sharing
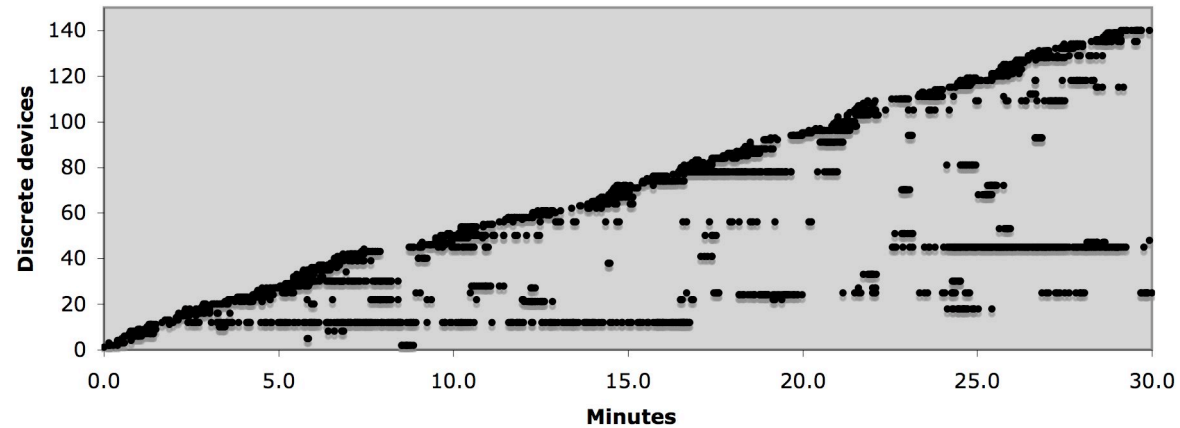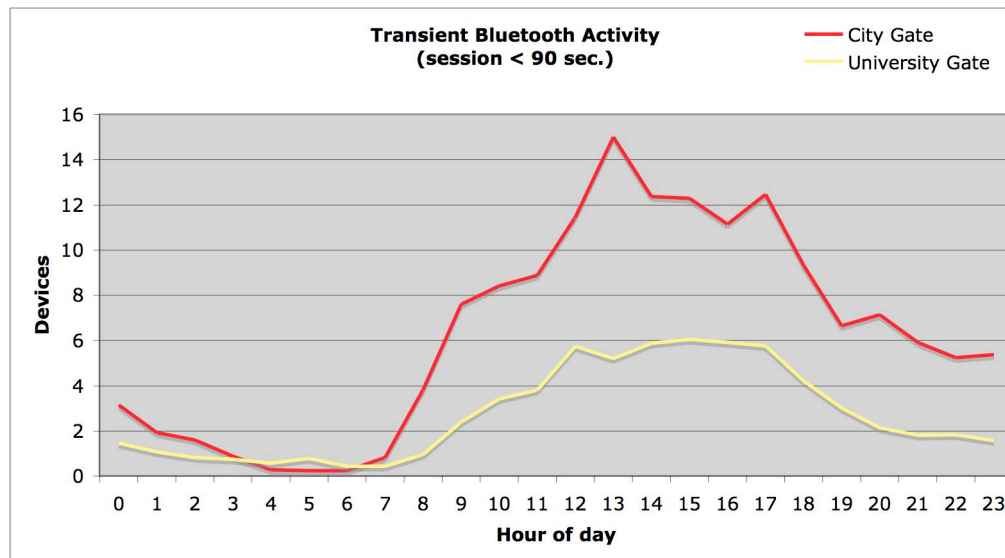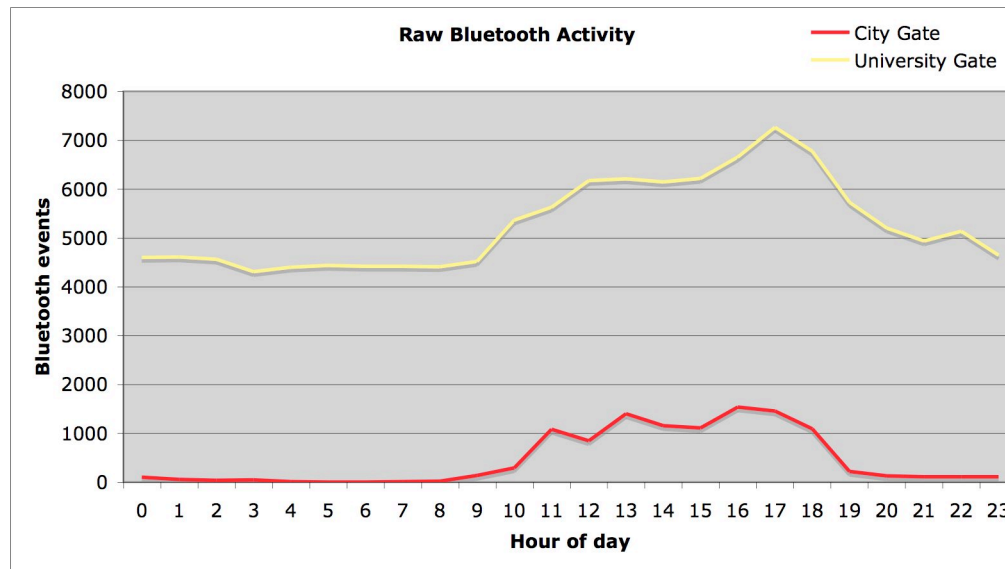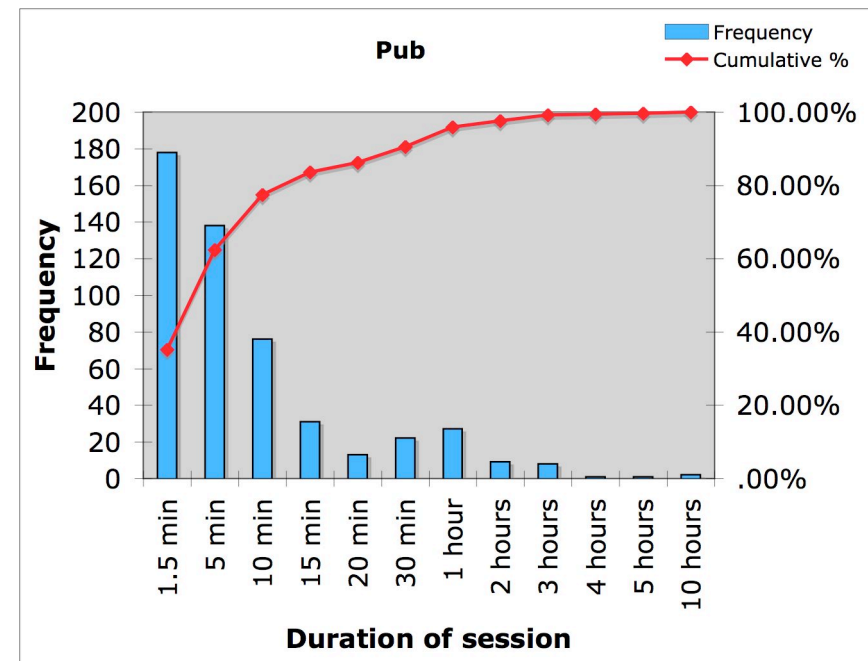- Stage 4: context aware mobile phone data services

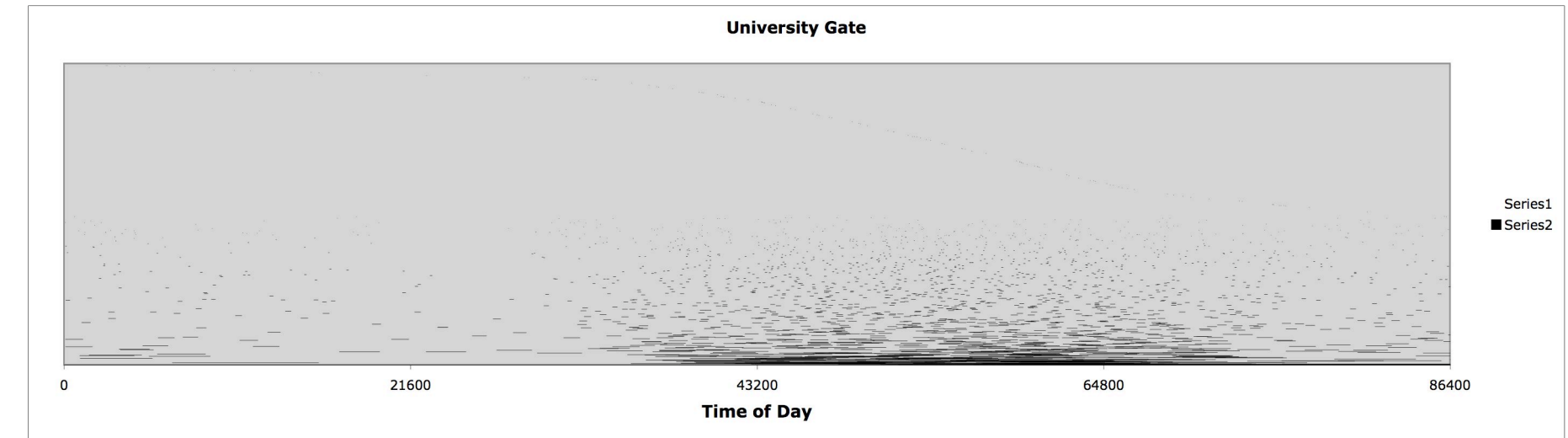**Mobile Gatecounts**
(30-Minute scans)
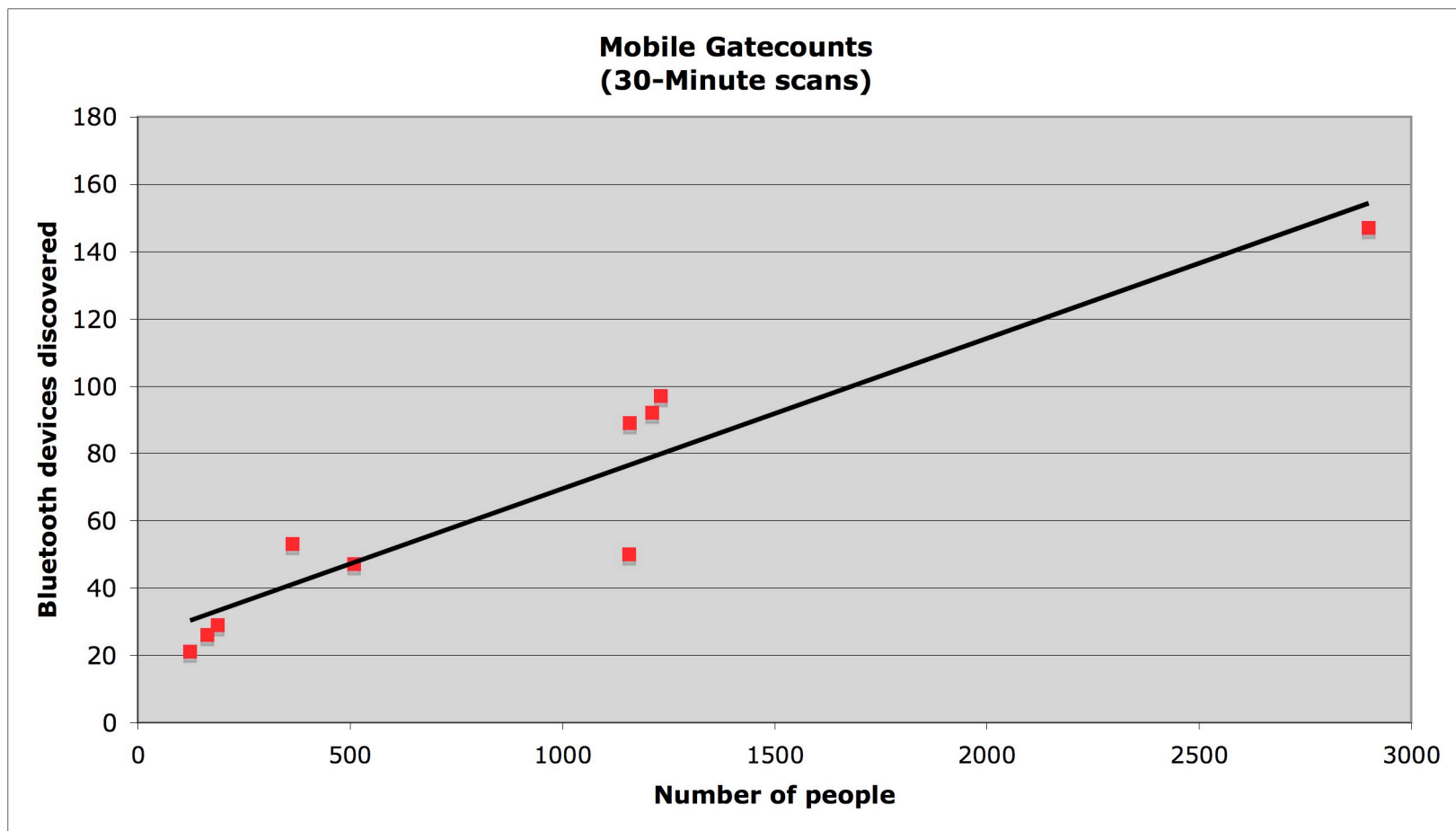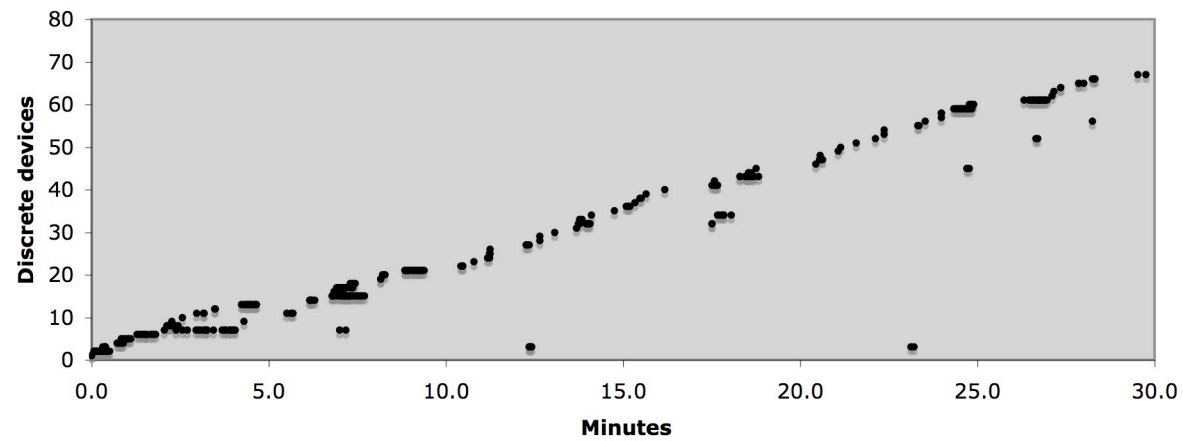
Mobile Gatecount 6

Mobile Gatecount 3

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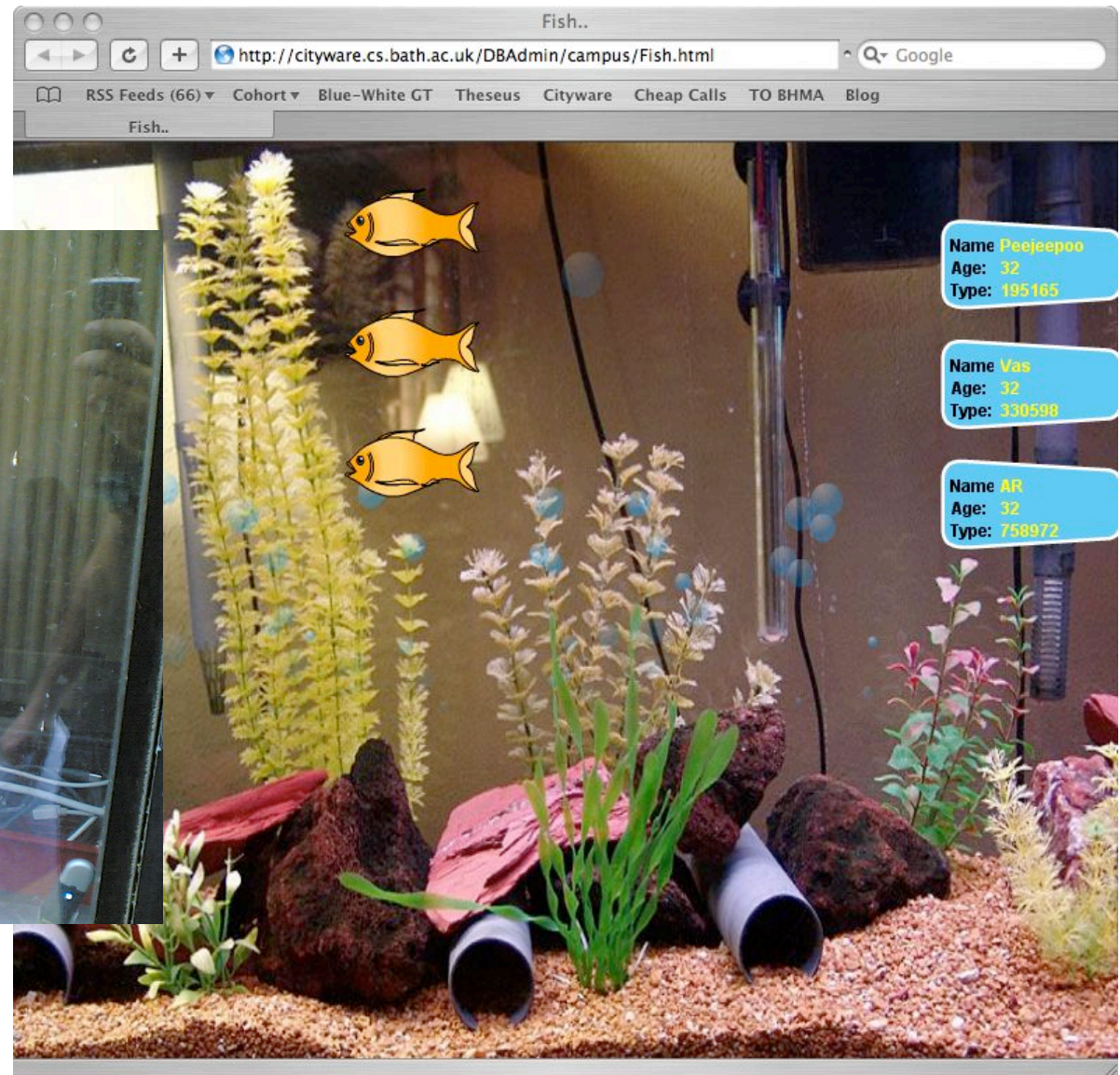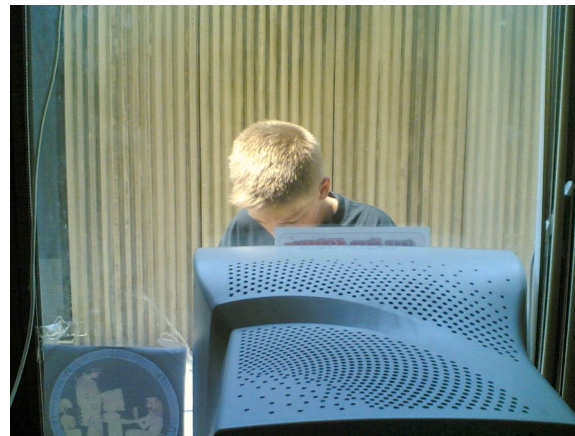
Raw Bluetooth Activity

— City Gate
— University Gate

Bluetooth events

| 8000
| 7000
| 6000
| 5000
| 4000
| 3000
| 2000
| 1000
| 0

Hour of day: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Transient Bluetooth Activity
(session < 90 sec.)

— City Gate
— University Gate

Devices

| 16
| 14
| 12
| 10
| 8
| 6
| 4
| 2
| 0

Hour of day: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

University Gate

Series1
■ Series2

Time of Day

0　　　　　　21600　　　　　　43200　　　　　　64800　　　　　　86400

Pub

Series1
■ Series2

Time of day

0　　　　　　21600　　　　　　43200　　　　　　64800　　　　　　86400

BlueFish (aka Hooked)

BlueFish (aka Hooked)
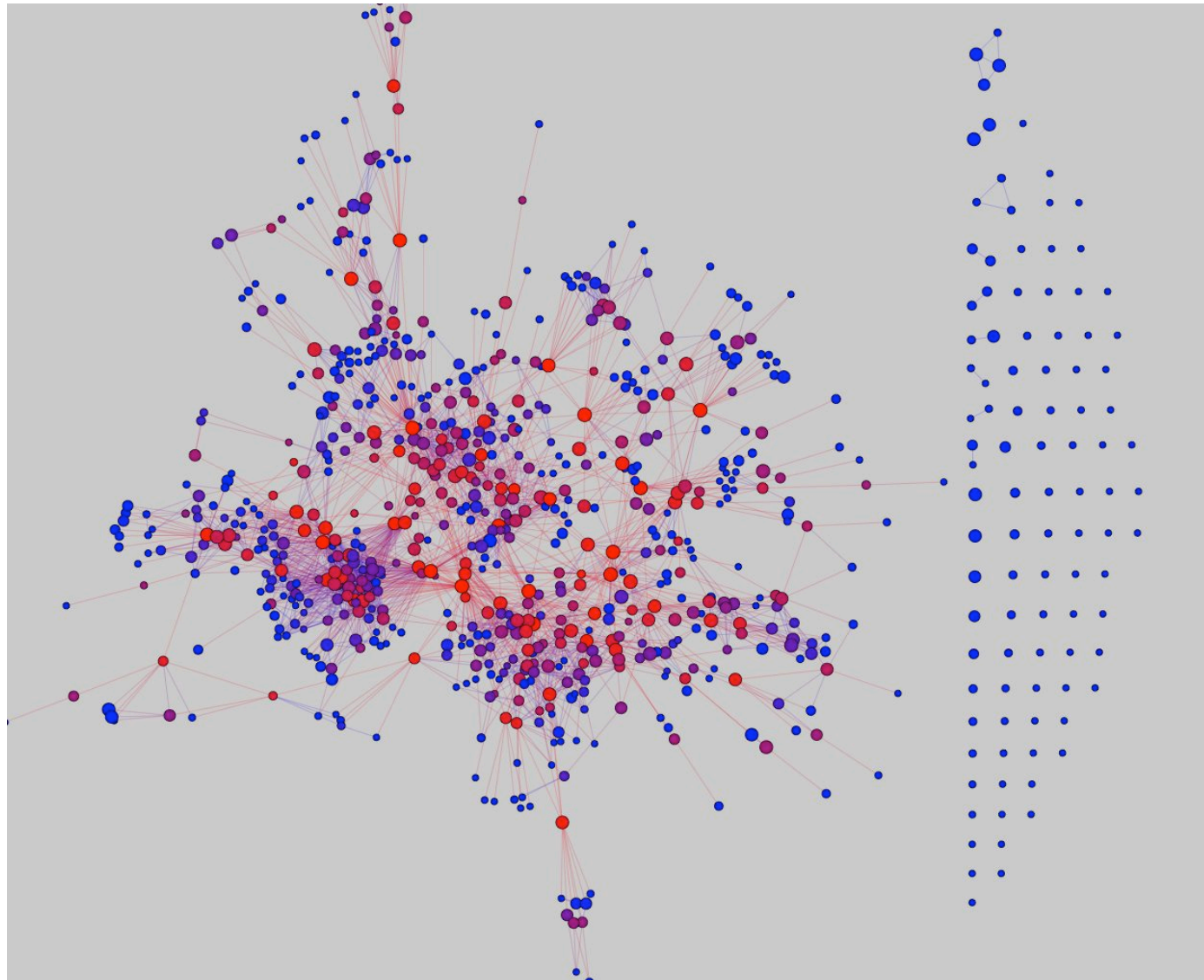
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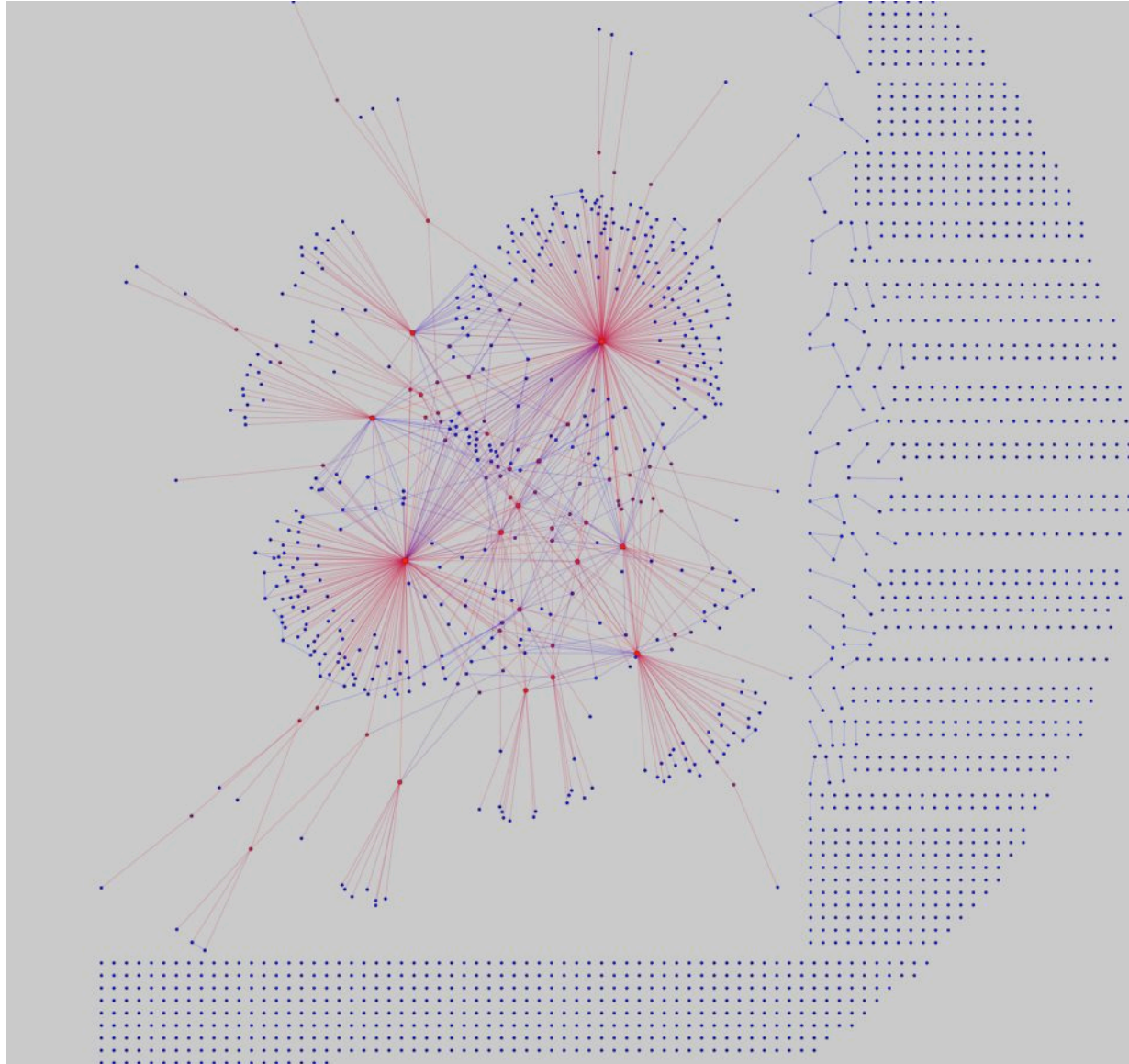
- www.cityware.org.uk
  - Eamonn O'Neill
- Space syntax
  - Alan Penn, Ava Fatah
- Security, privacy and trust
  - Tim Kindberg, Eamonn O'Neill, Vas Kostakos
- Context awareness & service discovery
  - Naranker Dulay, Emil Lupu, Morris Sloman, Markus Huebscher, Nat Pryce
- User engagement
  - Danaë Stanton Fraser, Tim Jones

- 2 PhD posts - 1 at Bath, 1 at Imperial
- 1 Systems Programmer post at Bath