Motivation

• Understand the “affordances” of people’s mobility, and

• identify opportunities for pervasive systems
Overview

• Data collection
• Structural properties
• Dynamic properties
• Diffusion
• Ongoing work
Data collection
Timeline view

[Graph showing timeline view with data points and time intervals]
Gatecount timelines
Gatecounts
Bluetooth visibility

- Around 7.5% of observed pedestrians had discoverable Bluetooth devices
Structural properties
<table>
<thead>
<tr>
<th></th>
<th>Size</th>
<th>Edges</th>
<th>Density</th>
<th>Core</th>
<th>$k$</th>
<th>$\lambda_{\text{max}}$</th>
<th>$\lambda$</th>
<th>$C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath</td>
<td>70516</td>
<td>652446</td>
<td>0.03%</td>
<td>69655</td>
<td>18.53</td>
<td>11</td>
<td>3.45</td>
<td>0.47</td>
</tr>
<tr>
<td>Campus</td>
<td>3109</td>
<td>120273</td>
<td>2.5%</td>
<td>3101</td>
<td>77.37</td>
<td>6</td>
<td>2.57</td>
<td>0.44</td>
</tr>
<tr>
<td>Street</td>
<td>11853</td>
<td>58111</td>
<td>0.08%</td>
<td>10584</td>
<td>9.80</td>
<td>12</td>
<td>3.23</td>
<td>0.28</td>
</tr>
<tr>
<td>Pub</td>
<td>13476</td>
<td>126768</td>
<td>0.1%</td>
<td>13383</td>
<td>18.81</td>
<td>9</td>
<td>2.61</td>
<td>0.10</td>
</tr>
<tr>
<td>Office</td>
<td>321</td>
<td>2419</td>
<td>4.7%</td>
<td>318</td>
<td>15.21</td>
<td>4</td>
<td>2.04</td>
<td>0.82</td>
</tr>
</tbody>
</table>
Dynamic properties
Dynamic properties

- Our data is not static
- 3D structure
- Chain of events
Presence

Nodes

Frequency

Links

Presence

Frequency

Nodes

Links
Model

- Fixed population size $n$
- Each node assigned probability $f$ and $p$
- At each iteration, node is activated with probability $f$
- If a node is activated, it remains active for $p$ times length of previous inactivity
- If two nodes are simultaneously active, they are linked to each other
Diffusion
Chain of events

- John, Mary, 14:20:30
- John, Paul, 14:20:32
- Mary, Nick, 14:20:33
- ...

Emulation

- Class “device”
- Class “virus”
- During encounter, virus is transmitted
- Device recovers (SIS) or dies (SIR)
Remove Persistent Encounters

Remove Brief Encounters
Ongoing work
DTN forwarding algorithm

- Static features
  - Node degree
  - Node betweenness
  - Node closeness
  - Average geodesic path ($\text{Bath} = 3.3$)
- Community detection (21 using Newman)
Considering time
Game of real life

The game of real life iteration $n$

The game of real life iteration $n+1$
Tamagotchi

Mobile Interactions (Day 3)
People with Bluetooth devices bumping into each other (shopping, school, work)

Cityware nodes record & upload data

Cityware servers analyse data

Facebook application presents data

Users' social network grows
Bluetooth helps Facebook friends

A team of UK researchers is combining the power of social network Facebook with communications tool Bluetooth to learn more about human interactions.

Bath University scientists have created a tool which can use the unique ID of Bluetooth devices, like a mobile phone, to build new friendship networks.

Users register with the Facebook tool, called Cityware, that tracks encounters in the real world via Bluetooth.

It is part of a wider project backed by Nokia, HP Labs and Vodafone.

Dr Vassilis Kostakos, research associate at the University of Bath, said: "Networks are everywhere - social and digital."

"The really nice thing about Bluetooth is that when you are walking down the street, although you are not talking to anyone, your Bluetooth device can be talking to other devices.

"People with Bluetooth devices are actually creating an ad hoc communications infrastructure where information can be spread within a network."

SEE ALSO

Using Bluetooth
07 Mar 07 | School Report

Art project tracks Bluetooth users
22 May 07 | Technology

Legal fight over Bluetooth chips
04 Jan 07 | Technology

RELATED INTERNET LINKS

Cityware

About Cityware on Facebook (requires registration)

The BBC is not responsible for the content of external internet sites

TOP TECHNOLOGY STORIES

Legal threats halt iPhone crack
Apollo Moon photos reveal detail
Yahoo plea over China rights case

MOST POPULAR STORIES NOW

1 'Massive' gem dug up in S Africa
2 Photo the Bangladesh army cannot stand
3 Wilson plea over 'suicide' claims
4 Africa in pictures: Wildlife
5 Wildfires rage on across Greece

Most popular now, in detail
New challenges

• Best utilisation of this platform?
• Create a “world socio-map”?
• Develop adaptable systems
• Develop more secure systems
• Put numbers on human relationships
• Put numbers on “fabric of everyday life”
Thank you

Vassilis Kostakos
vk @ cs.bath.ac.uk

http://www.cityware.org.uk