Experiences with urban deployment of Bluetooth

Vassilis Kostakos
Overview

- Bluetooth scanning
- User-related
- Bluetooth CSI
- BlueVirus (ebola?!)
Bluetooth scanning
Requirements

- Capture BT address & BT name
- Static environments (pub)
- Dynamic environments (shopping street)
Bluetooth protocol

- Get list of addresses (within range)
- Iterate on each address: request name
- Address resolution: multiples of 1.28s
- Name resolution: ???
Single dongle

- Name resolution takes too long
  - >5sec per device
  - ~100sec timeout
- During name resolution, new devices are not recorded
Single dongle

- Optimisations
- Name resolution timeout
- Enable/disable name resolution
- Address resolution interval
Multiple dongle

- Some devices still missed
- if all dongles are doing name resolution
“Smart” multi-dongle
Comparison

- Single dongle: OK for fairly static environments
- Multi-dongle: Good for detecting changes in static environments
- Smart multi-dongle: Good for capturing high-speed flows
User-related
Bluefish

CHI 2007 (Concept)
Bluefish
What is your Bluetooth name?

- Name-changing patterns
- Data is too noisy
- Intentional categories
  - Sexual, greeting, invitation, insult
- Lexical categories
  - Default, custom
  - Identifiers, associations, t-shirt, graffiti

O’Neill et al., Ubicomp 2006
Bluetooth & Graffiti
a.k.a. “Juicy Lucie”
Han waz ere '96

Rosie waz ere '06

Qwa groovy

Sixty Rocky

George's world

Laura woz ere '19
Do you ever send stuff?
(Bluetooth honeypots)

- Bluetooth honeypot
- Various names
- Various device classes

- Are you the girl in the corner! :o);
Do you receive stuff? (BlueSpamming)

- Hypothesis: name of sender affects recipient’s reaction
- Issues in automating this process
- Protocol behaviour, user prompts
Viruses, diffusion, mobility
Timeline view
Gatecount timelines

Gatecount 10

Gatecount 6

Gatecount 5

Gatecount 8

Gatecount 9

Gatecount 3
Power laws and exponential decays

Kostakos & O’Neill, Space Syntax Symposium 2007 (forthcoming)
Gatecounts
Bluetooth visibility

- Around 7.5% of observed pedestrians had discoverable Bluetooth devices
Dynamic properties

• Our data is not static
• 3D structure
• Chain of events
Chain of events

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

Game of real life
Tamagotchi

Mobile Interactions (Day 3)

Scan Time: 14:30:00 to 22:54:00
Emulation

- Class “device”
- Class “virus”
- During encounter, virus is transmitted
- Device recovers (SIS) or dies (SIR)
Virus spread - bath_sis.txt

Virus spread - bath_sir.txt

Infections

Virus life expectancy

Day of epidemic
DTN forwarding algorithm

- Static features
  - Node degree
  - Node betweenness
  - Node closeness
  - Average geodesic path (Bath = 3.3)
  - Community detection (21 using Newman)
Considering time
Thinking about...

- Time - not used enough!
- Location - not space!
- “Easter present”
Late-breaking results

- Growth & preferential attachment?
- Rich-get-richer
- Temporal aspects are scale free
- Those who try hard get richer
Thank you

Vassilis Kostakos
vk@cs.bath.ac.uk

http://www.cityware.org.uk