Delay Tolerant Networking using spatially detailed human mobility patterns

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By exploiting the *features* and *idiosyncrasies* of *human* **social, ad-hoc, mobile networks**, and understanding *human* **temporal** and **spatial movement patterns**; *opportunistic* routing of *sensing* and *messaging* data can be *efficient* and *delay tolerant*, *without* reliance upon installed *infrastructure*.

1 Motivation

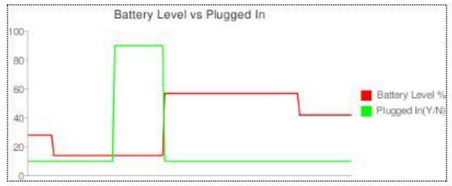
We want to be able to sense aspects of our environment, without the need to deploy expensive sensor networks, for example, to detect and react to pollution levels in a city, using just the devices in the pockets of its citizens connected by delay tolerant, 'Pocket Switched Networks'.

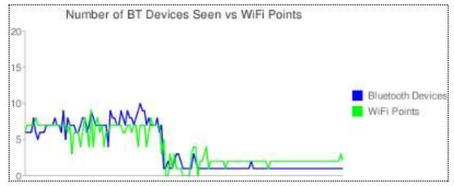
2 Background

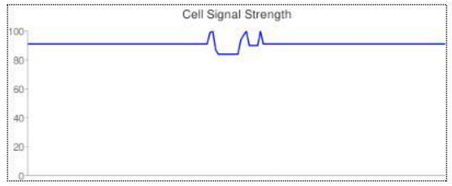
The Small World Problem (Travers & Milgram 1969) examined social connectedness, suggesting that an interesting aspect is that, while persons *a* and *z* may not know each other directly, they may share one or more mutual acquaintances.

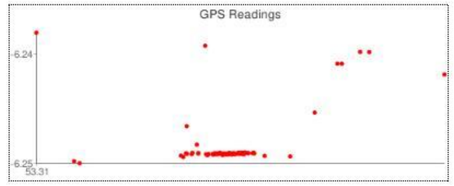
People have patterns of co-location (Bubble Rap - Hui 2006), and human networks show a cyclic pattern of connectivity between groups of nodes (6 hours). This periodicity of human nature is important in determining how automated applications disseminate information in a network.

Visualization of sample collected data









WiFi Mac	Occurrances	Avg. Signal Strength	AP Names
00192F3291E0	65	51.9	CSI-WLAN
00192F3291E1	65	52	WaveLAN Network
00192F3291E2	65	52	eduroam
001FF3C3FFE5	59	56	SRG
00192F329120	49	85.4	CSI-WLAN
00192F329122	50	85.4	eduroam
00192F329121	49	85.6	WaveLAN Network
001C2E6990B9	2	58	EWA@GUEST
001C2E6990B8	1	55	EWA@ECN
0013606CD881	10	59.9	WaveLAN Network
0013606CD882	5	56.4	eduroam

Cell ID	Occurrances	Avg. Signal Strength
667578	69	90.7101449275
0	2	87.5
50221	2	94
667576	5	88.6
667585	72	91.2361111111

BT Mac	Occurrances	BT Names
00164e0f9bbe	63	
000d931adea3	65	
001583bf0dd1	29	
0014515749b6	64	
001f00b1ed0a	150	

3 Experimental Setup

In the first phase of our experiment we collect data from participants mobile devices, including GPS Co-Ordinates, Wi-Fi points, cell towers and Bluetooth devices nearby, along with phone call, SMS and address book records.

We will back propagate correlation between GPS co-ordinates and WiFi points to give higher quality of location estimation.

We believe that using detailed context such as *location* along with detailed social context will improve delivery: time ratio.

4 Goals

We will simulate realistic human movements to analyse the properties of the network that this generates.

We will investigate correlations between social context and movements.

We will design efficient communications mechanisms across human networks to enable environmental sensing without fixed infrastructure.

Publications

Steve Neely, M. Stabeler, and P. Nixon. ***SensorMash: Exploring System Fidelity through Sensor Mashup***. *Adj. Proc. Conference on Pervasive Computing, 2008.* **(Winner of the best One Minute Madness presentation)**

Matthew Stabeler, G. Stevenson, S. Dobson and P. Nixon ***Basadaeir: harvesting user profiles to bootstrap pervasive applications*** . *Adj. Proc. Conference on Pervasive Computing, 2009.*

Ross Shannon, M. Stabeler, A. Quigley and P. Nixon. ***Profiling and targeting opportunities in pervasive advertising***. *1st Workshop on Pervasive Advertising, Pervasive 2009.*

Simon Dobson, G. Stevenson, G. Williamson, S. Knox, M. Stabeler, L. Coyle, S. Neely and P. Nixon ***An Open-Source Infrastructure for Pervasive Computing***. *PerAda Magazine, 2008.*

Lorcan Coyle, J. Ye, S. McKeever, S. Knox, M. Stabeler, S. Dobson and P. Nixon ***Gathering datasets for activity identification***.
Proceedings of the Workshop on Developing Shared Home Behaviour Datasets to Advance HCI and Ubiquitous Computing Research at CHI 2009. Boston, MA., 2009.

Matthew Stabeler, D. Cellai, P. Nixon and S. Dobson ***Delay tolerant networks and spatially detailed human mobility*** . Workshop on the Emergence of Delay-/Disruption-Tolerant Networks at ICUMT. *St Petersburg, Russia.*

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