Novel Sensing Techniques for Urban Transport

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HCII, Carnegie Mellon University

Monday, August 10 2009, Oulu, Finland

Chapter 1: The Human is the focus

Human Computer Interaction 101

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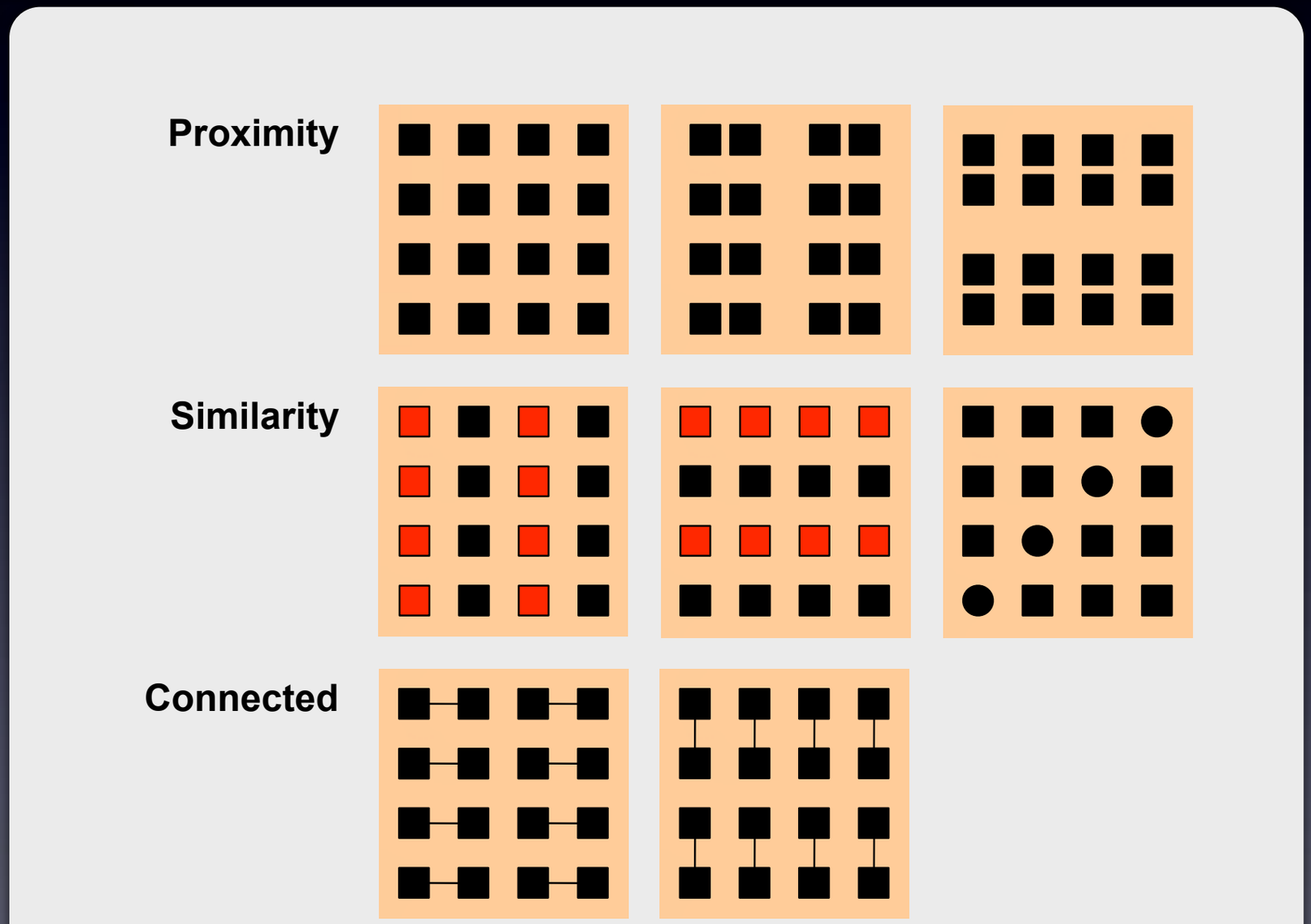
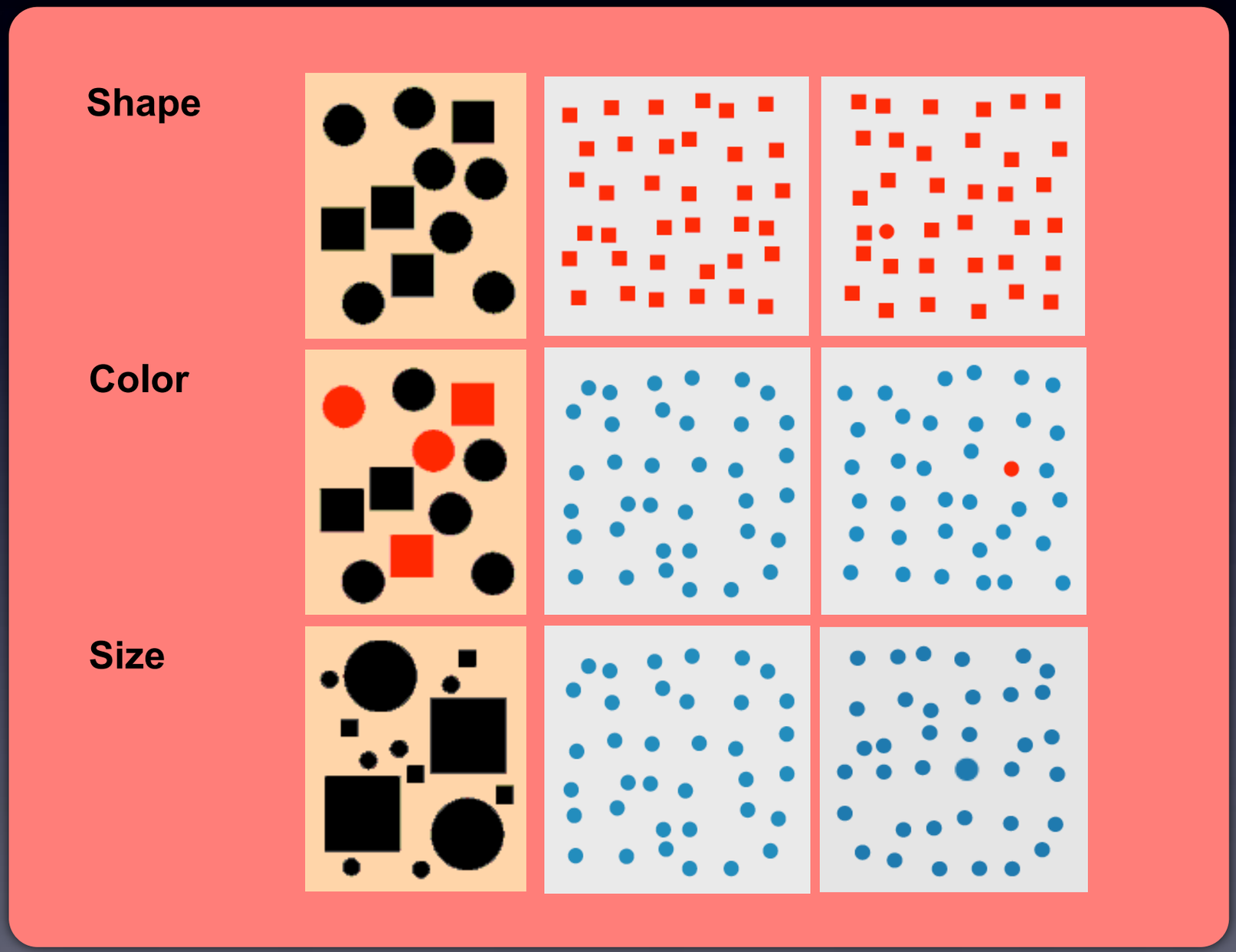
C:\>

1 user 1 computer

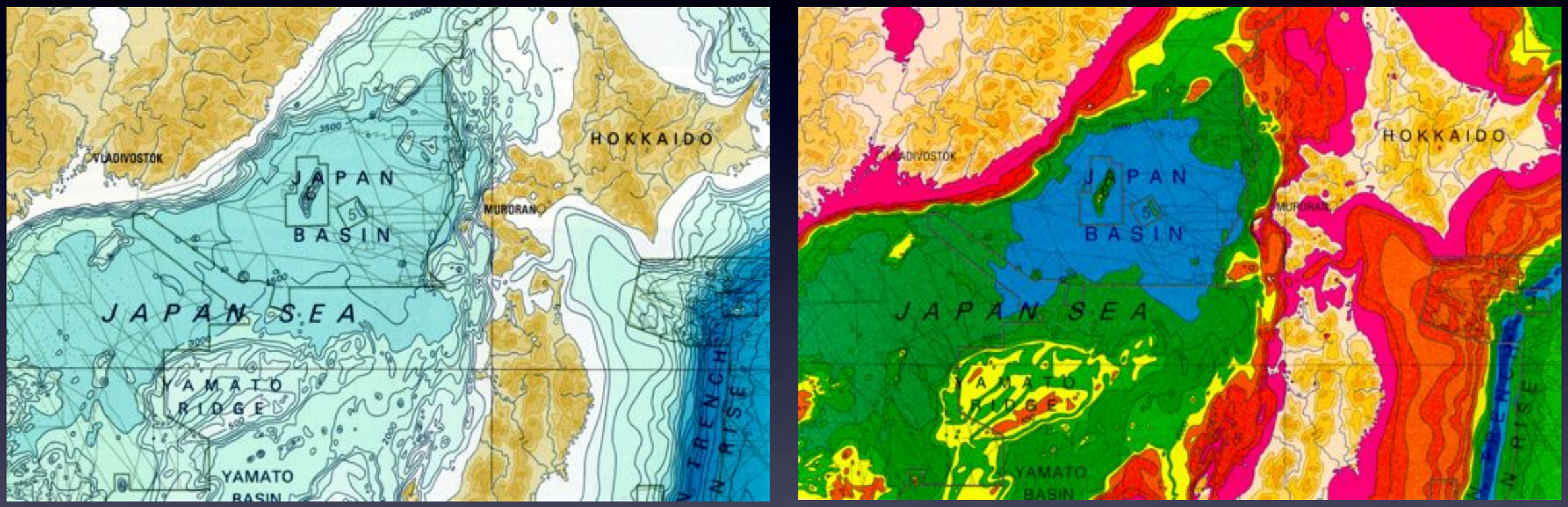
Grouping things



Making things separate



Intensity vs. Hue



The human eye has 10 times more rods than cones. This means that humans are better at interpreting changes in **intensity** rather than changes in **color**.

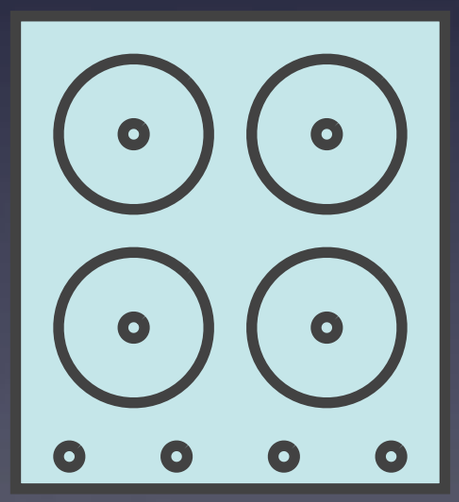
Focus

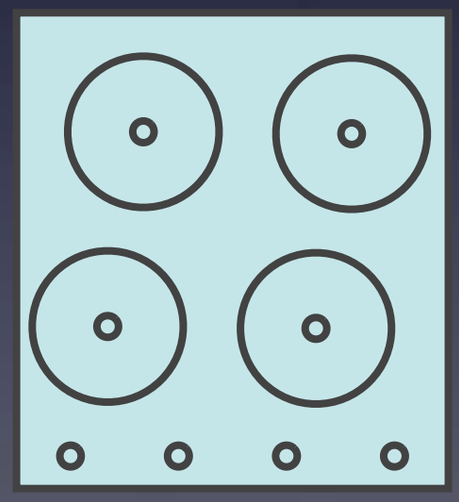
BAD

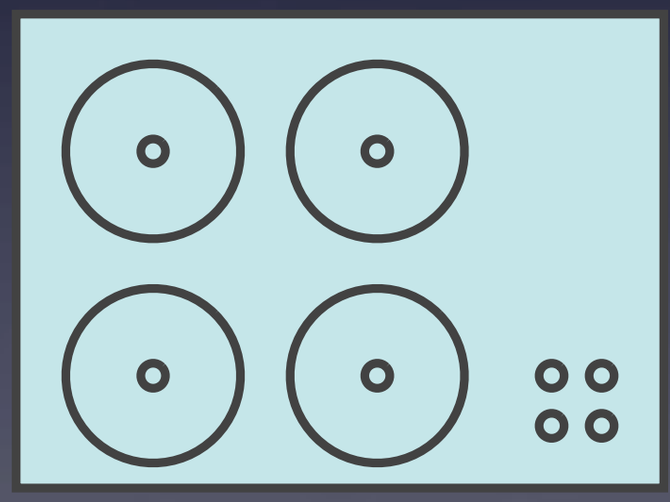
GOOD

Humans find it difficult to perceive simultaneously highly saturated, spectrally extreme colors.

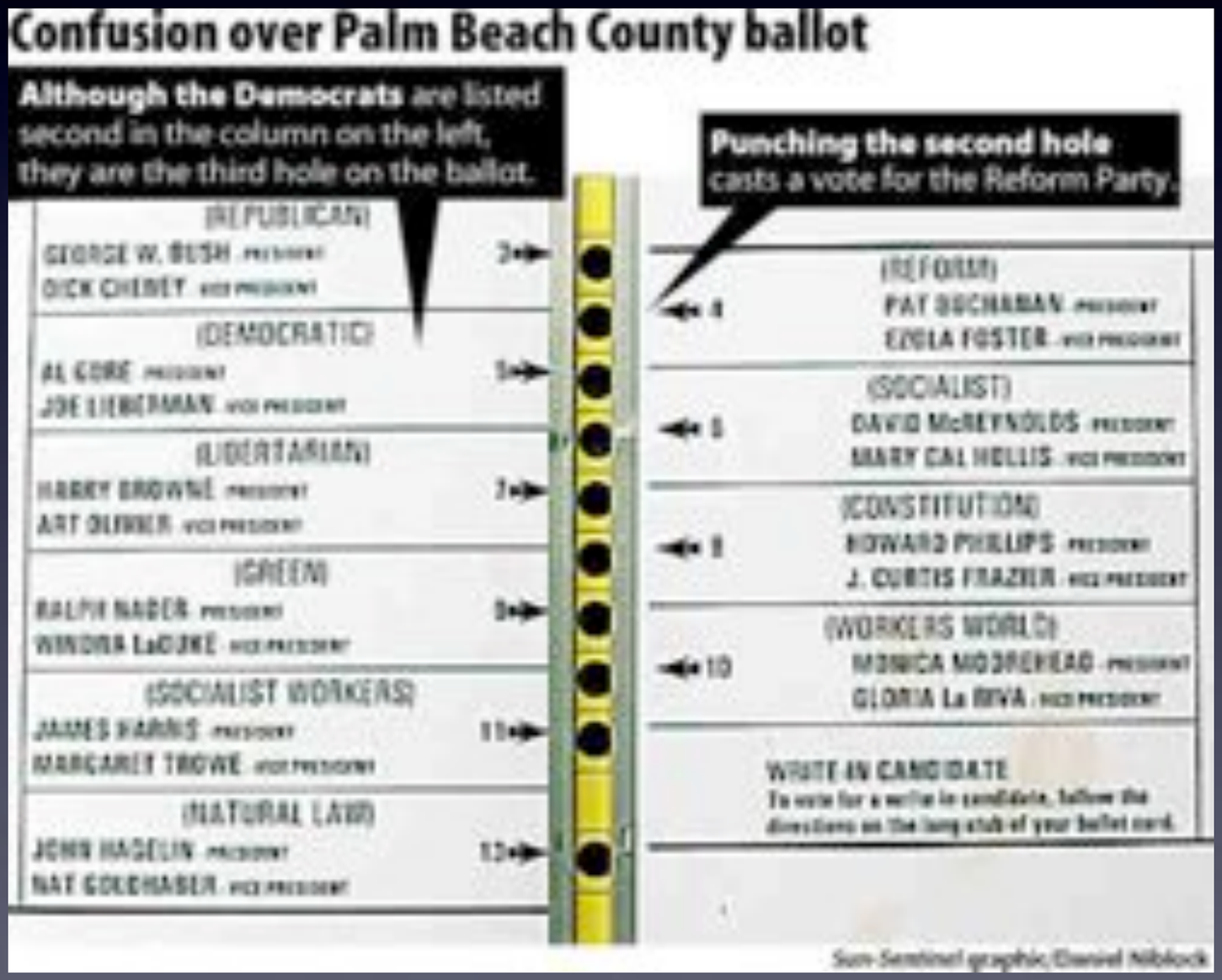
Mappings







Mappings


Confusion over Palm Beach County ballot
Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.
Punching the second hole casts a vote for the Reform Party.
(REPUBLICAN)
GEORGE W. BUSH
DICK CHENEY
3
(DEMOCRATIC)
AL GORE
JOE LIEBERMAN
5
(LIBERTARIAN)
HARRY BROWNE
ART OLIVIER
7
(GREEN)
RALPH NADER
WINONA LaDUKE
9
(SOCIALIST WORKERS)
JAMES HARRIS
MARGARET TROWE
11
(NATURAL LAW)
JOHN HAGELIN
NAT GOLDHABER
12
(REFORM)
PAT BUCHANAN
EZOLA FOSTER
4
(SOCIALIST)
DAVID McREYNOLDS
MARY CAL HOLLIS
6
(CONSTITUTION)
HOWARD PHILLIPS
J. CURTIS FRAZIER
8
(WORKERS WORLD)
MONICA MOOREHEAD
GLORIA La RIVA
10
WRITE-IN CANDIDATE
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.
Sun-Sentinel graphic/Daniel Nibblock

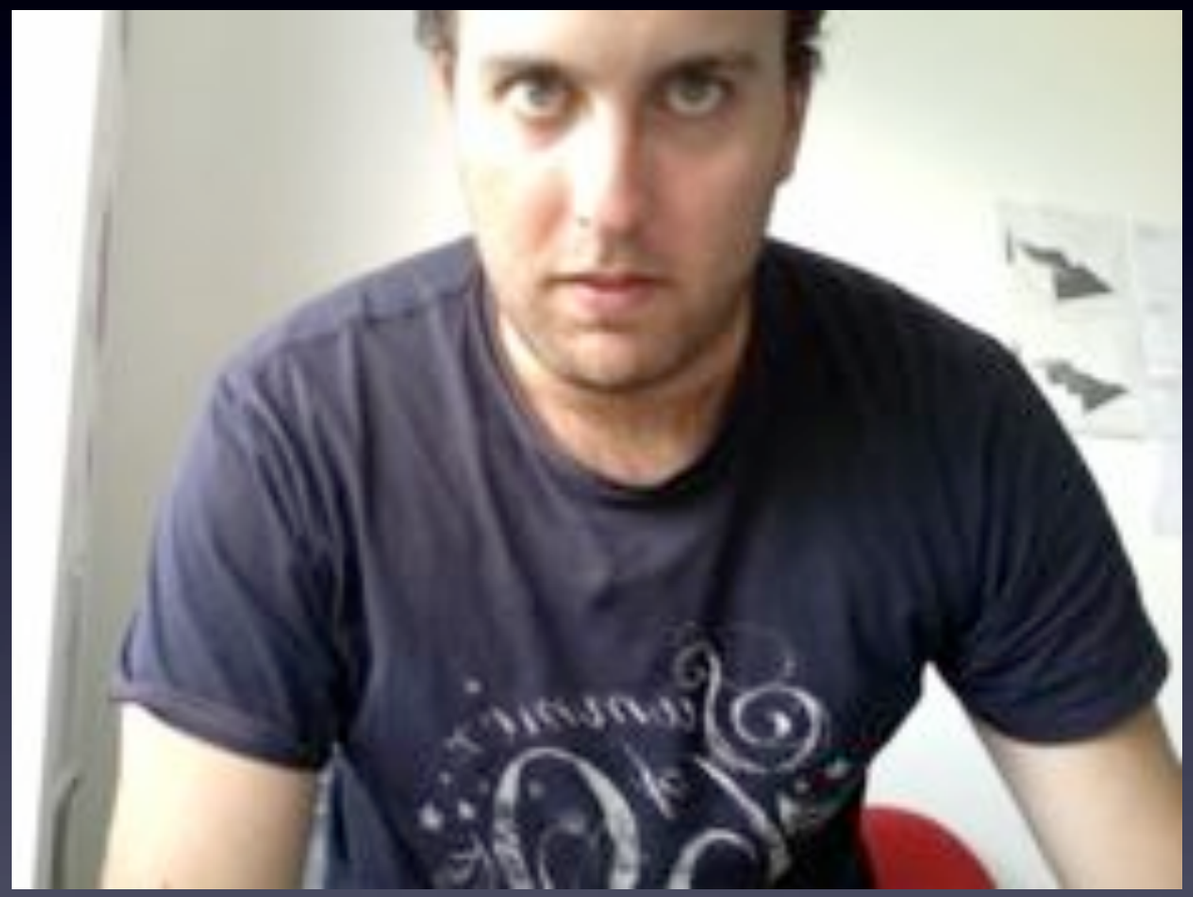
Feed-back &
Feed-forward

Emergence of networking

- Many users - many computers
- Online collaborative systems

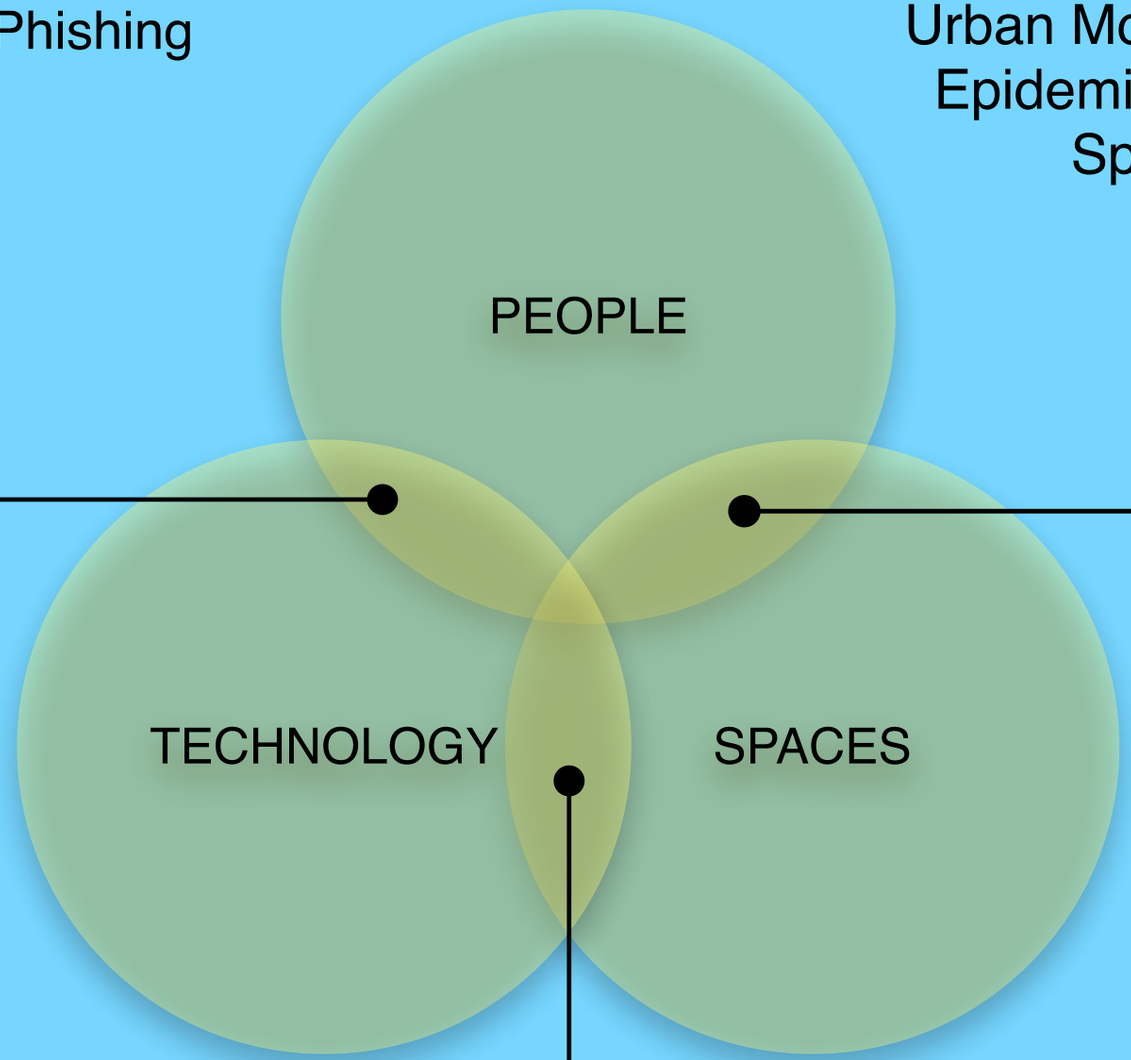
Making eye contact

Perception of authority



Human Computer Interaction,
Trust, Privacy, Phishing

Spatial & Transpatial Social Networks
Urban Mobility & Encounter
Epidemiology & Diffusion
Space Syntax



Augmented Spaces
Situated Services
Delay Tolerant Networks

Let me show you my lab

Hack the city!

Welcome to my Lab

the city is the system

Plan of attack

- Step 1: Collect data. What is out there?
- Step 2: Create models to explain what is out there. Identify metrics.
- Step 3: Use the models to create **better** systems.

Chapter 2: Pervasive Computing 1.0

Controversy is a measure of progress

Last Updated: Thursday, 16 August 2007, 14:37 GMT 15:37 UK

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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.

Cityware nodes have been set up in Bath and London

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

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  22 May 07 | Technology
- Legal fight over Bluetooth chips
  04 Jan 07 | Technology

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- About Cityware on Facebook (requires registration)

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2. Photo the Bangladesh army cannot stand
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- Most popular now, in detail

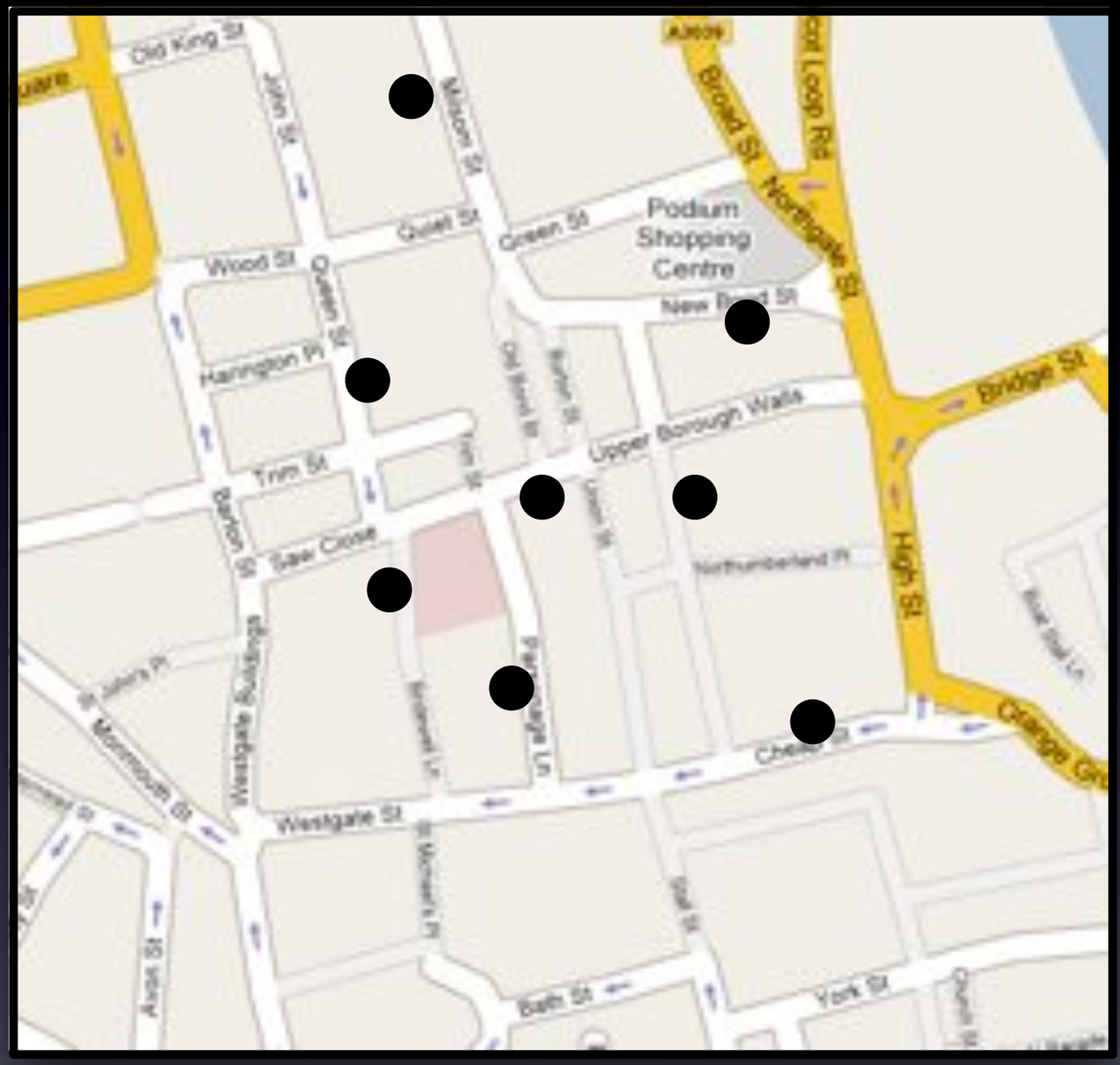

Gypsy Bandito
Big Brother 2.0


Computer Software News
Bluetooth + facebook = creepy, but kind of cool

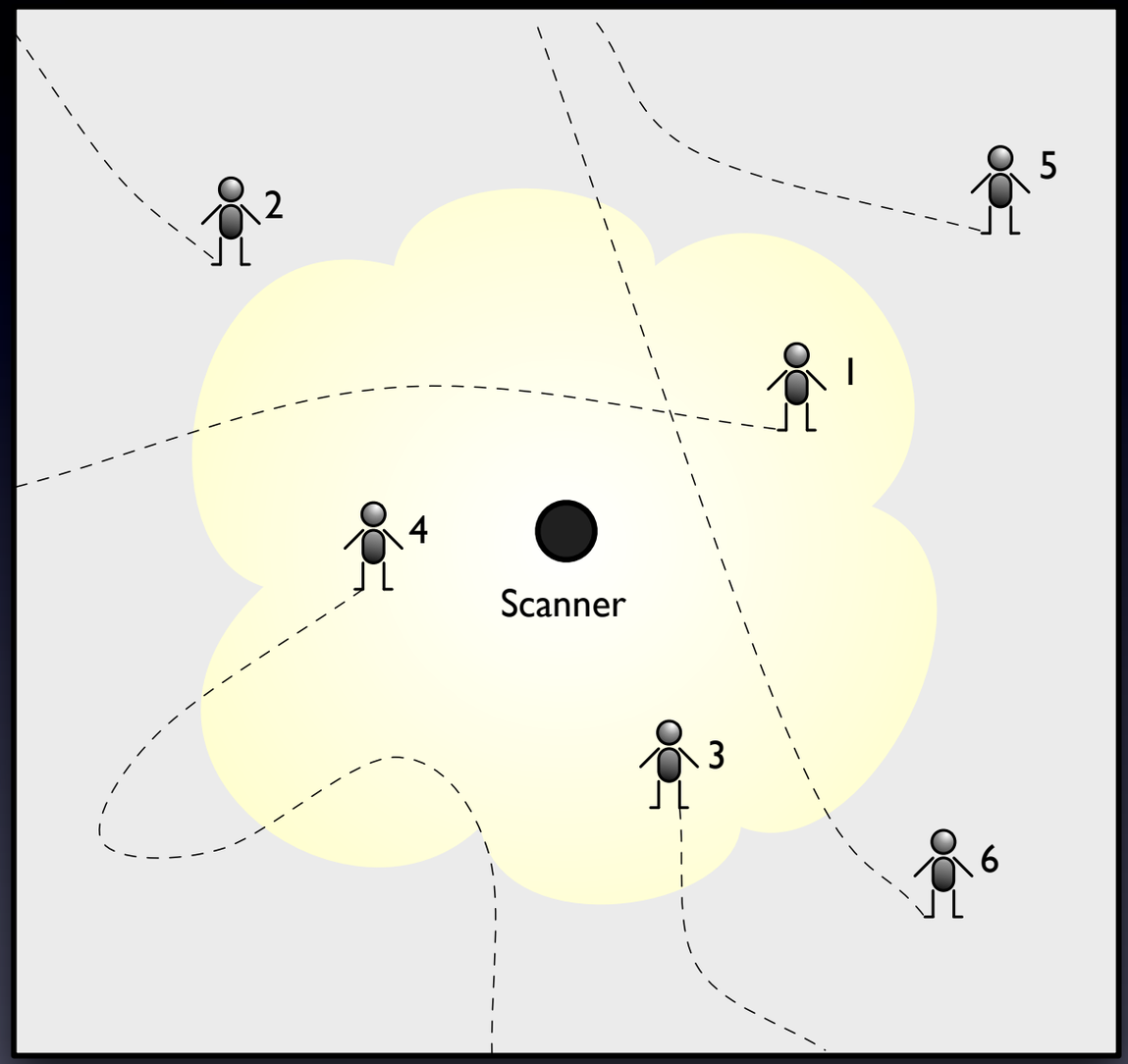

DigiMemo.com

Mixed reactions

- People are unsure how to react
- It is definitely 2.0



O'Neill, E., Kostakos, V., Kindberg, T., Fatah gen. Schiek, A., Penn, A., Stanton Fraser, D. and Jones, T. (2006). Instrumenting the city: developing methods for observing and understanding the digital cityscape. In proceedings of UbiComp 2006, Lecture notes in Computer Science 4206, Springer, pp. 315-332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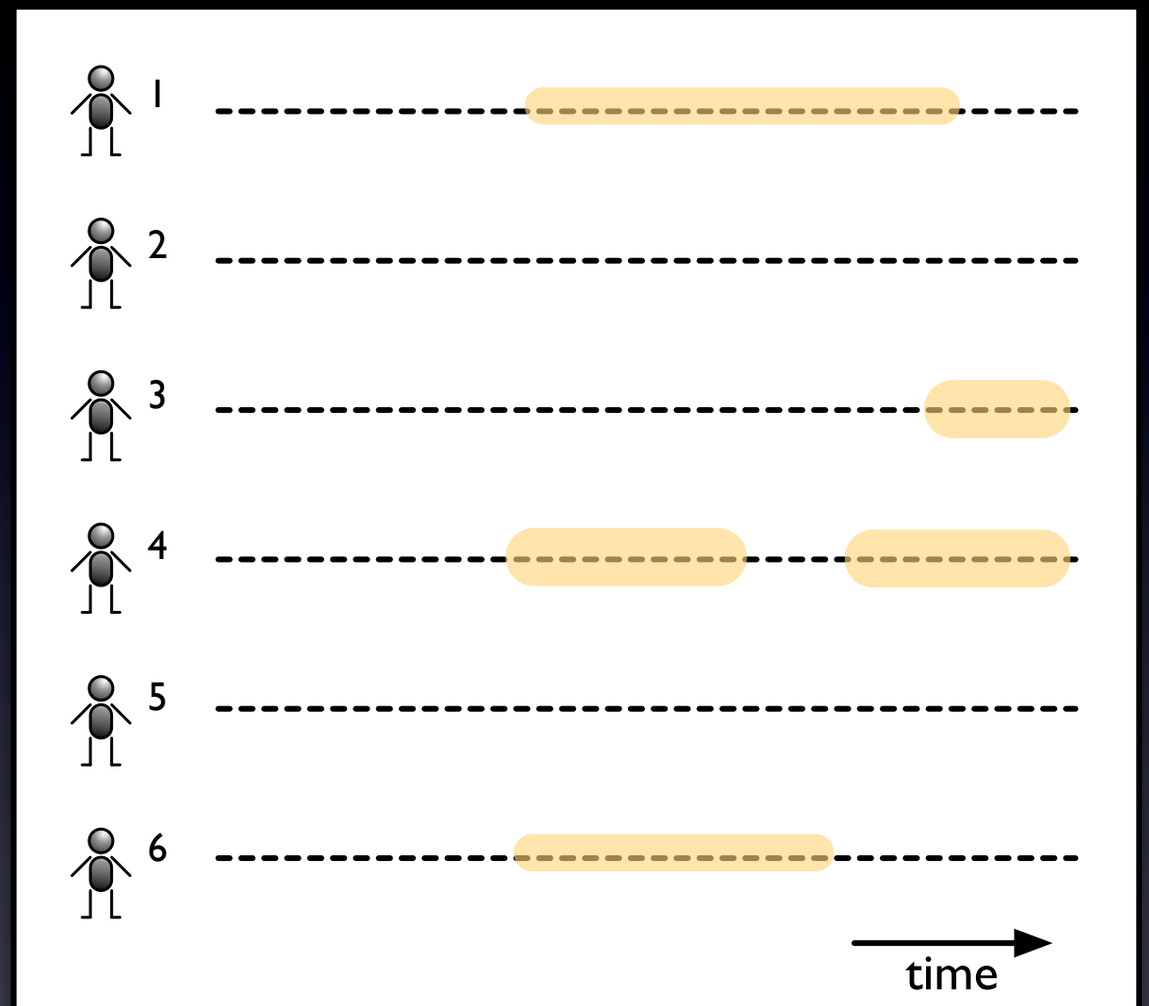
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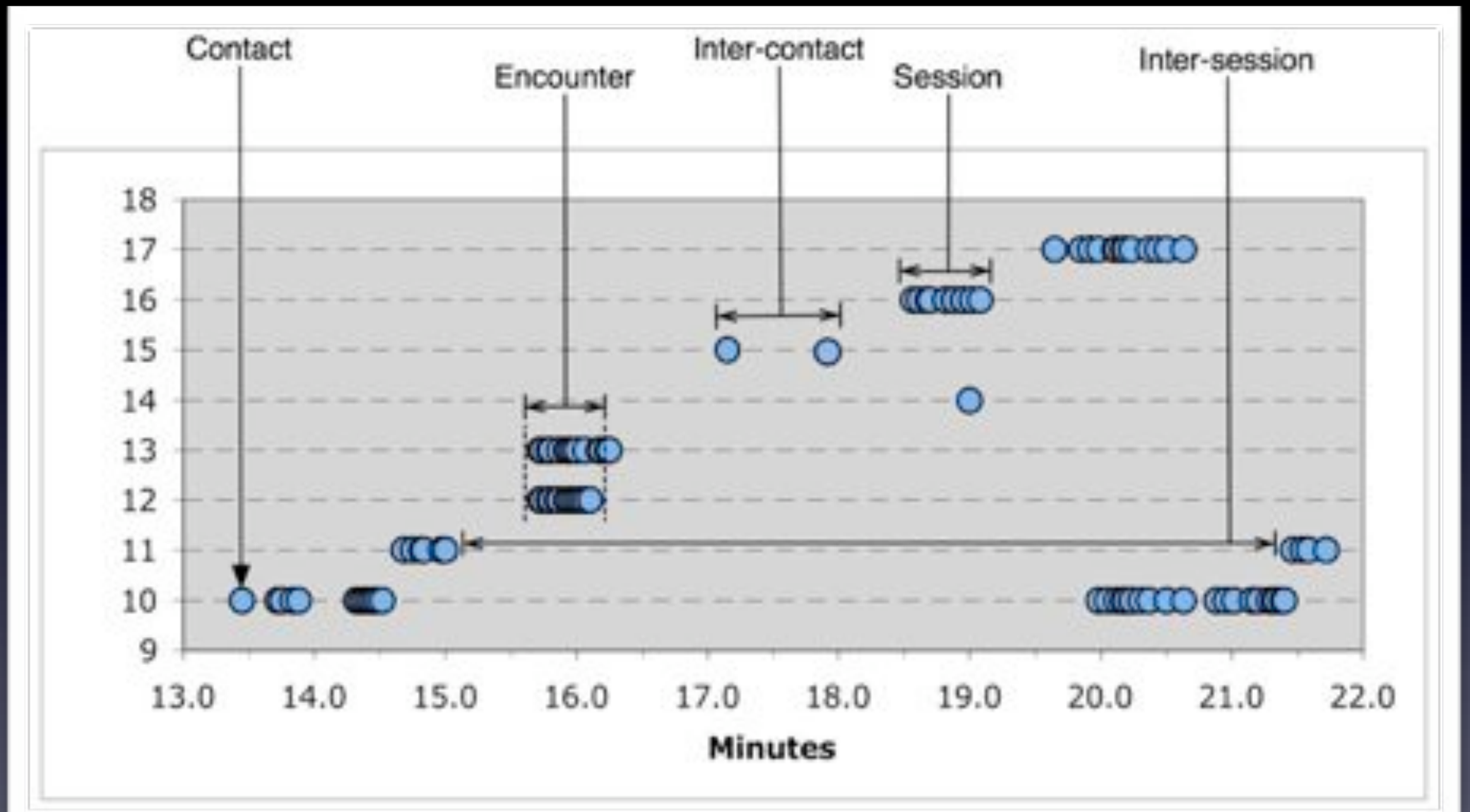
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Inter-session
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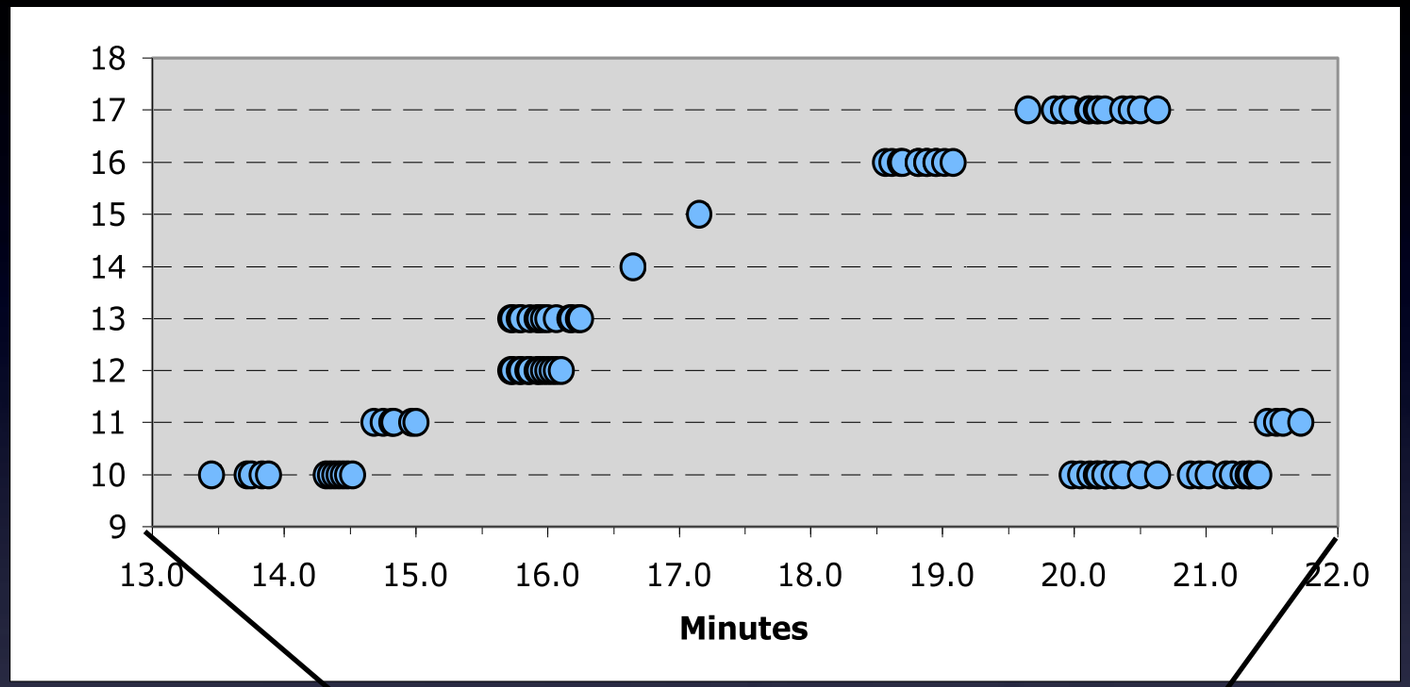
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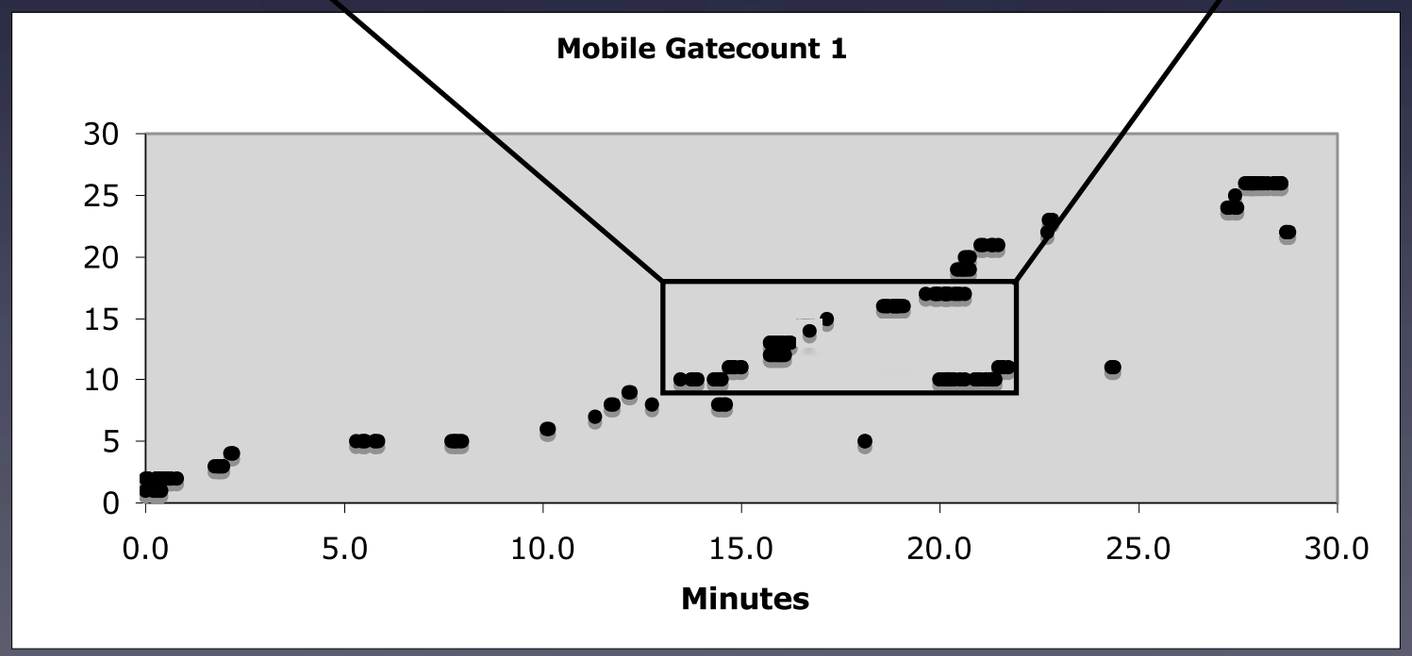
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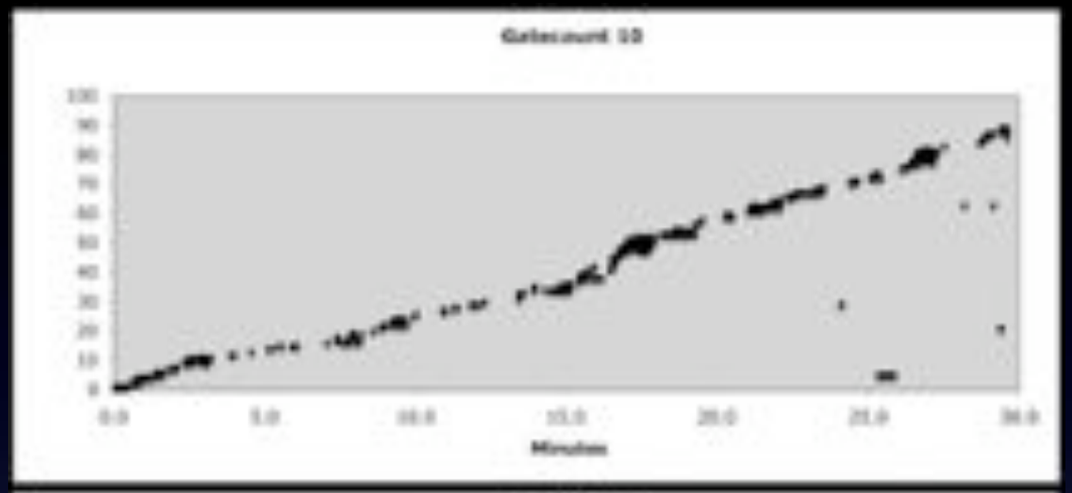
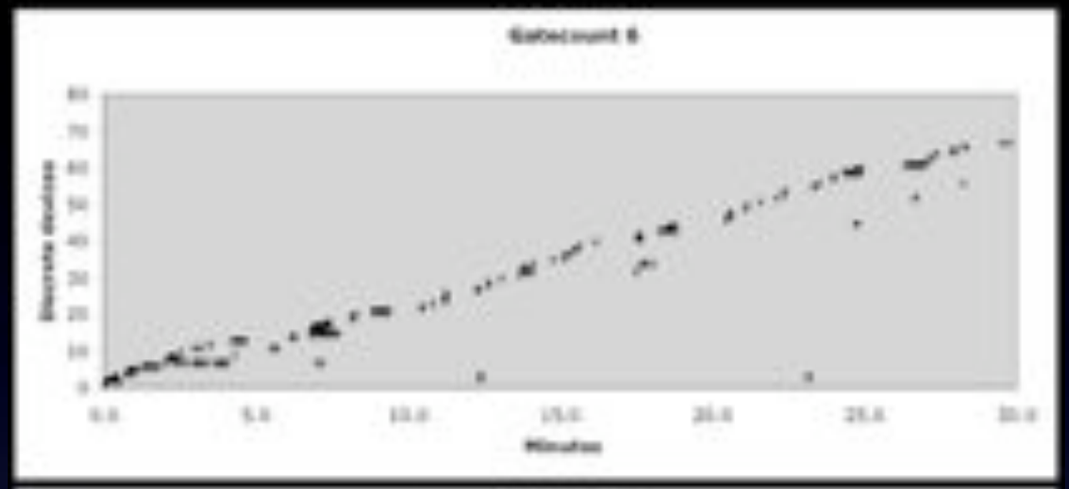
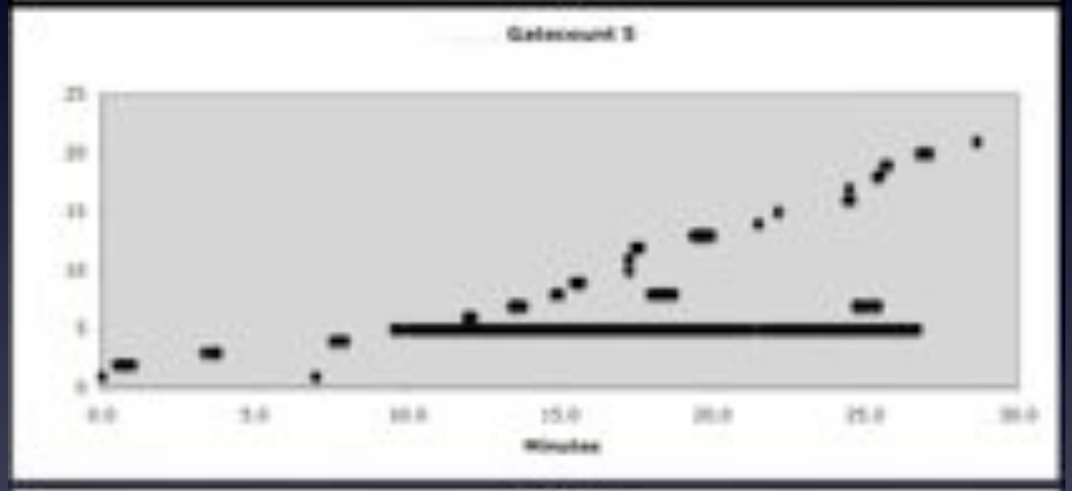
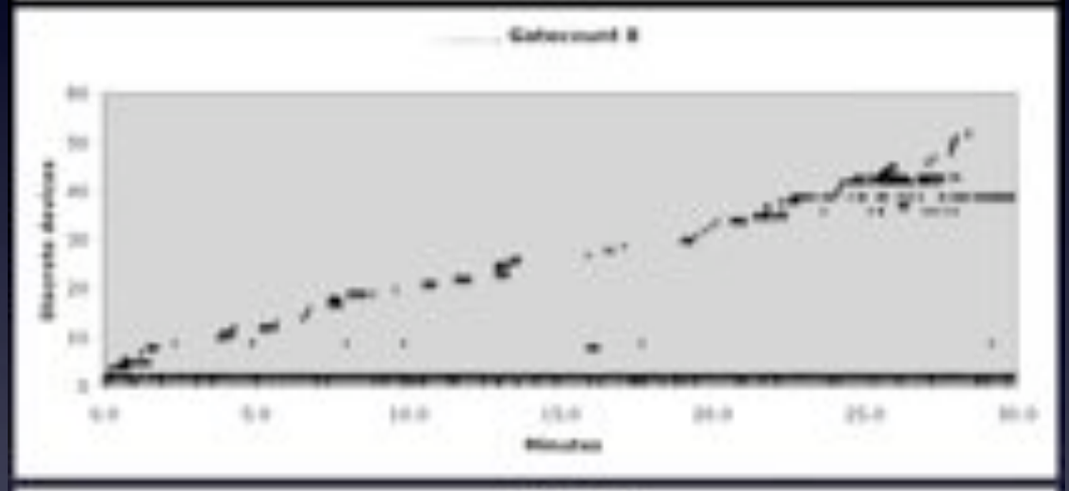
Minutes

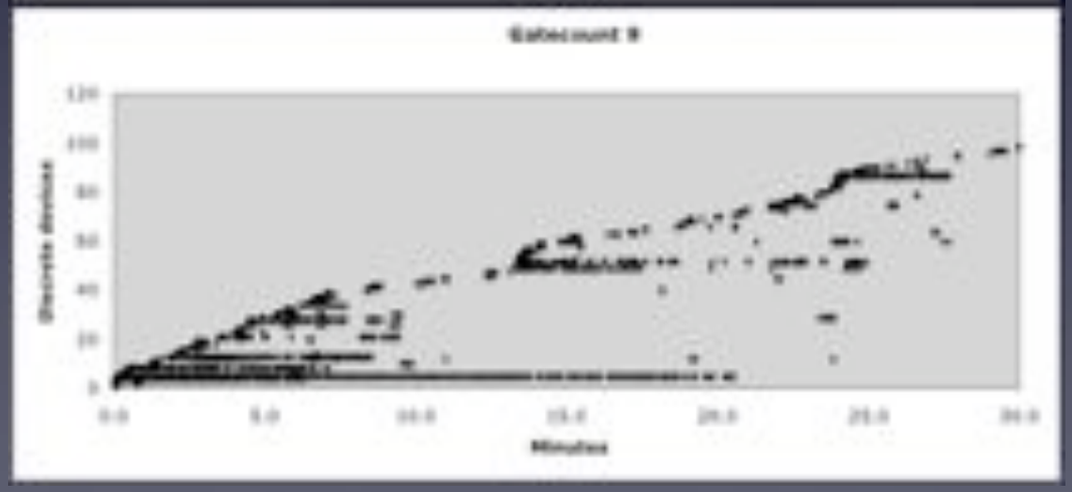
Gatecount timelines

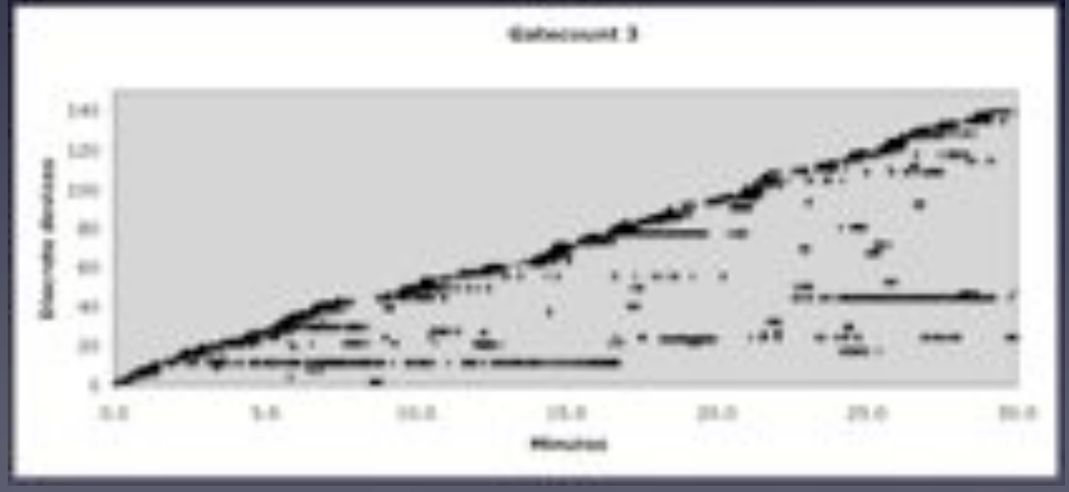


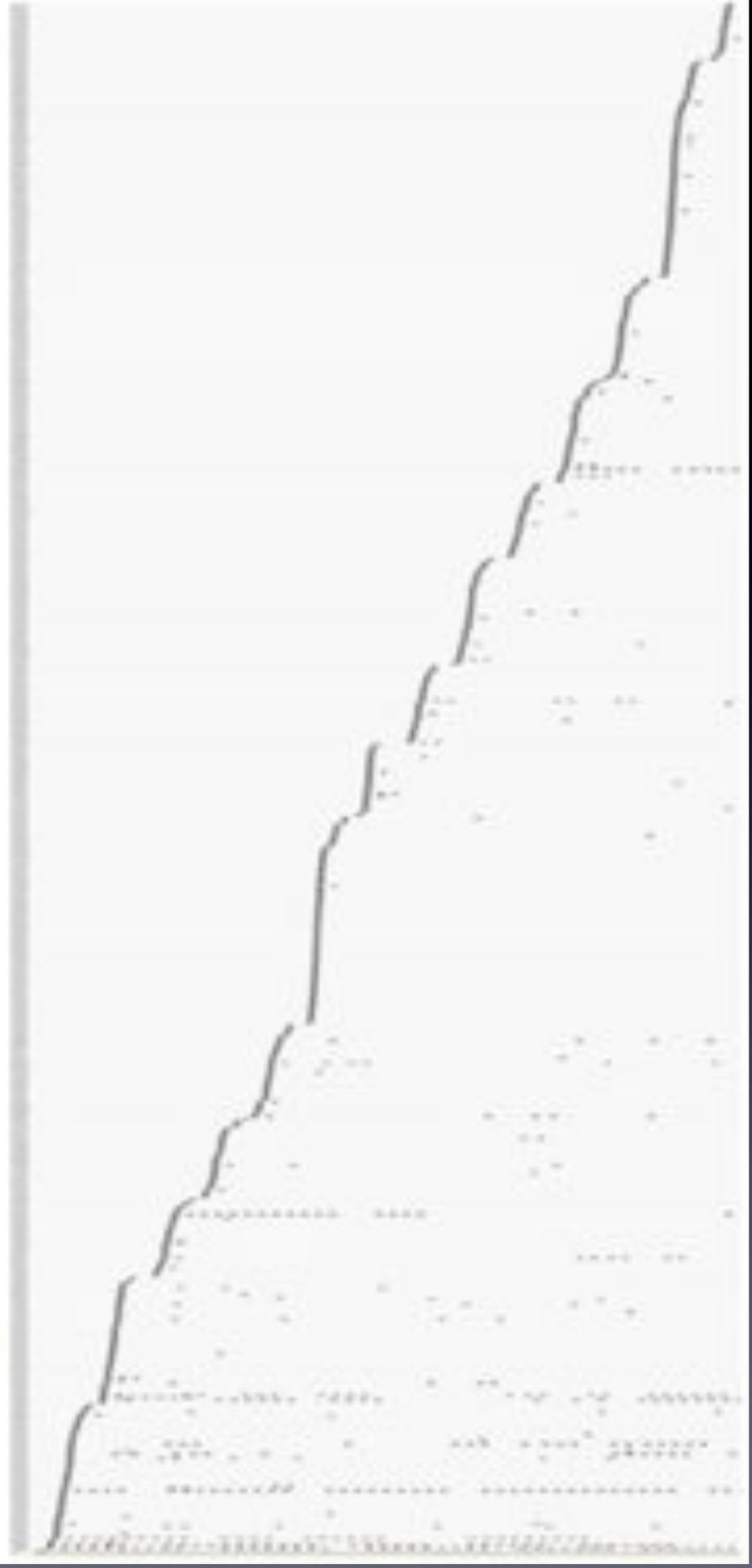


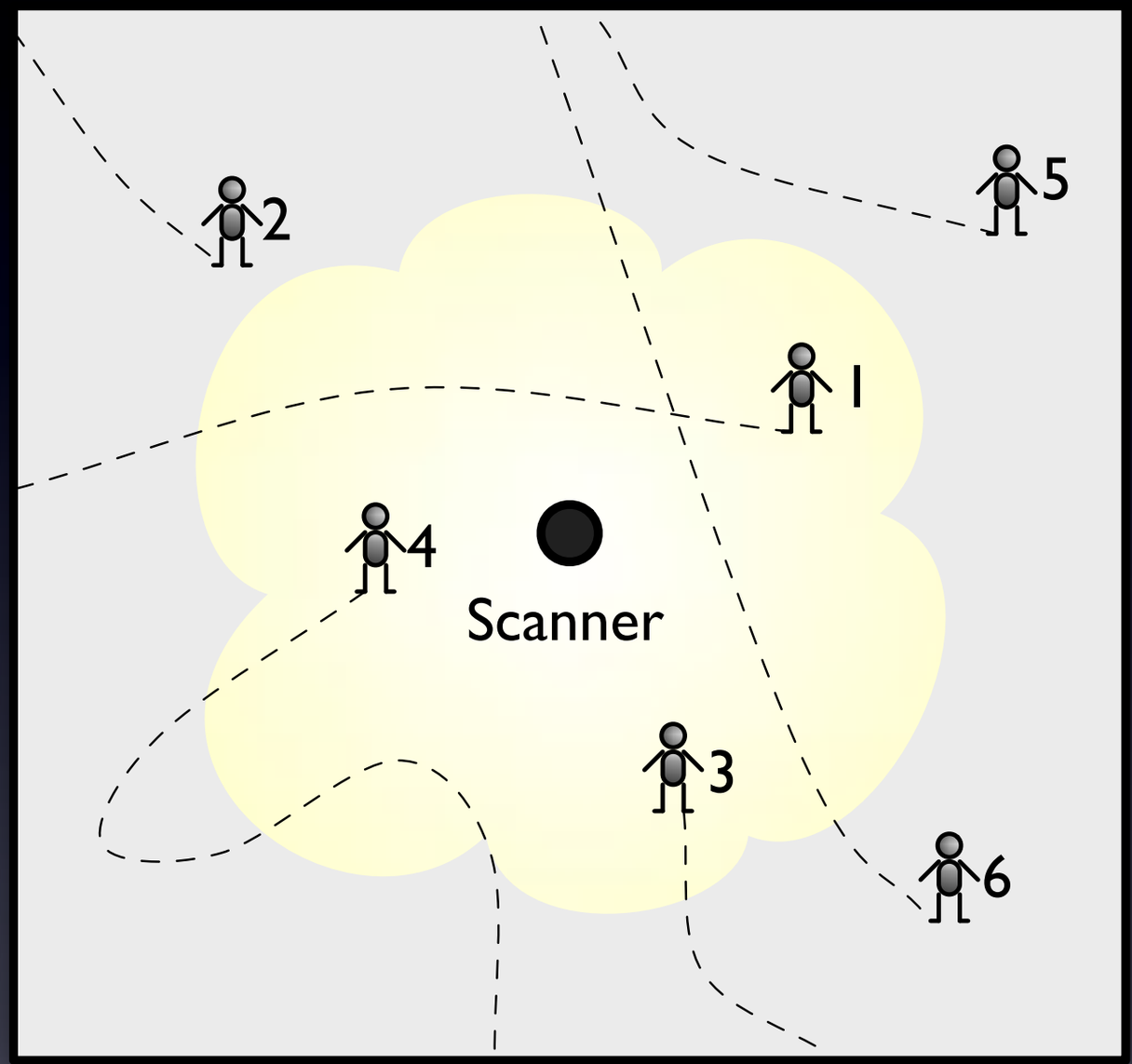








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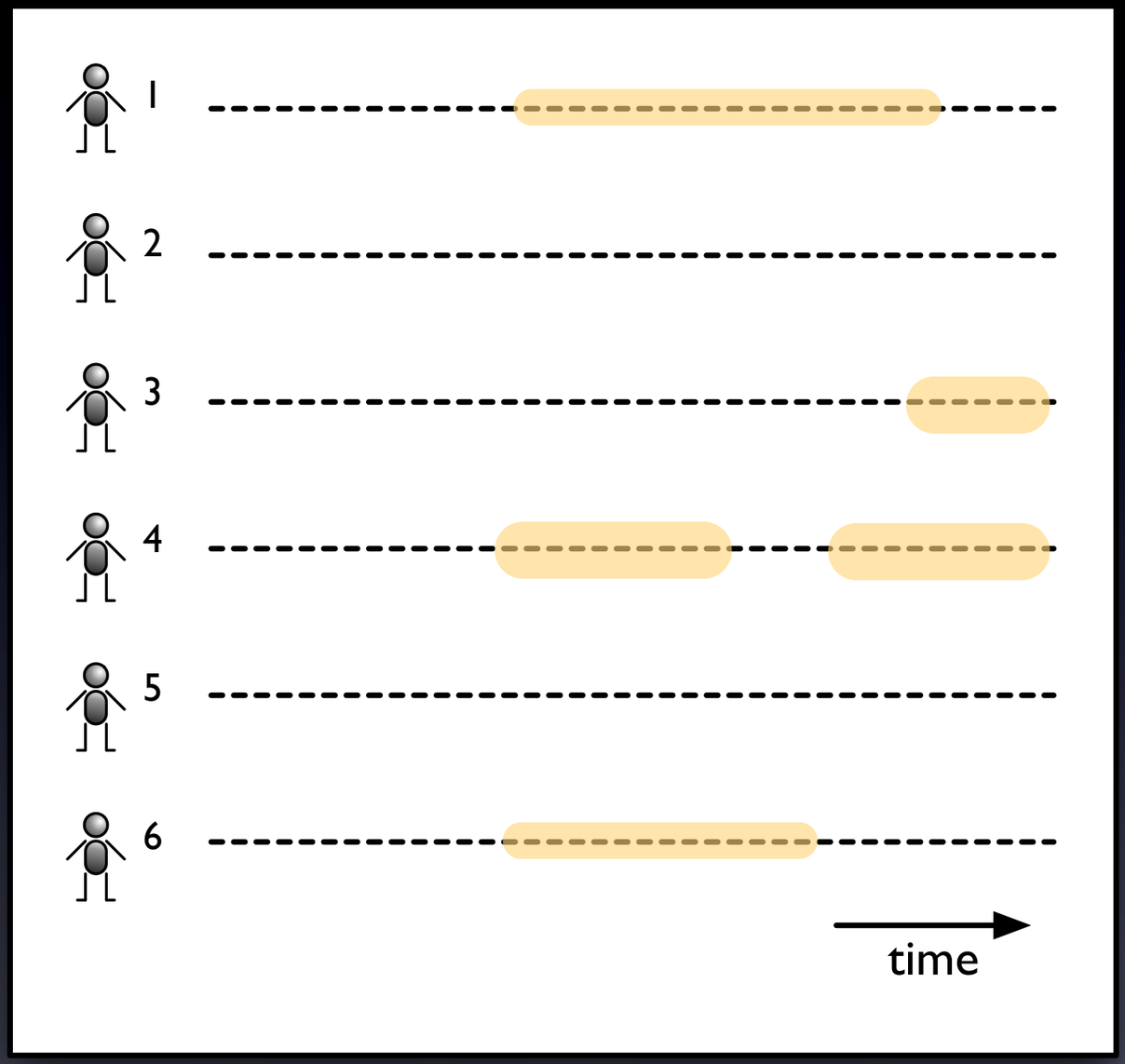
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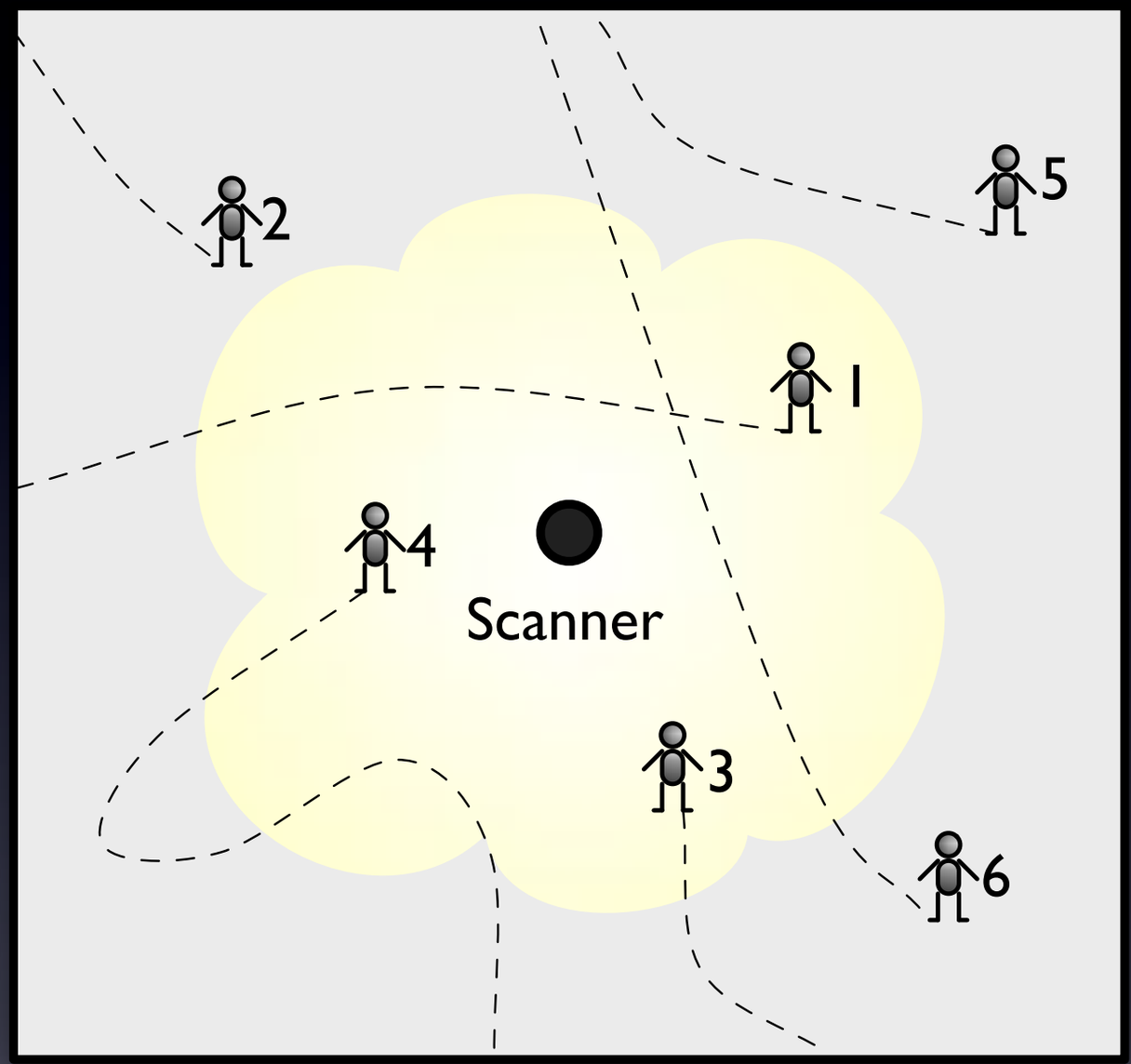
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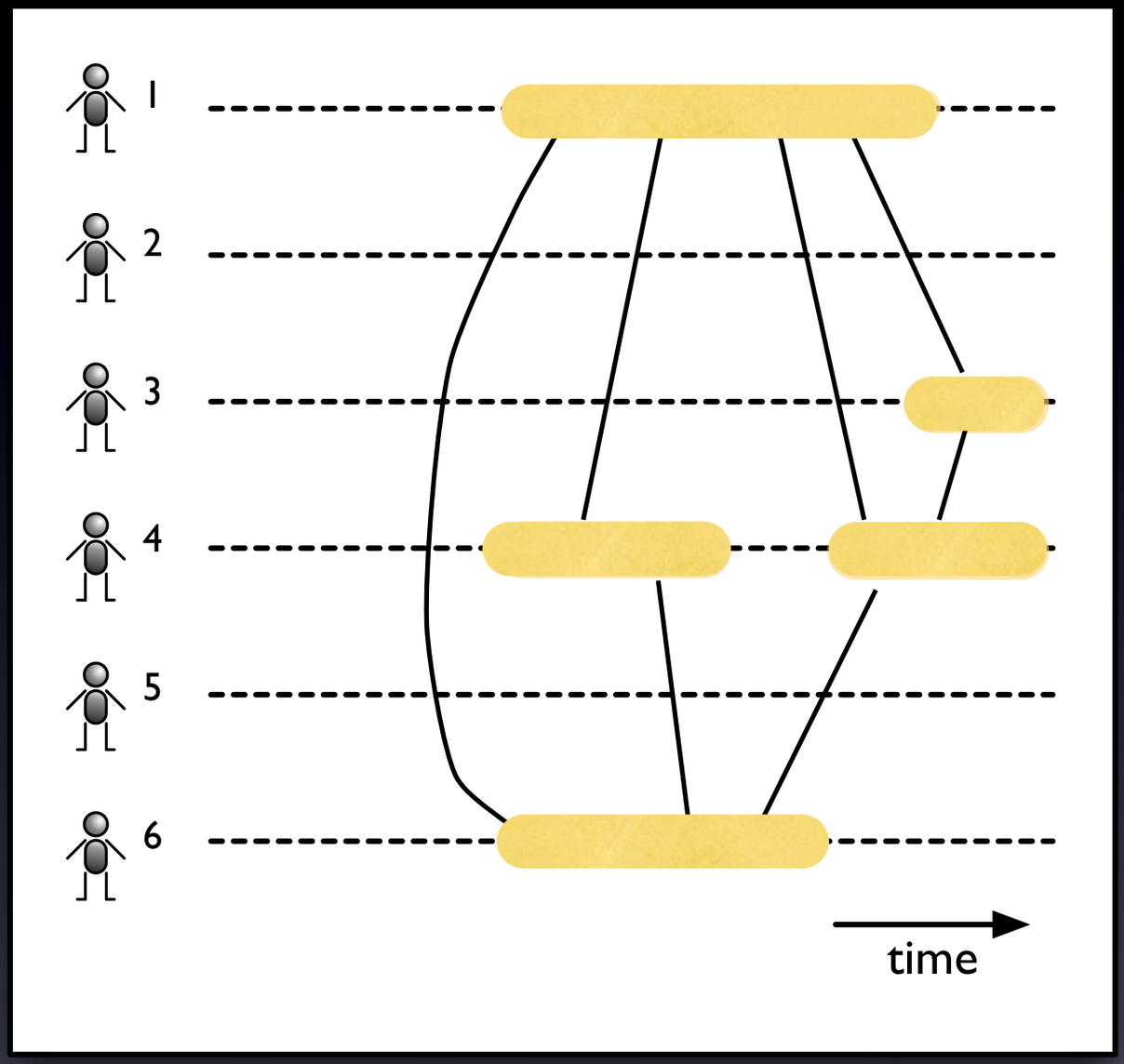
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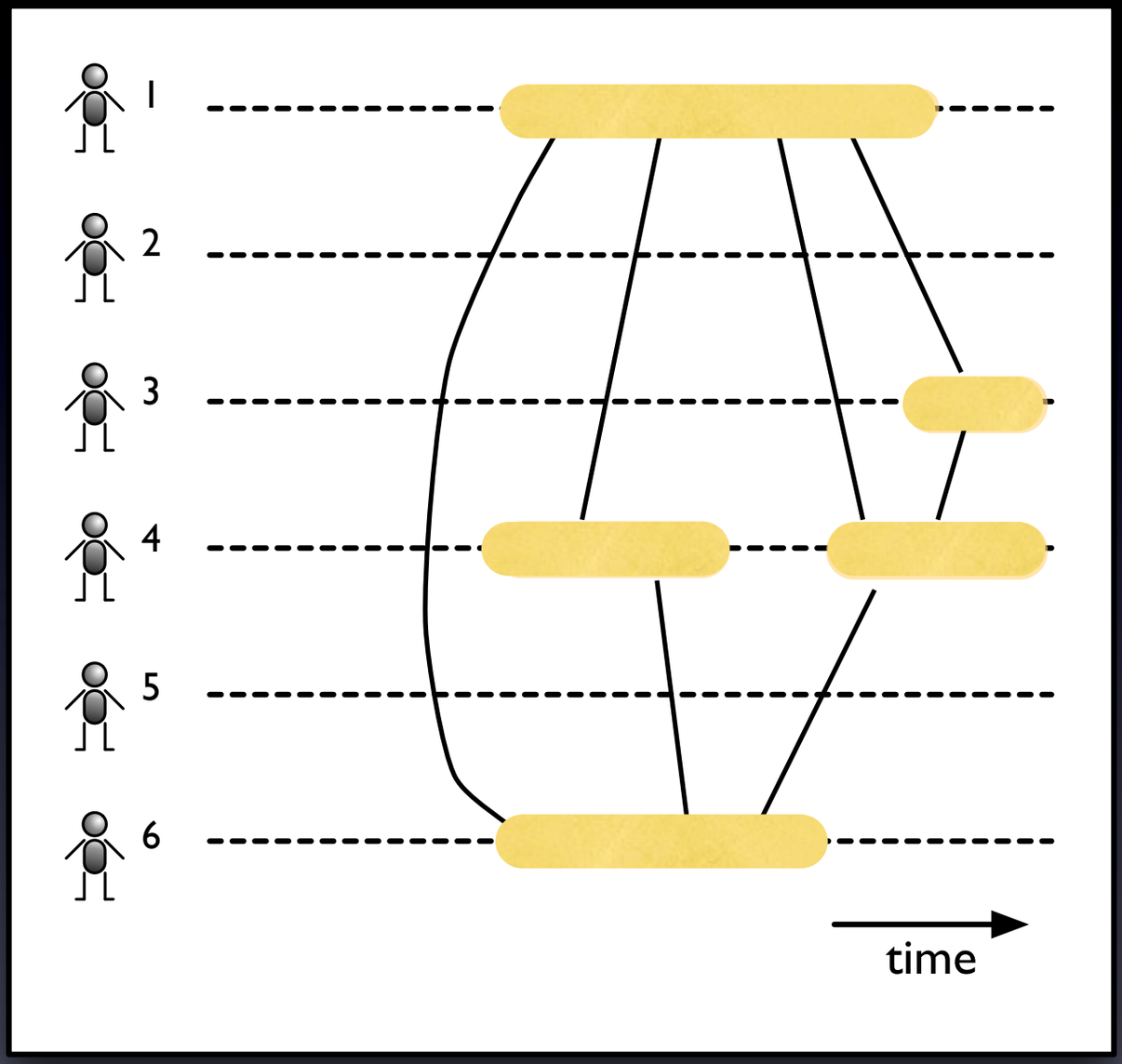
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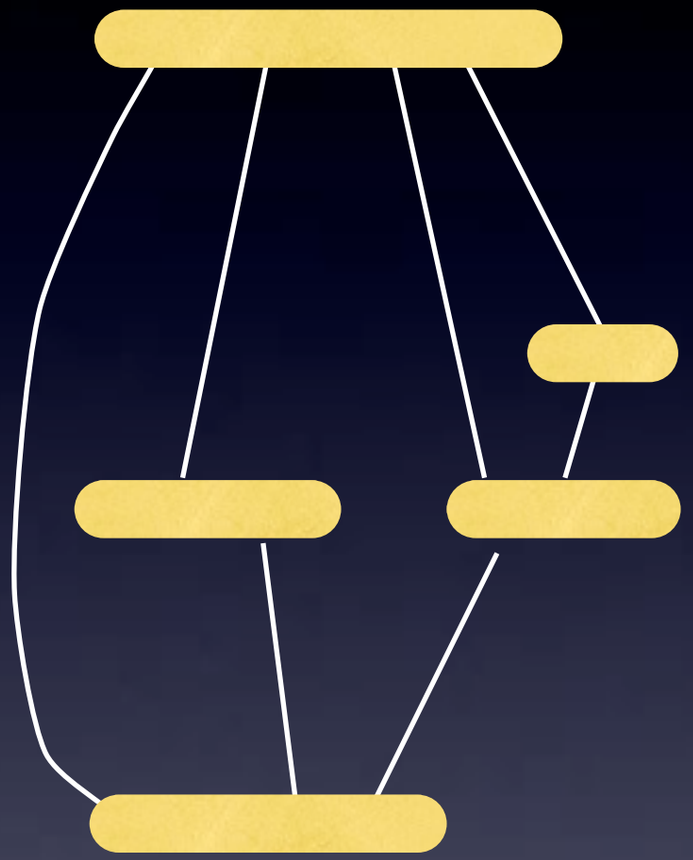
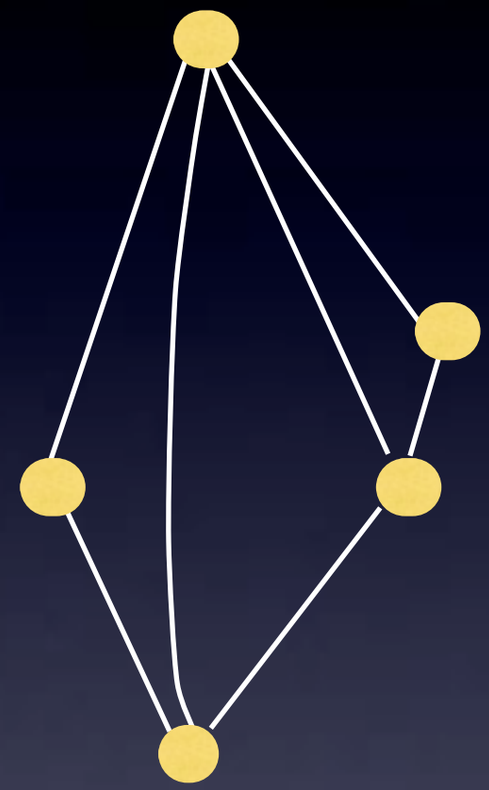
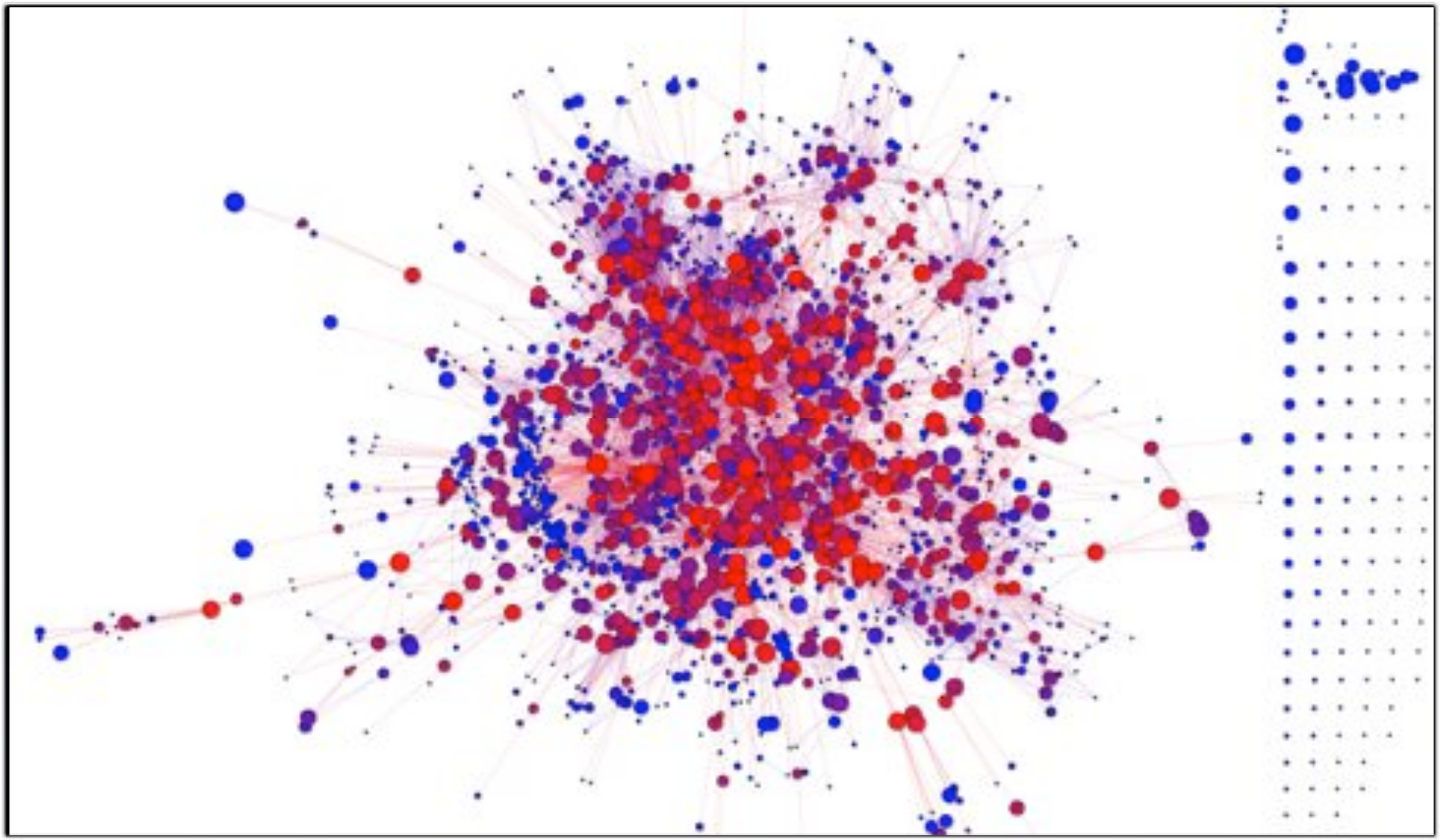
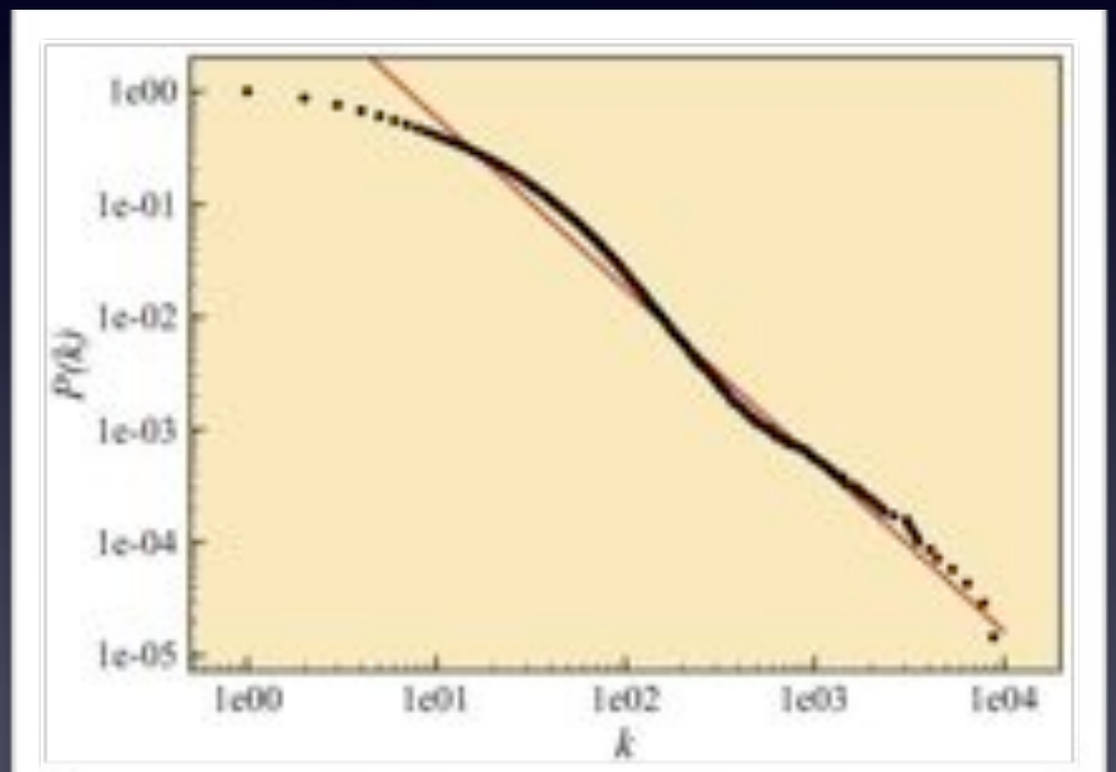


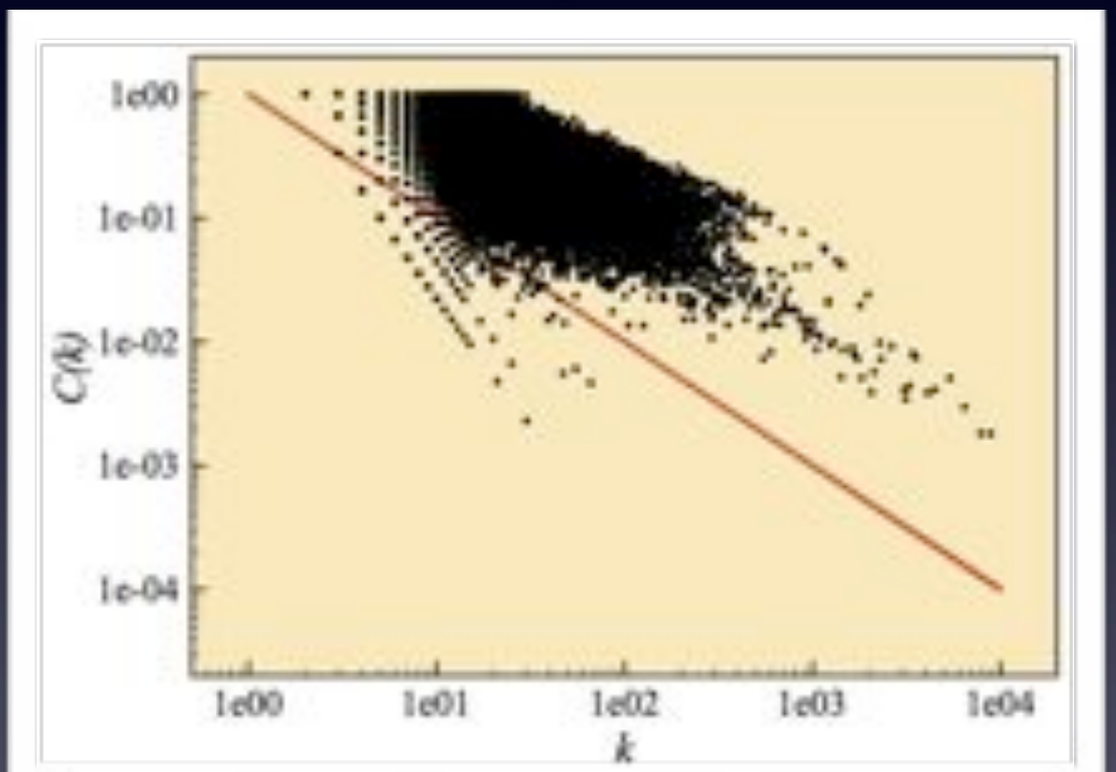


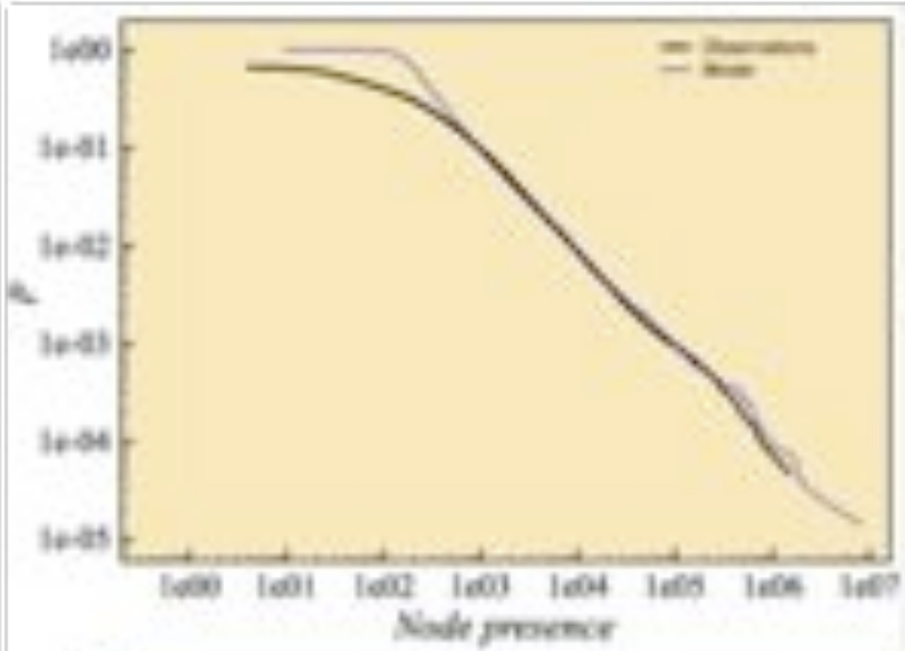


Kostakos, V., O'Neill, E., Penn, A. (2007). Brief encounter networks. arXiv:0709.0223

Power laws and exponential decays



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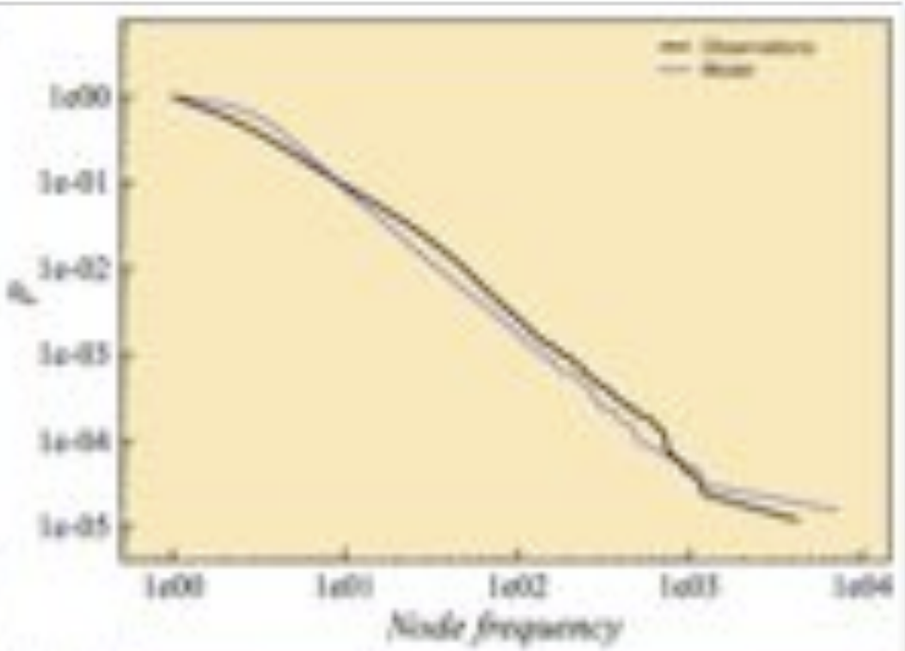
Node presence


Observations
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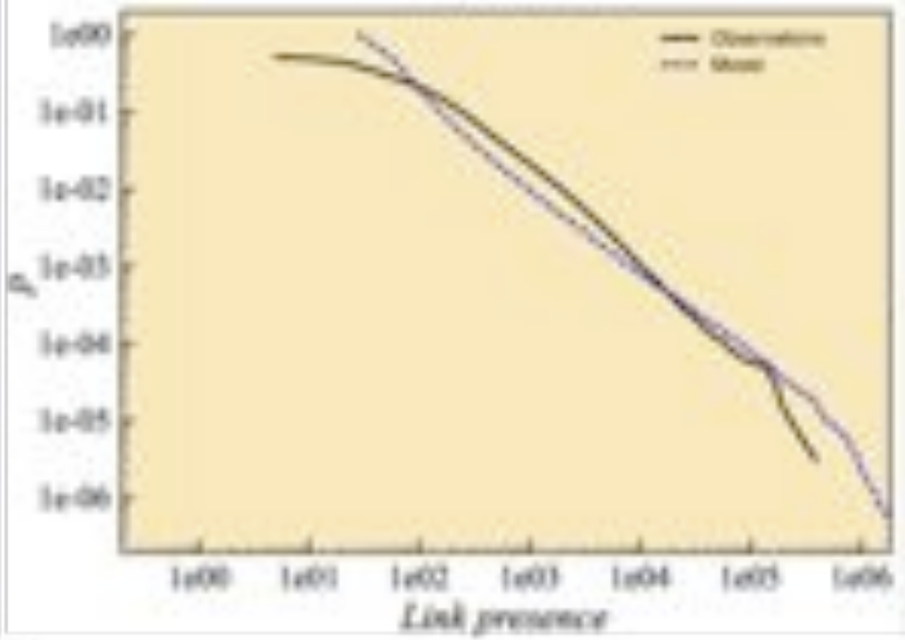
Node frequency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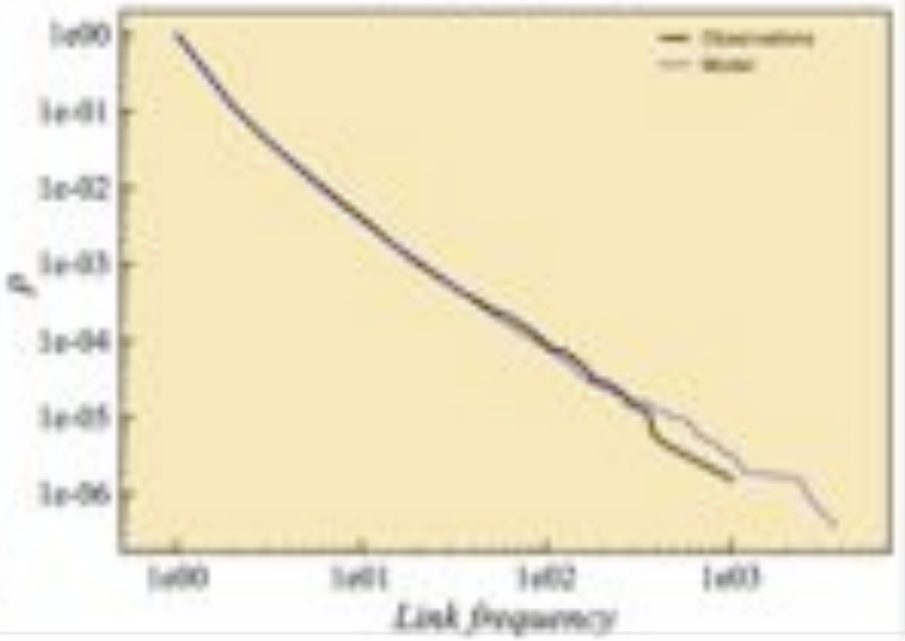
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Link frequency


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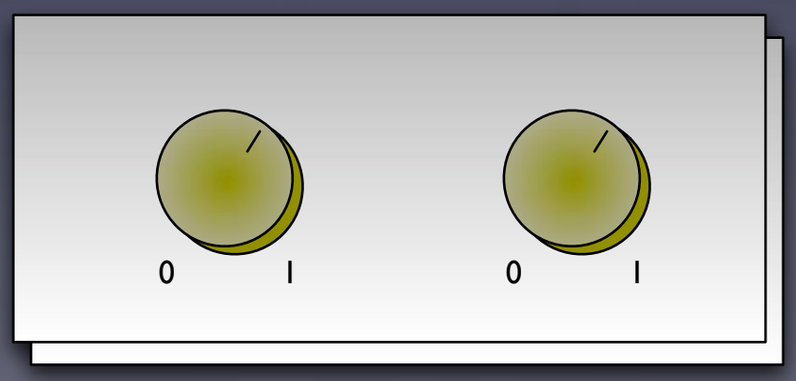
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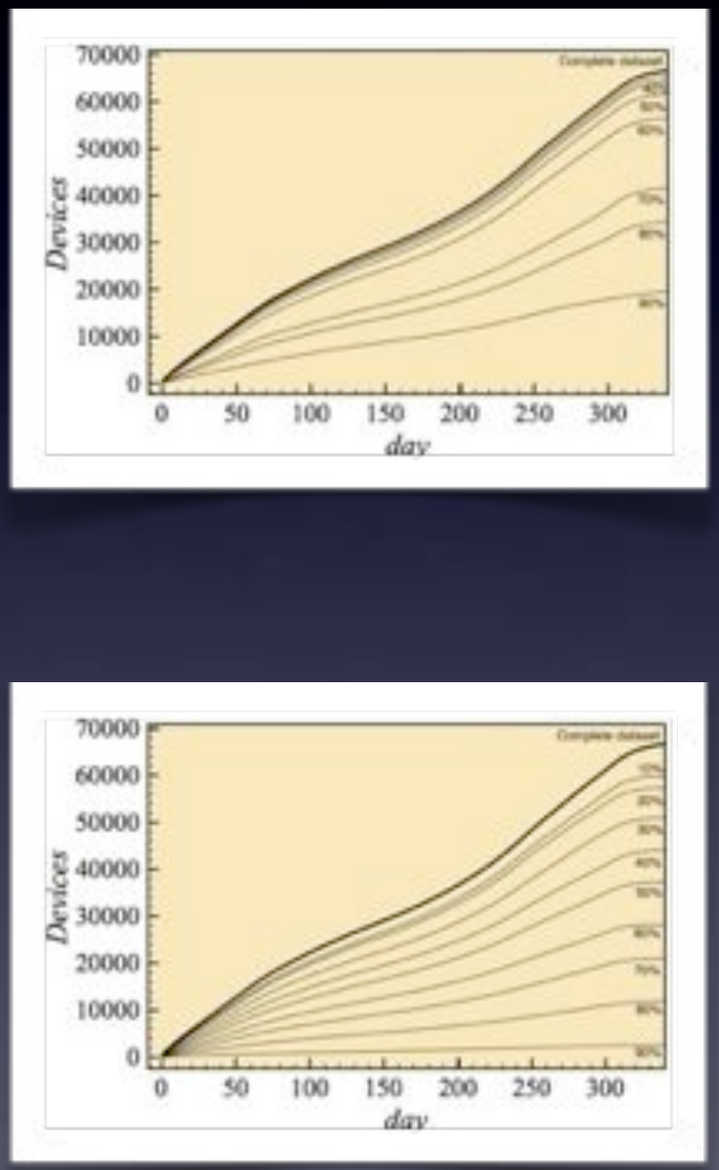
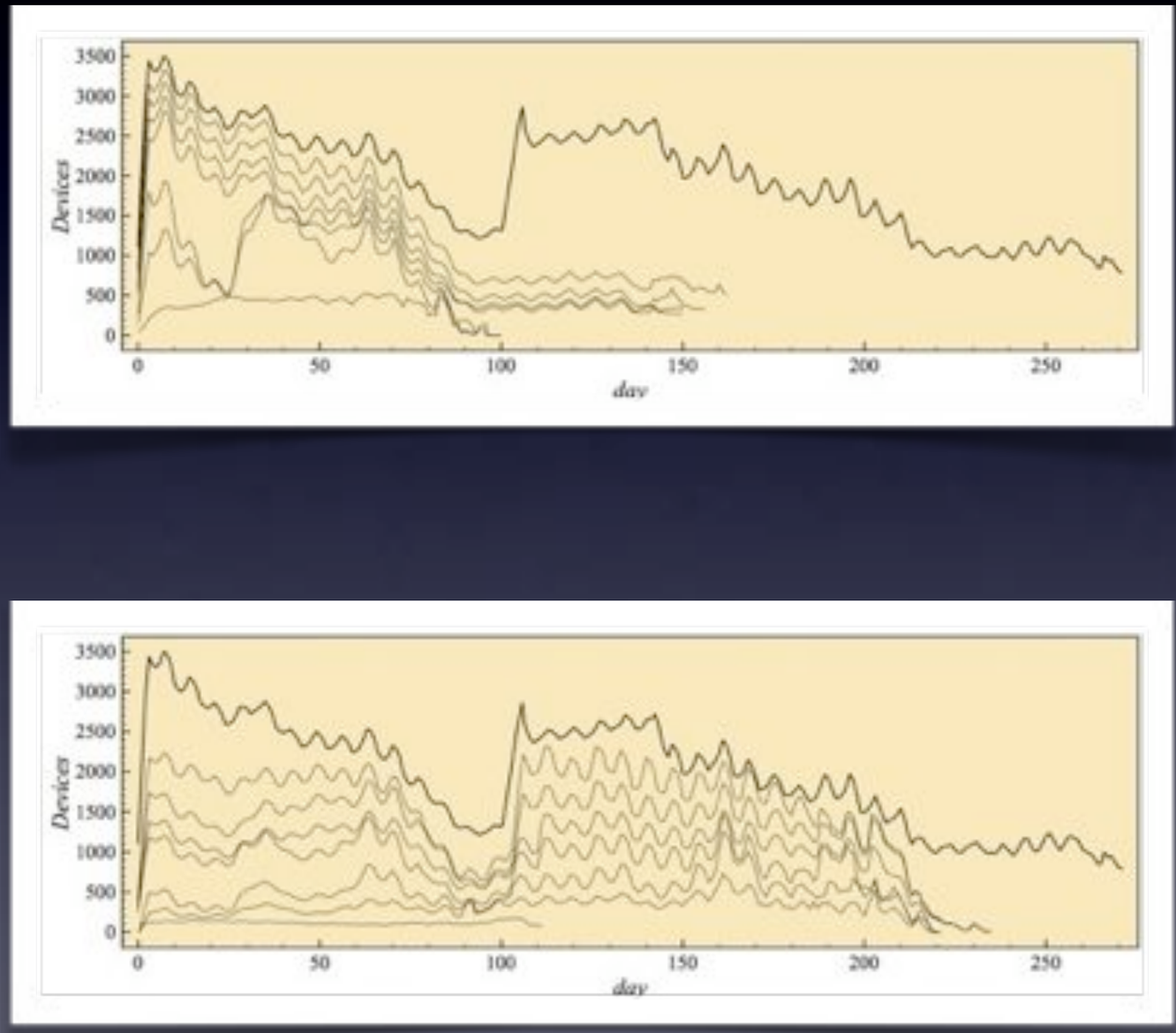
No Friends

No Strangers

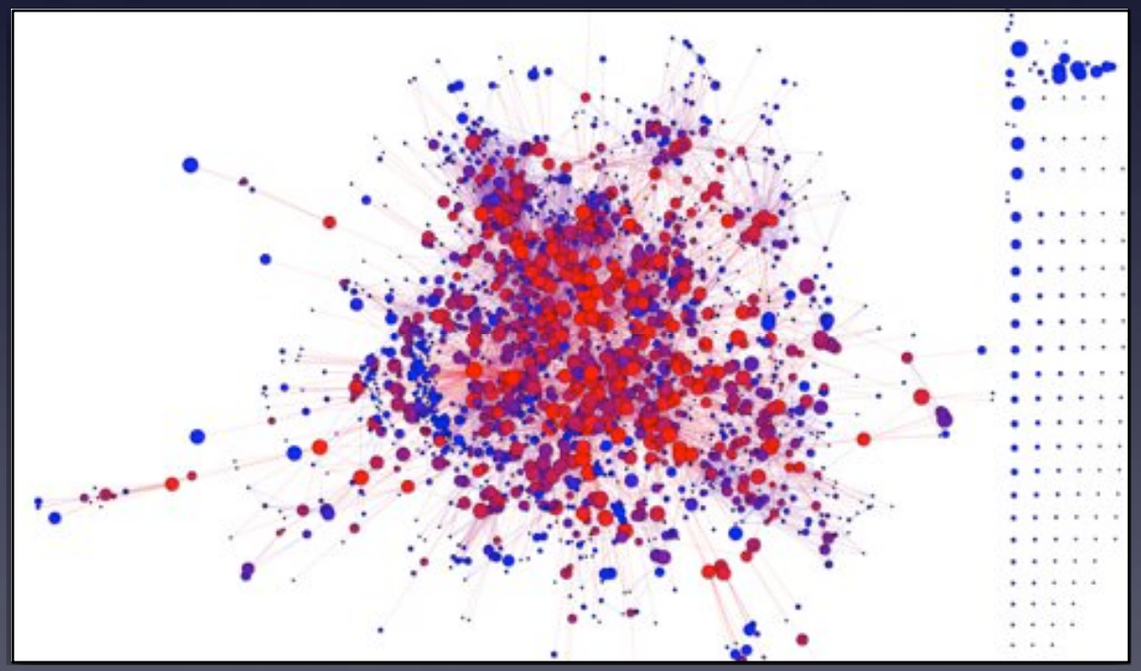
Information

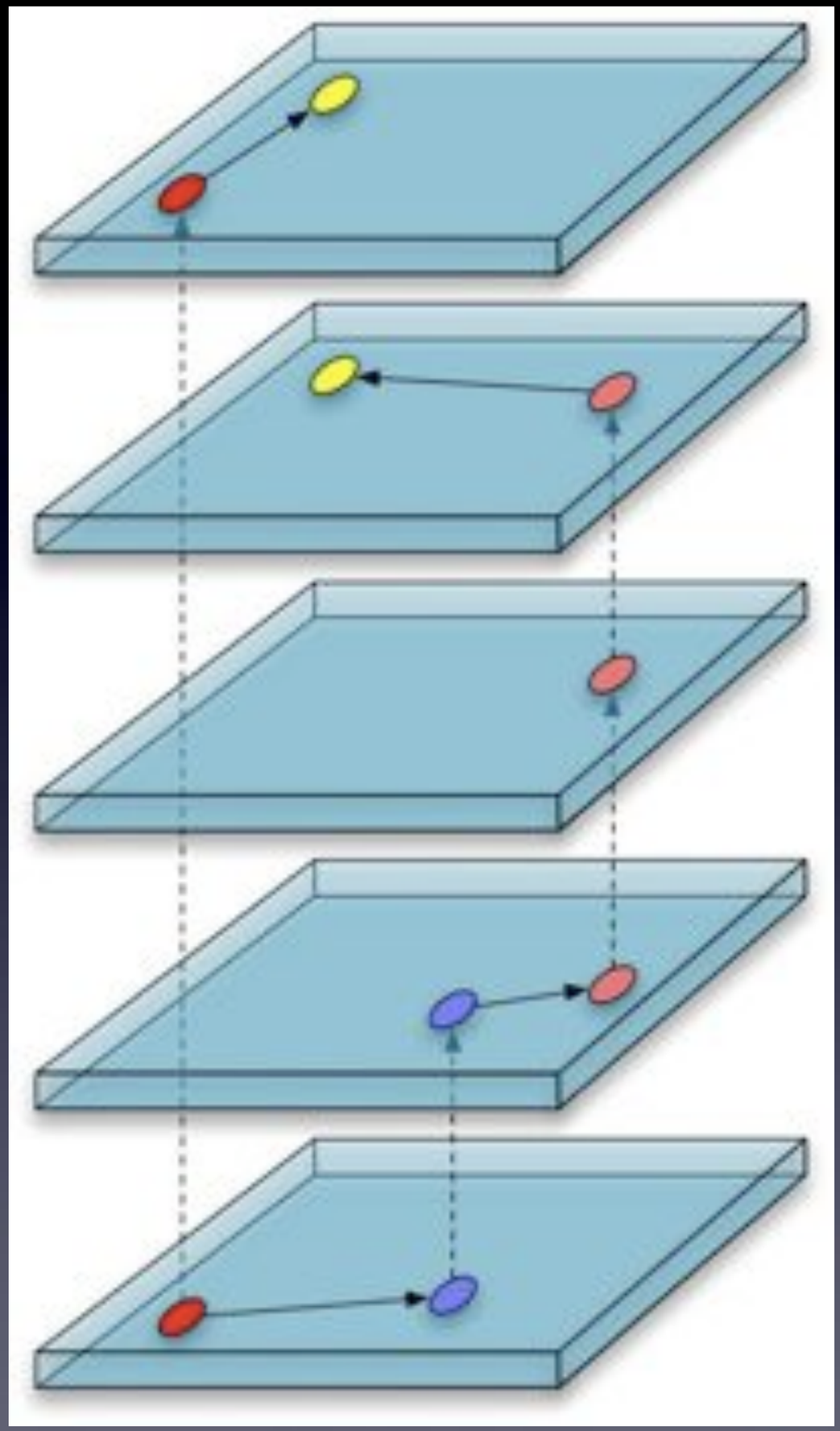


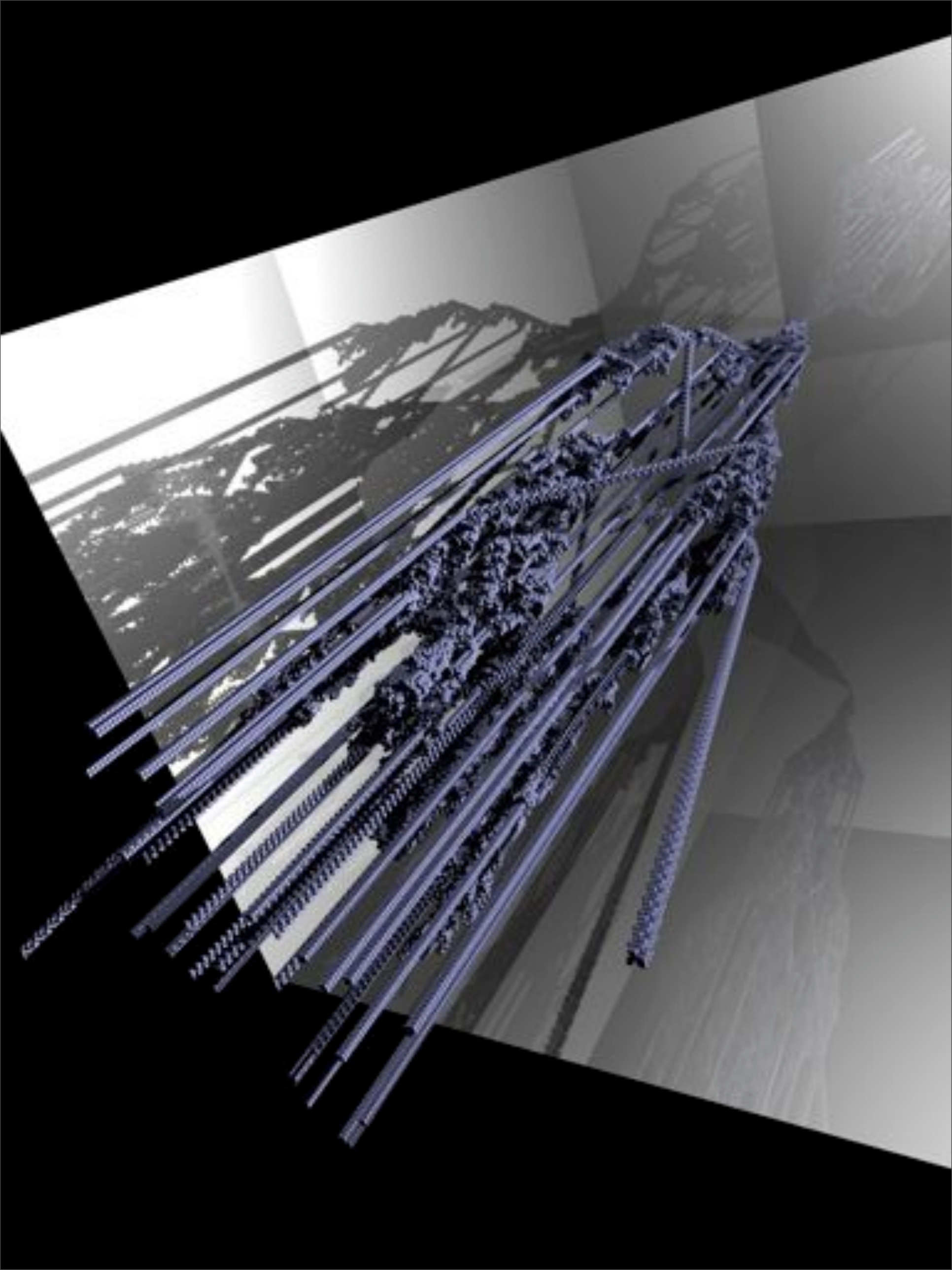
Viruses

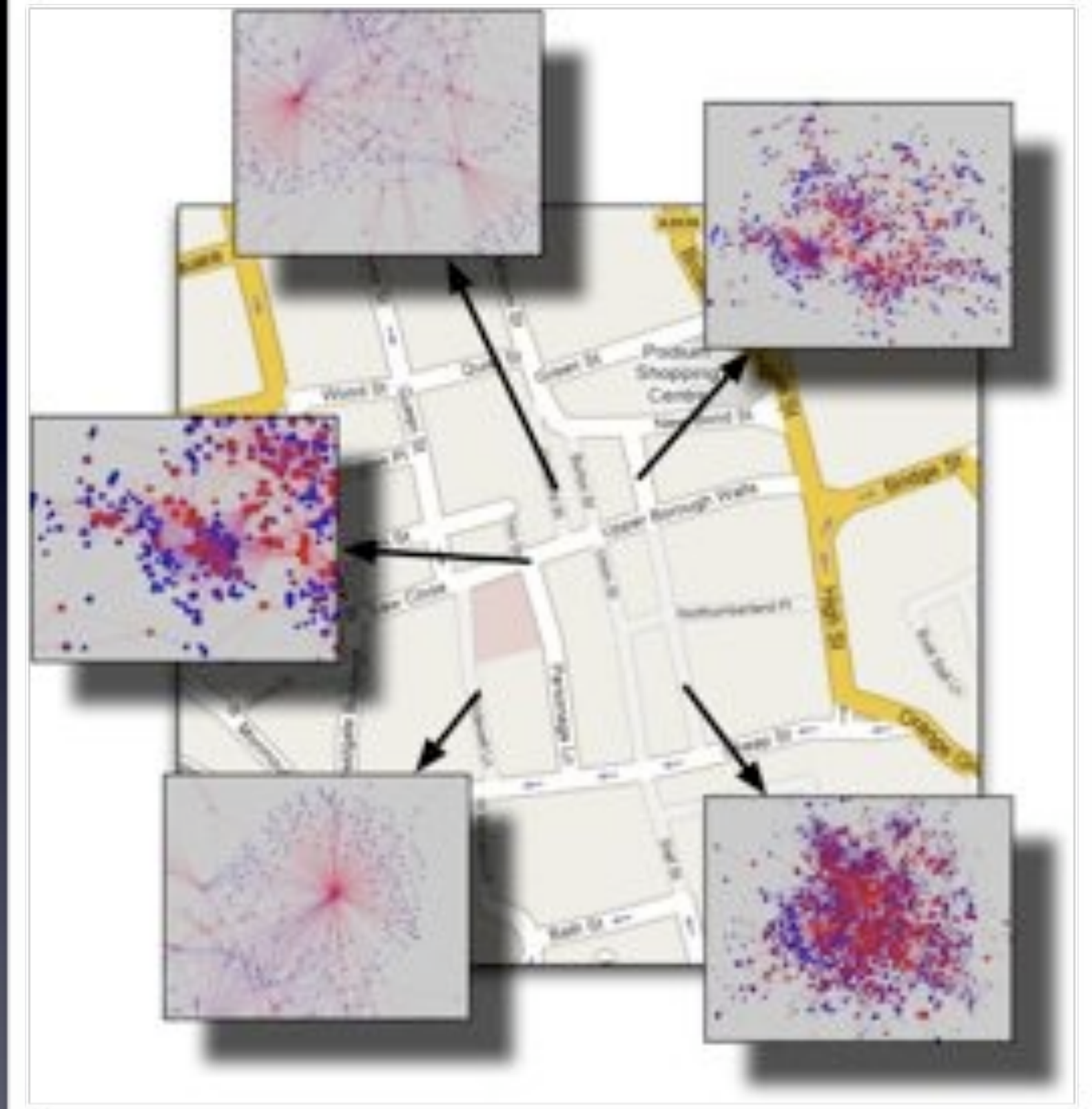


Considering time



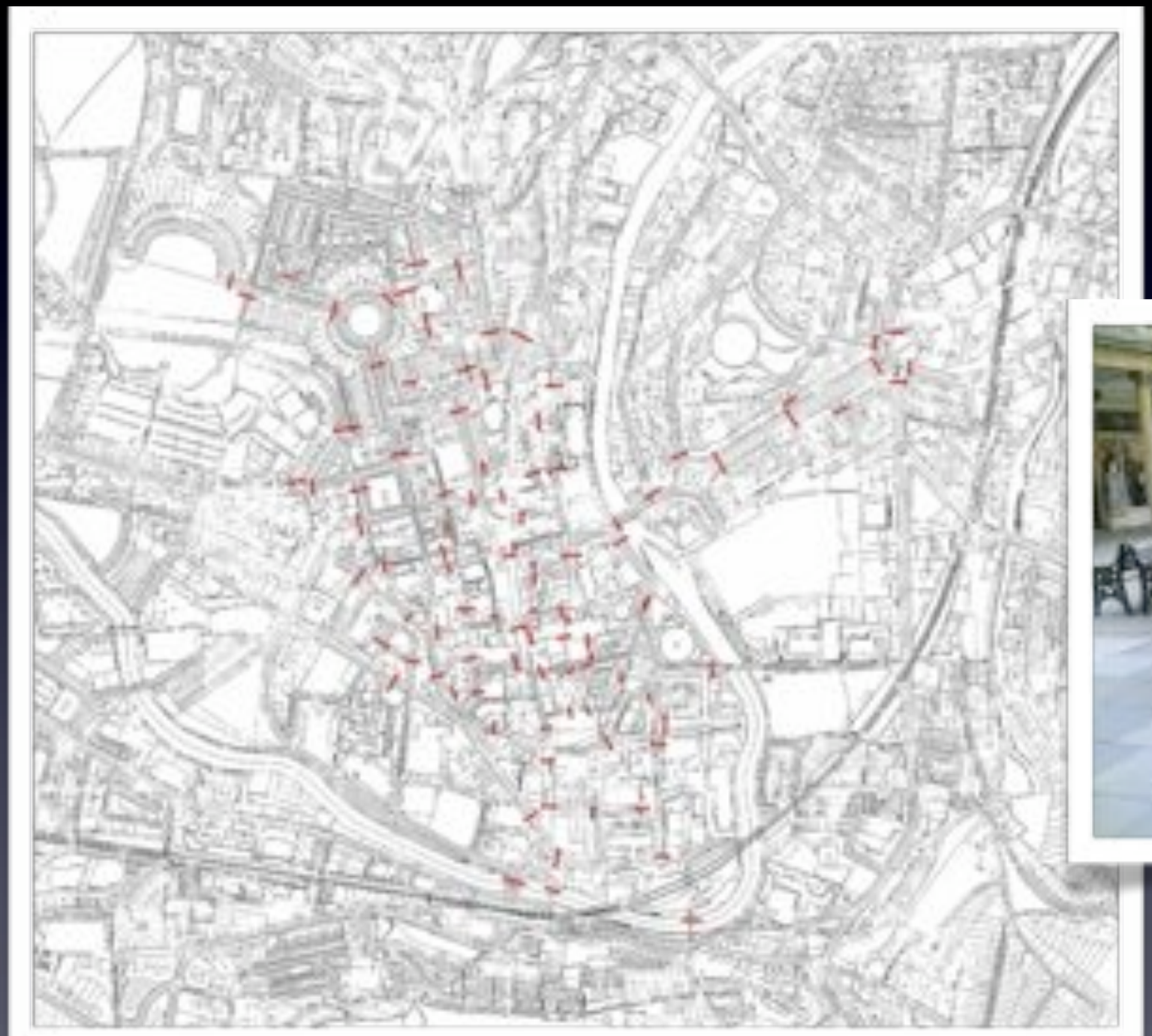


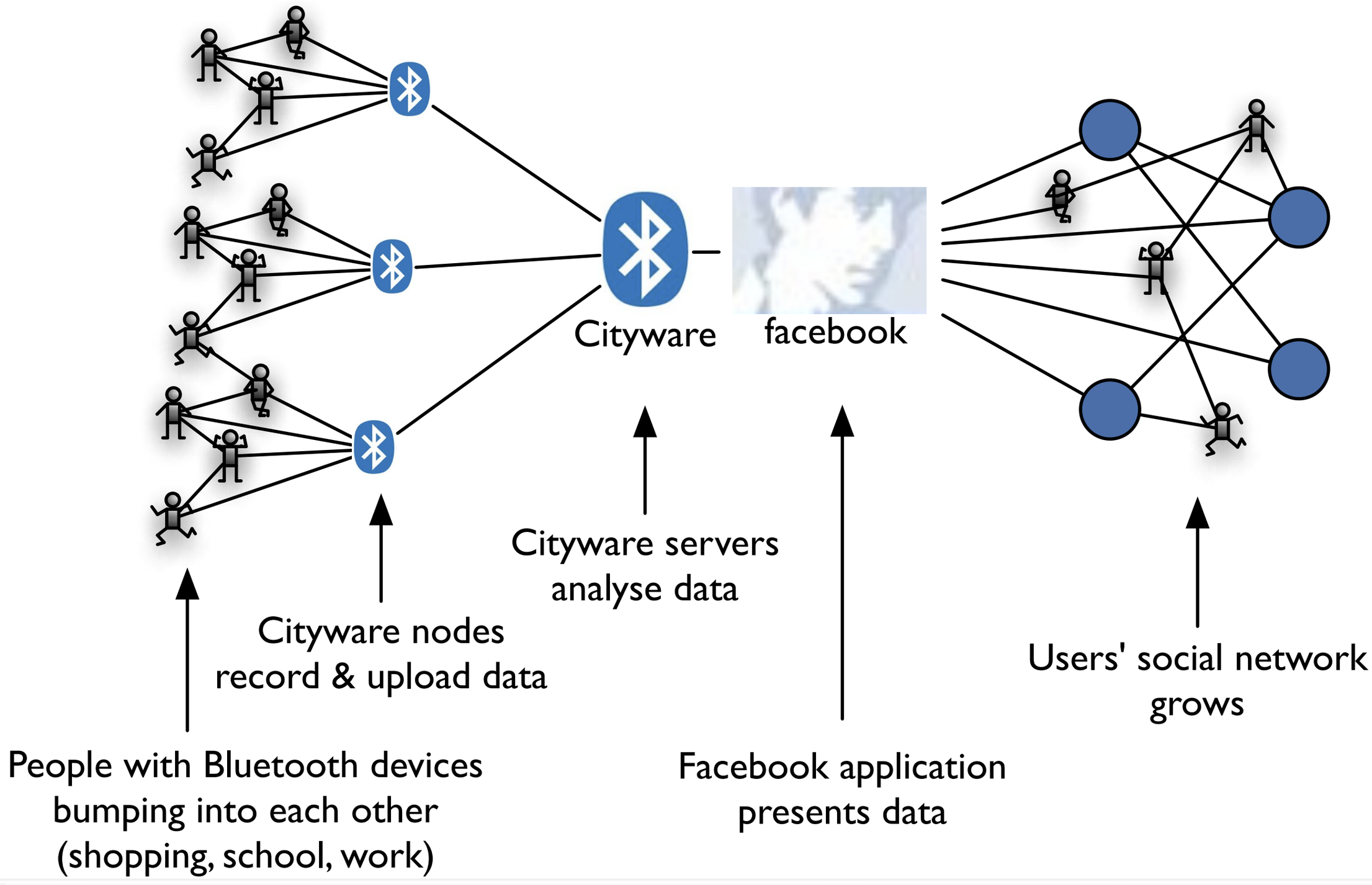




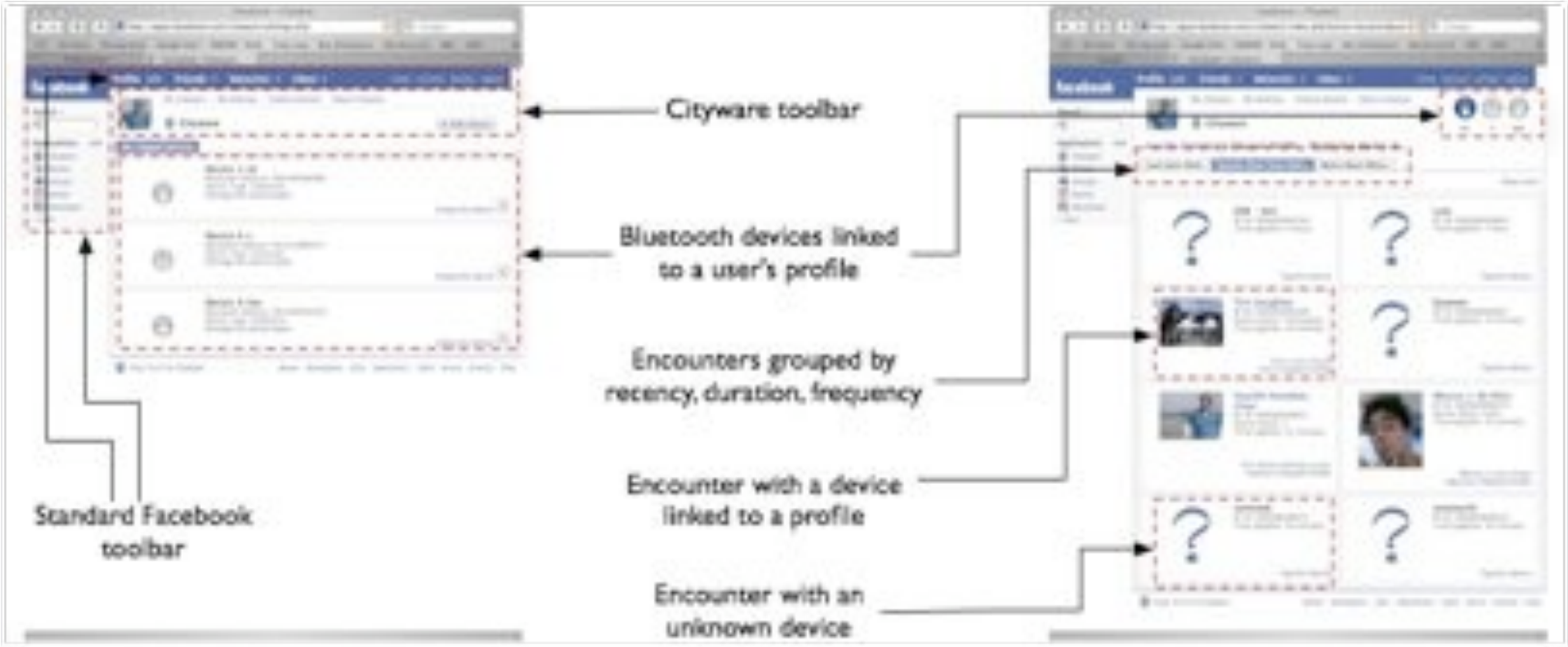
Kostakos, V. (to appear). Space Syntax and pervasive systems. In B. Jiang and X. A. Yao (Eds.), Geospatial Analysis and Modeling of Urban Structure and Dynamics, Springer, New York.

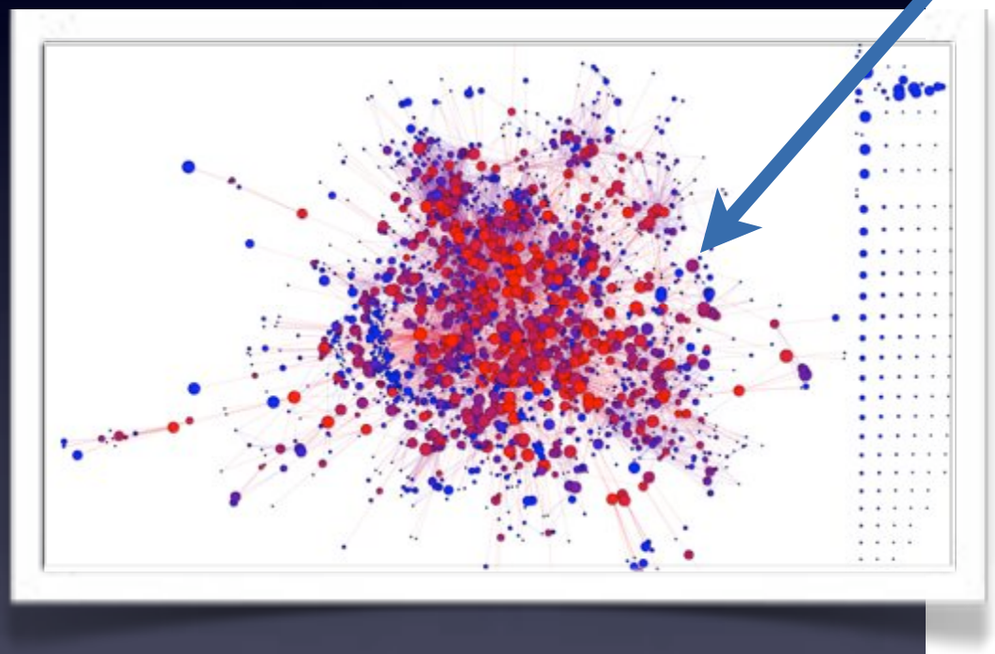
Data annotation

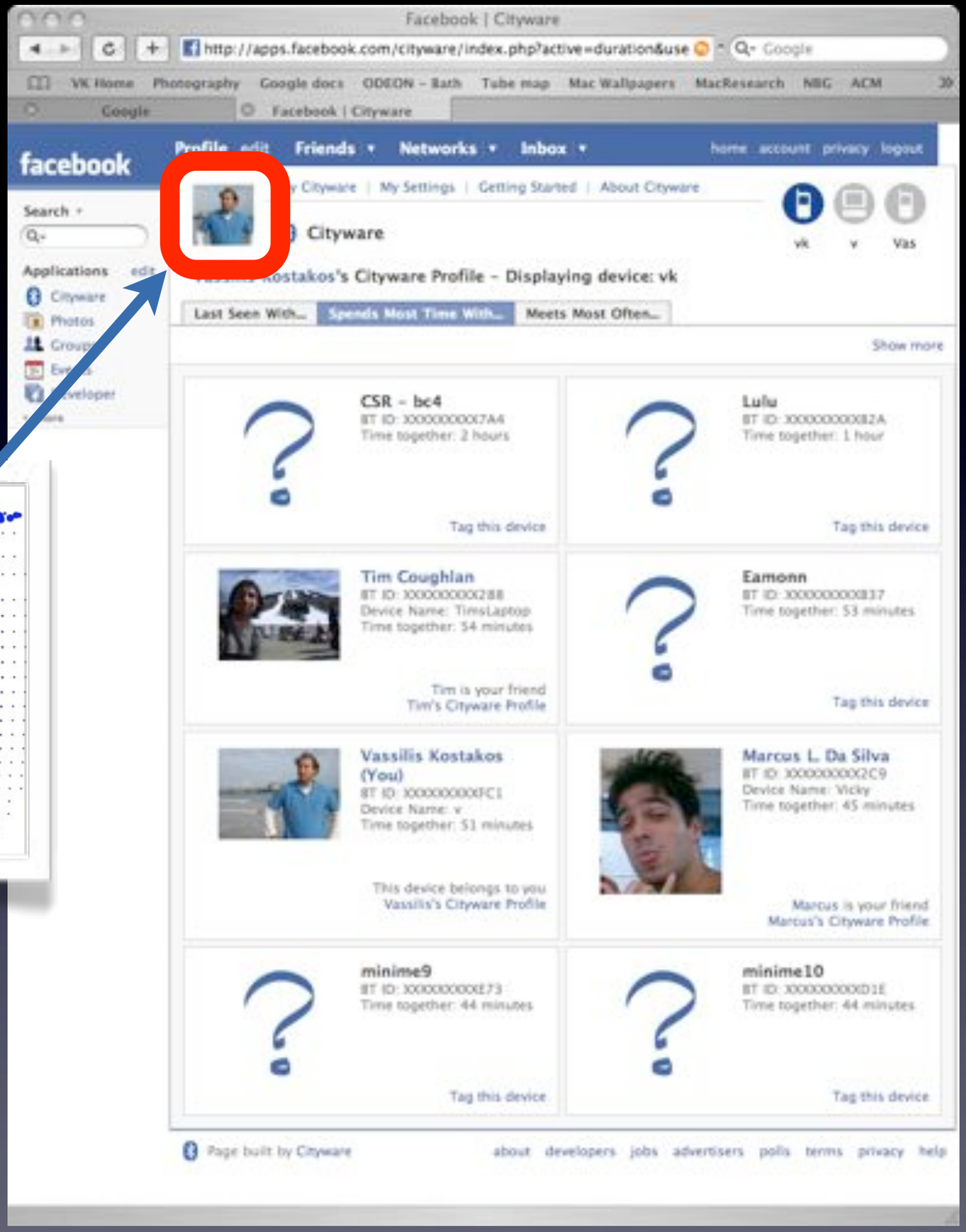




Kostakos, V. and O'Neill E. (2008). Cityware: Urban Computing to Bridge Online and Real-world Social Networks. In M. Foth (Ed.), Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City. Hershey, PA: Information Science Reference, IGI Global, pp. 195-204

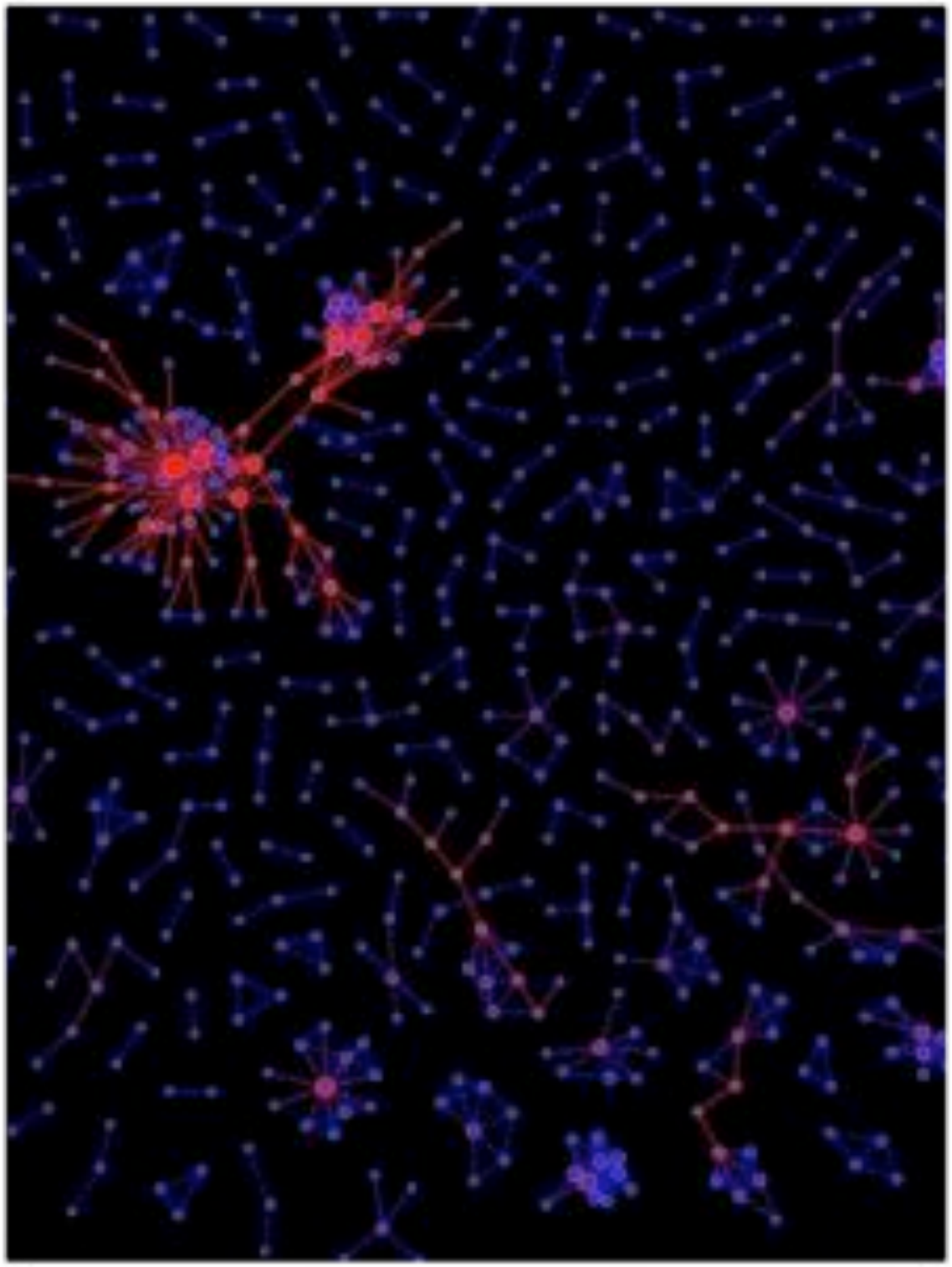

Cityware toolbar
Bluetooth devices linked to a user's profile
Encounters grouped by recency, duration, frequency
Encounter with a device linked to a profile
Encounter with an unknown device
Standard Facebook toolbar



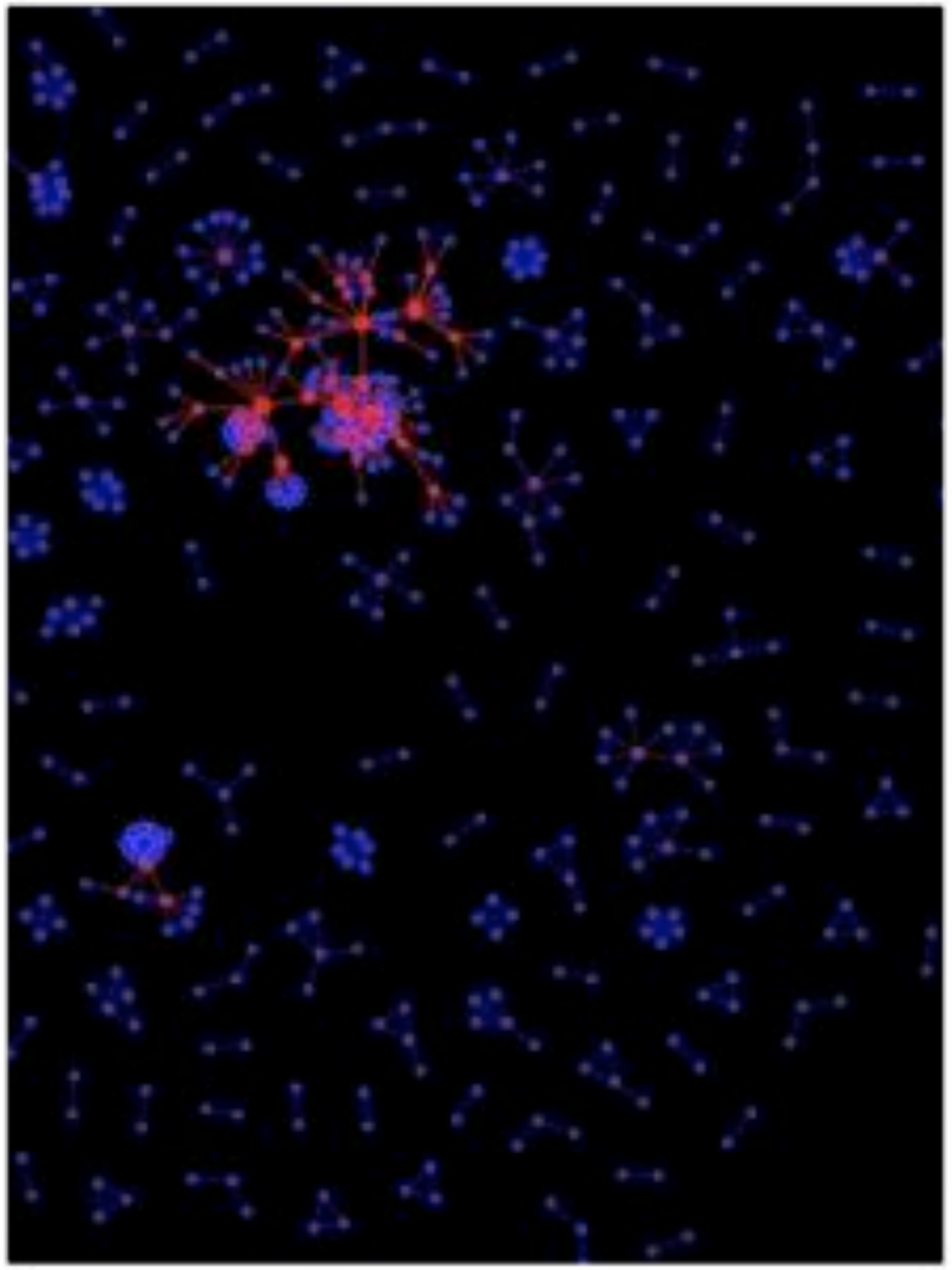

Facebook | Cityware
http://apps.facebook.com/cityware/index.php?active=duration&use
facebook
Profile edit
Friends
Networks
Inbox
home account privacy logout
My Settings
Getting Started
About Cityware
Search
Cityware
vk
v
Vas
Applications edit
Cityware
Photos
Vassilis Kostakos's Cityware Profile - Displaying device: vk
Last Seen With...
Spends Most Time With...
Meets Most Often...
Show more
CSR - bc4
BT ID: 300000000A4
Time together: 2 hours
Tag this device
Lulu
BT ID: 300000000B2A
Time together: 1 hour
Tag this device
Tim Coughlan
BT ID: 300000000288
Device Name: TimsLaptop
Time together: 54 minutes
Tim is your friend
Tim's Cityware Profile
Eamonn
BT ID: 300000000837
Time together: 53 minutes
Tag this device
Vassilis Kostakos (You)
BT ID: 300000000FC1
Device Name: v
Time together: 51 minutes
This device belongs to you
Vassilis's Cityware Profile
Marcus L. Da Silva
BT ID: 300000000C9
Device Name: Vicky
Time together: 45 minutes
Marcus is your friend
Marcus's Cityware Profile
minime9
BT ID: 300000000E73
Time together: 44 minutes
Tag this device
minime10
BT ID: 300000000D1E
Time together: 44 minutes
Tag this device
Page built by Cityware
about developers jobs advertisers polls terms privacy help

Cityware for Facebook

- US
  - MIT
  - Stanford
  - Boston
  - Urbana-Champaign
  - Michigan
  - Portland
  - Oklahoma
  - New York
  - Ohio
- UK
  - Cambridge
  - Oxford
  - Nottingham
  - Lancaster
  - Warwick
  - Bristol
  - Manchester
- Melbourne
- Bremen
- Cairo
- Iceland

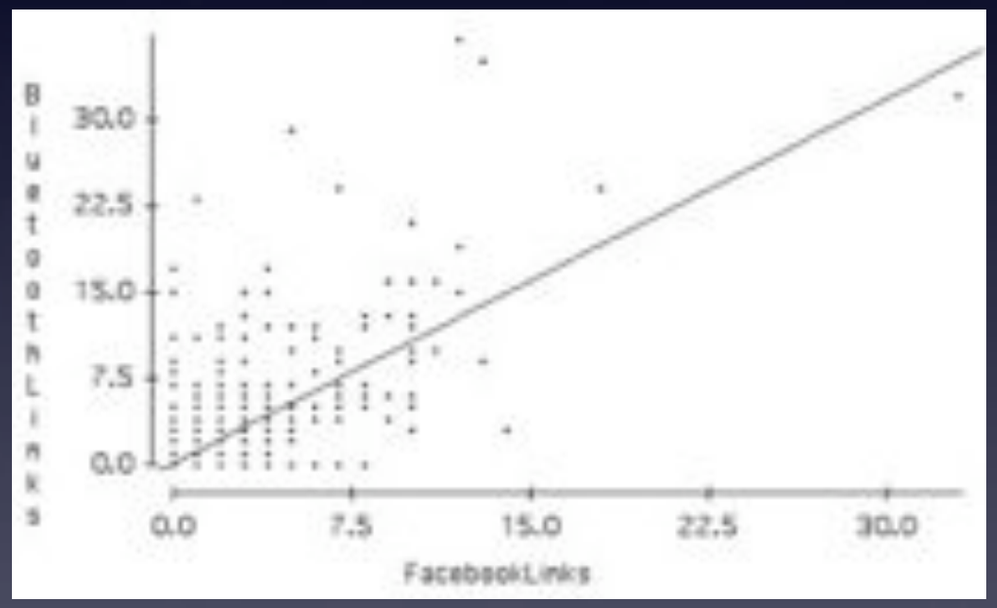


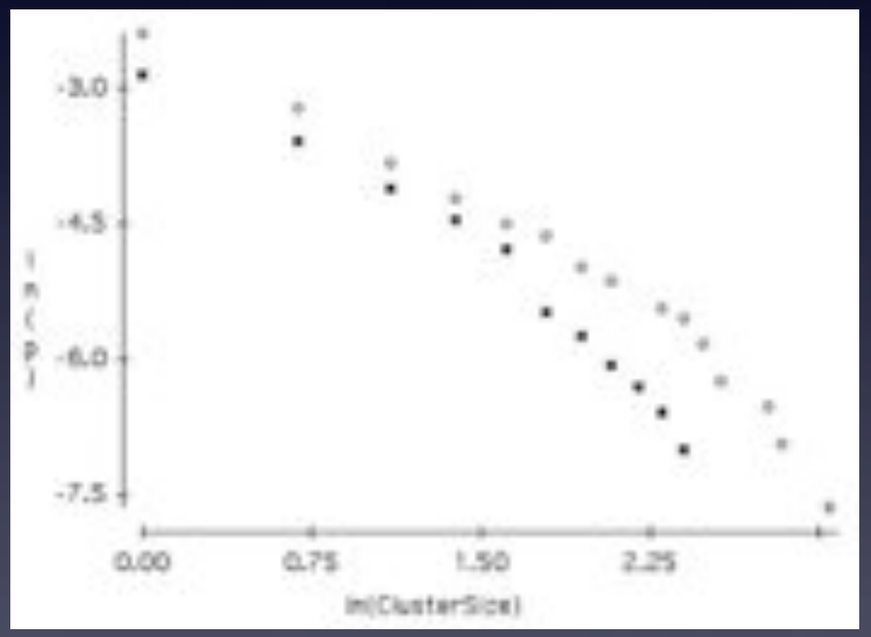
Facebook



Bluetooth

Bluetooth vs. Facebook



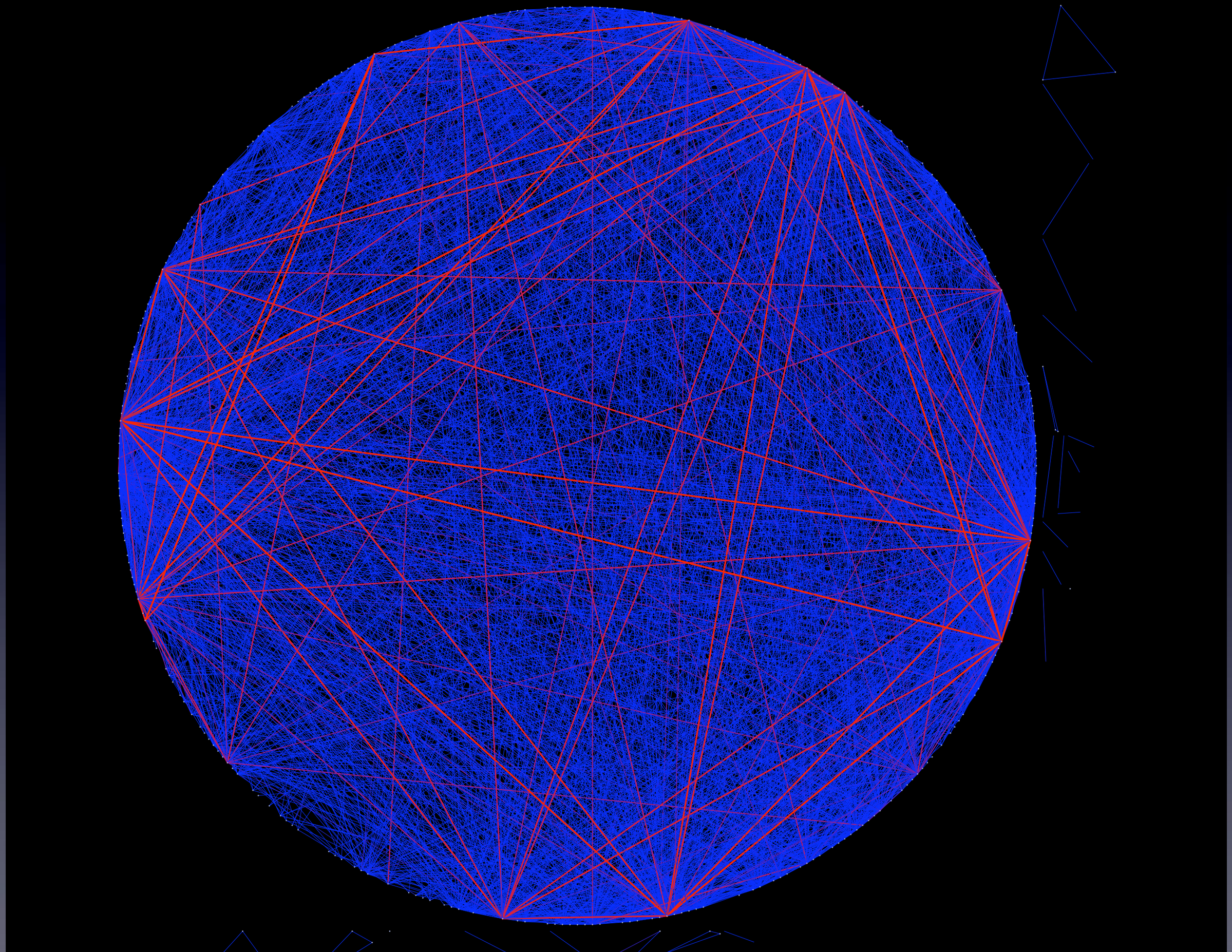


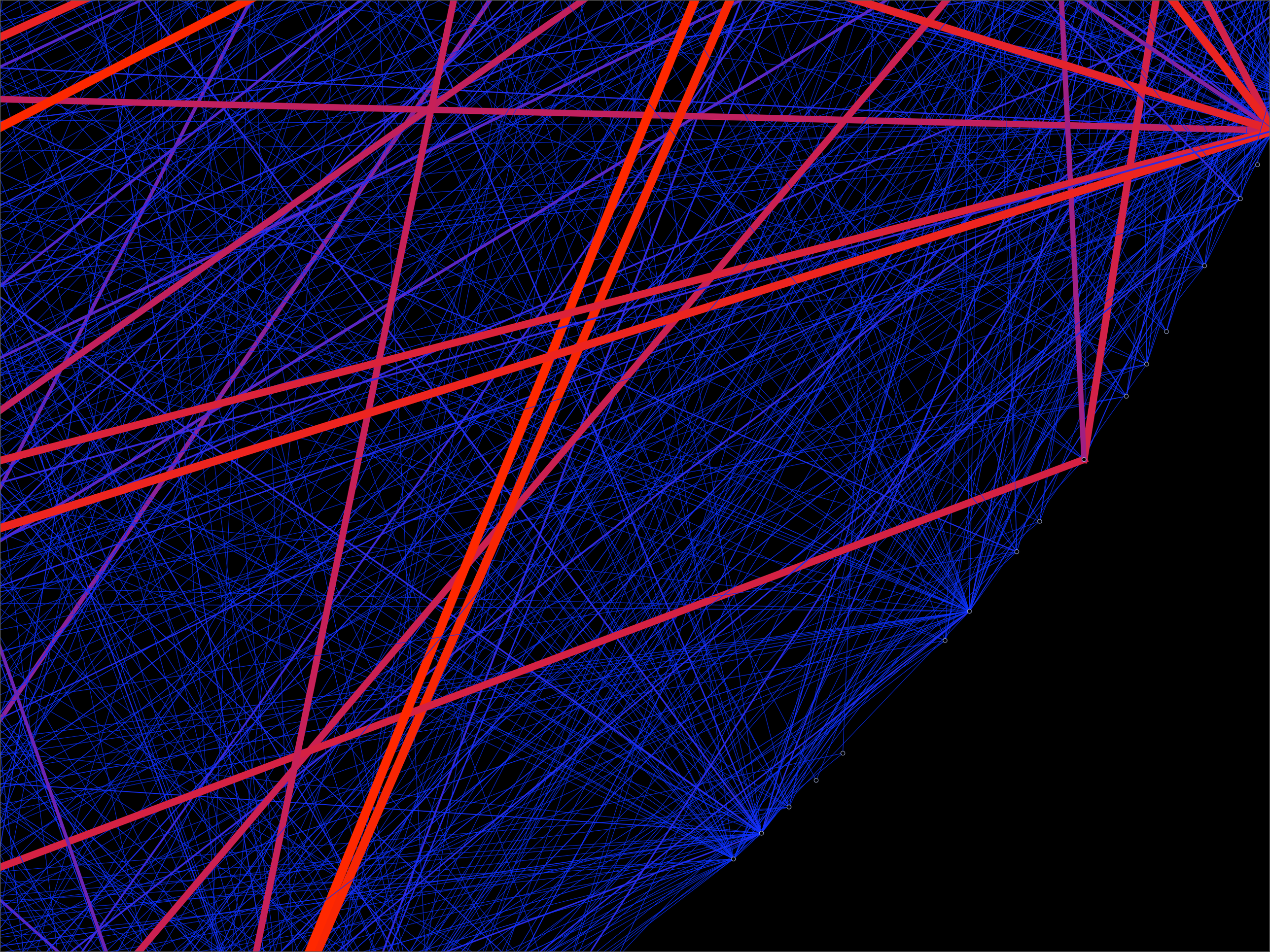
o - Facebook

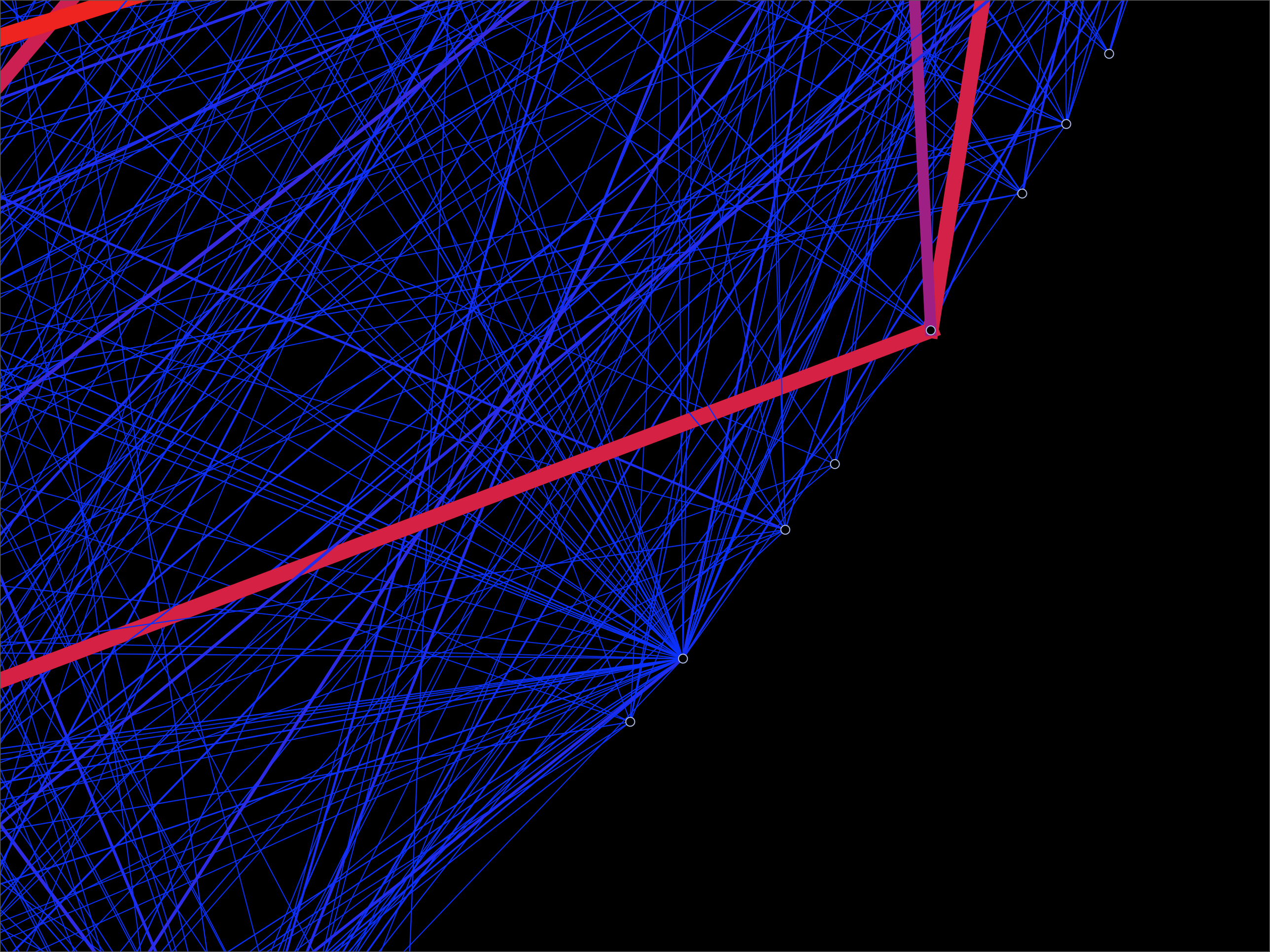
x - Bluetooth

Relationships between scanning sites

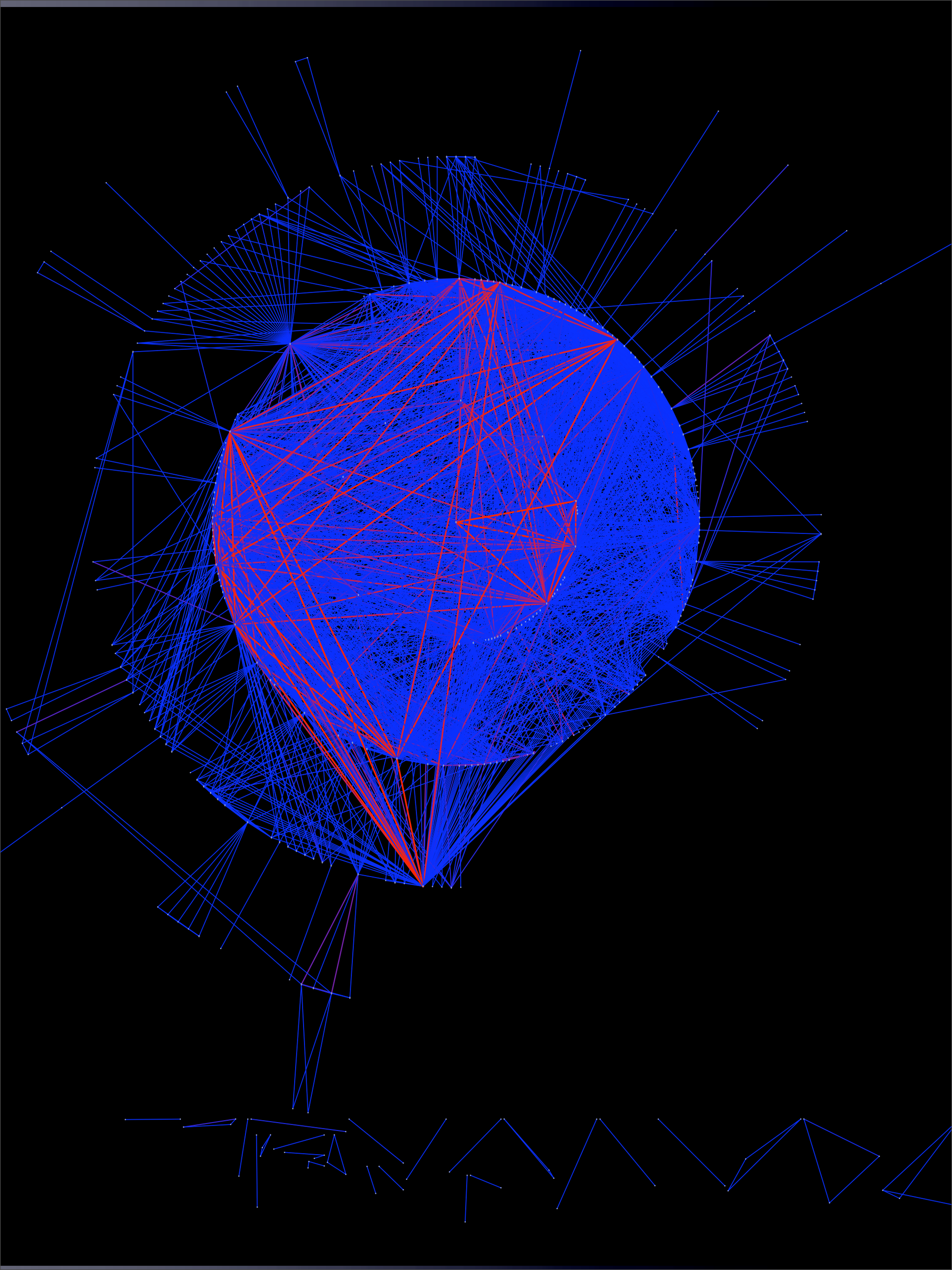
- Node: a physical location on the earth
- Link nodes that have been visited by same individual (bluetooth)
- “Heavy links” have many people travelling on them



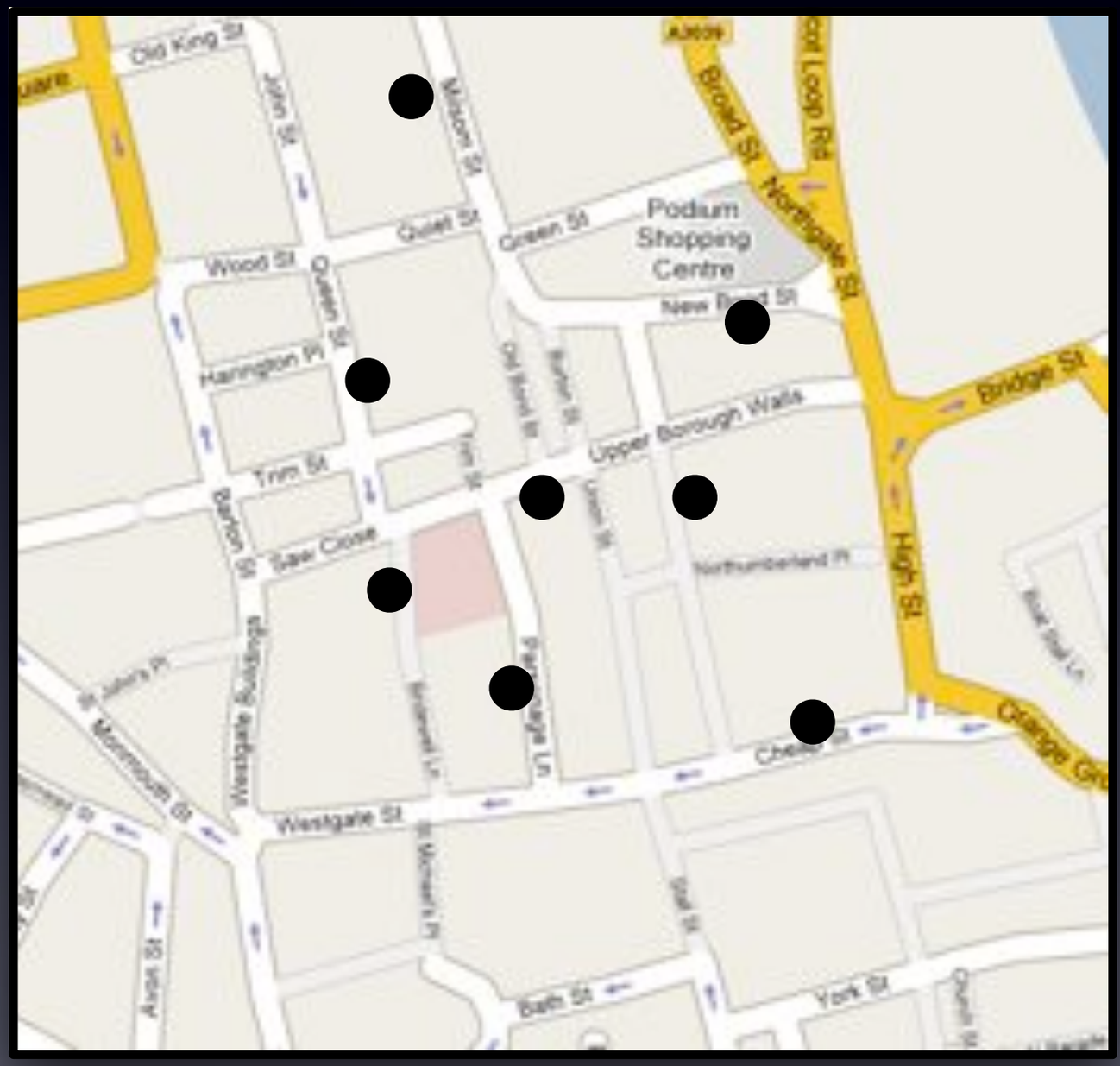




It’s a small world!

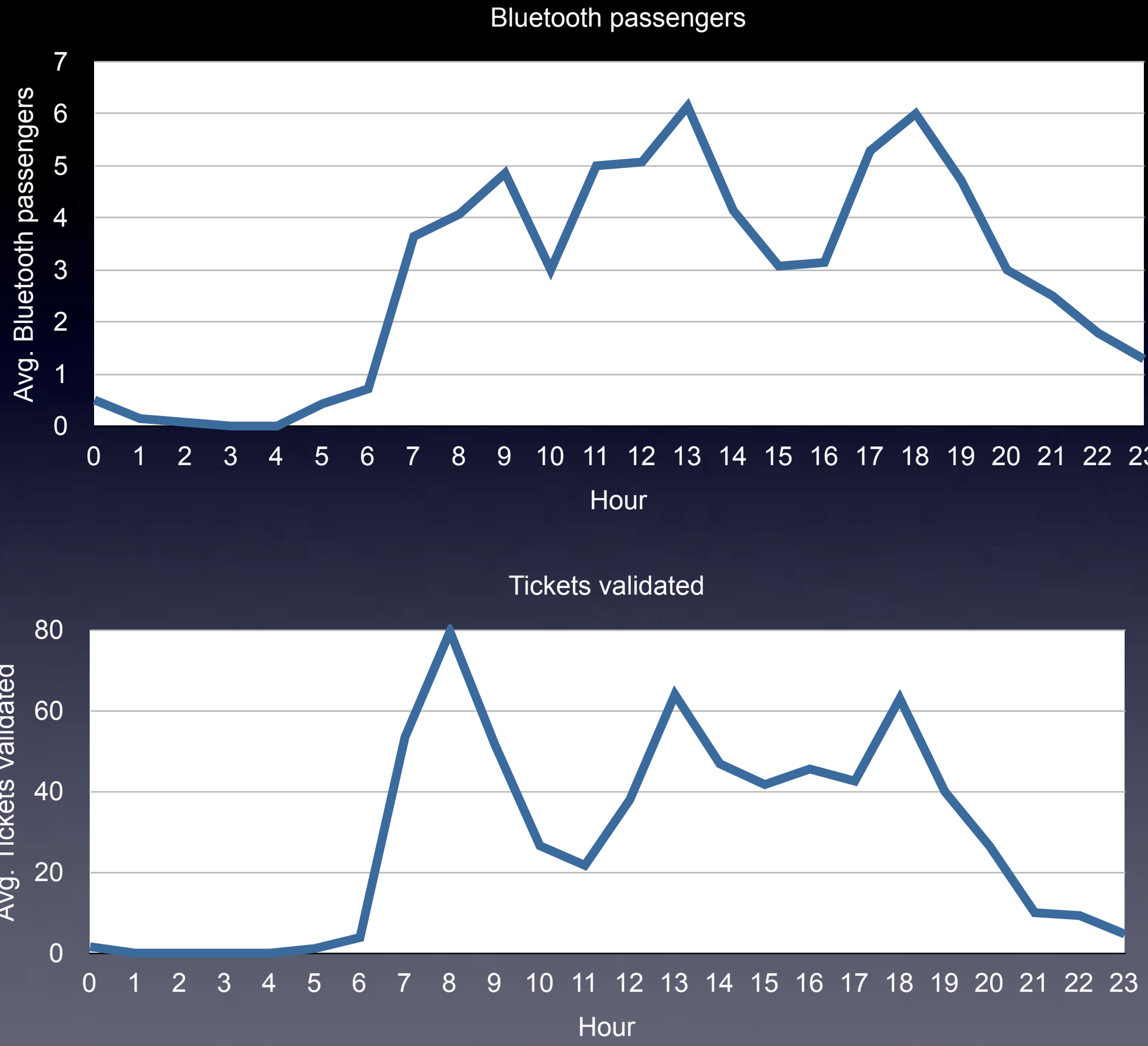


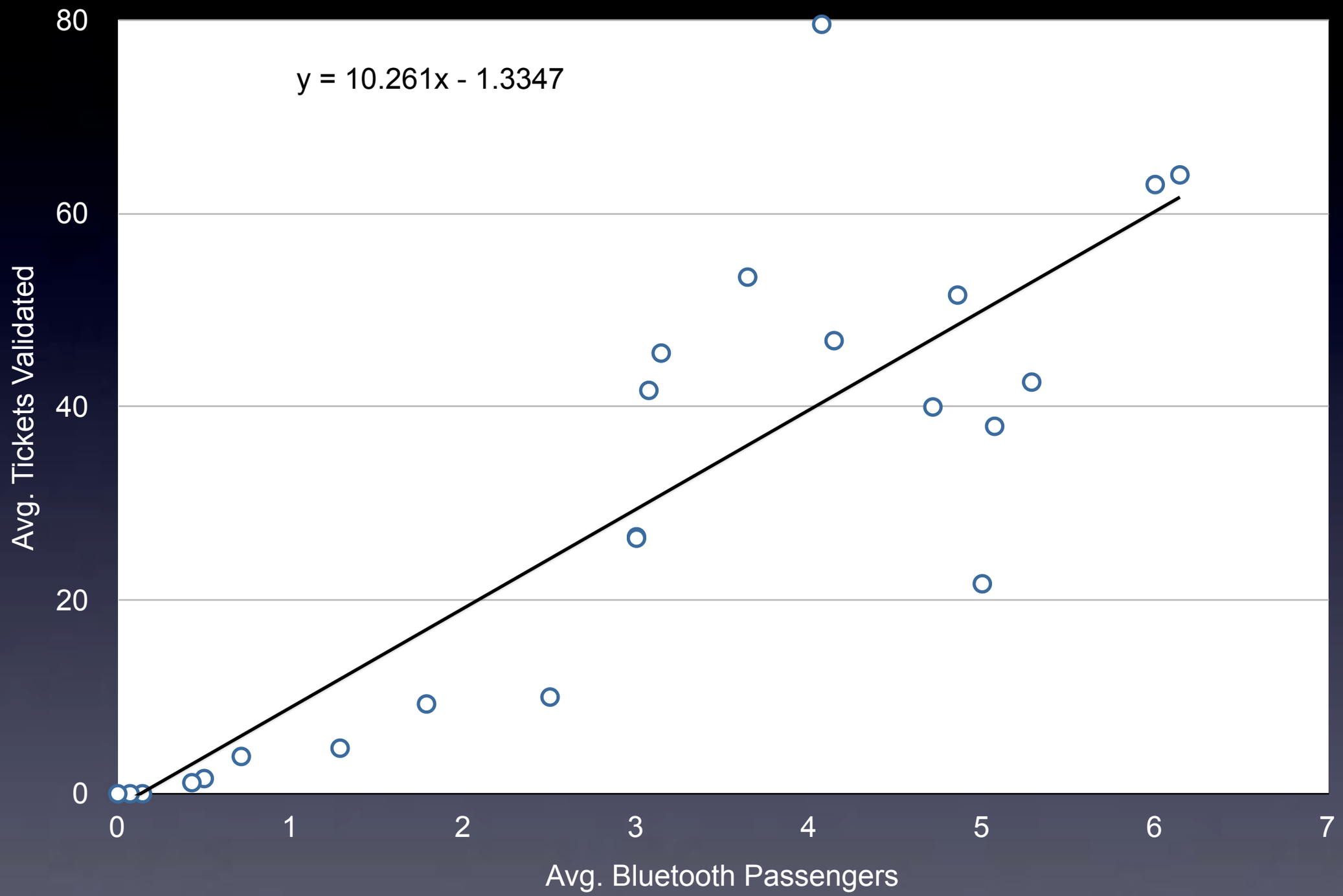
Real-time traffic measurement



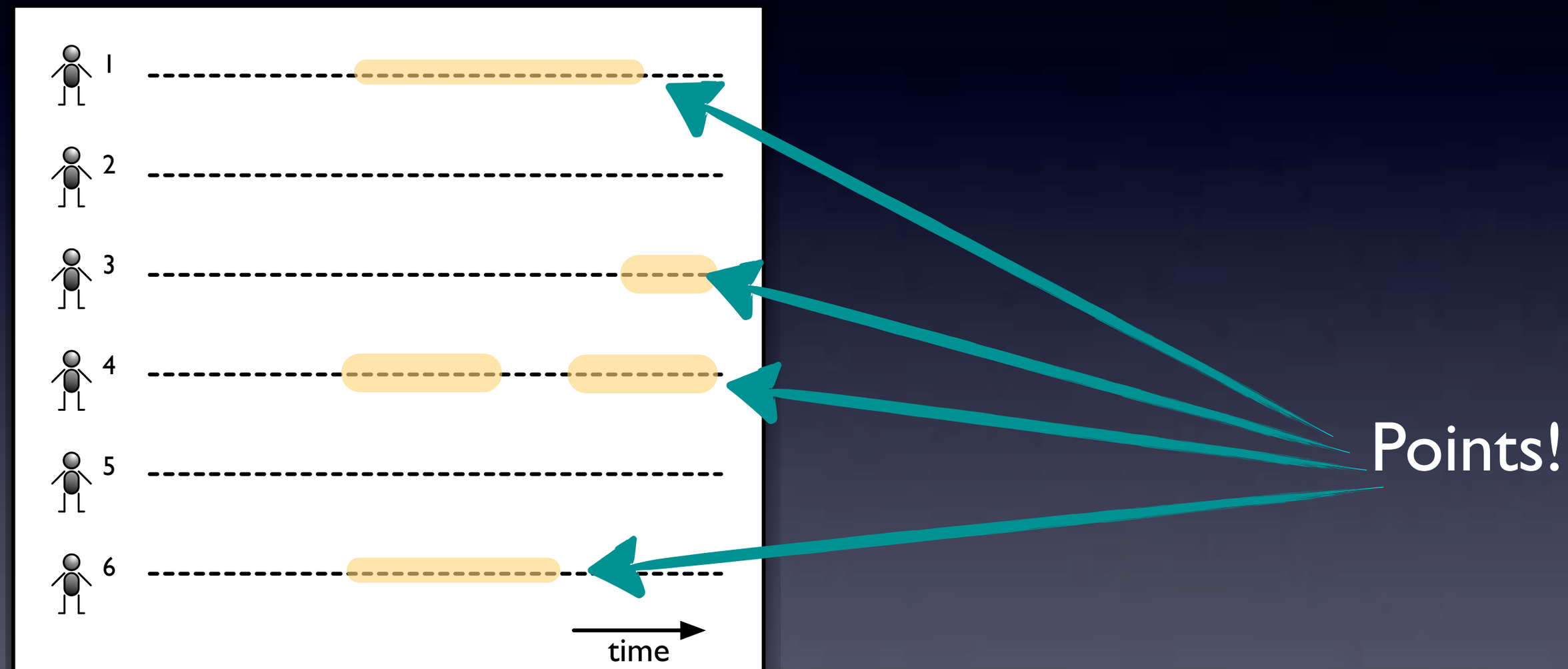
Intelligent sensing for public transport

Kostakos, V. (2008). Towards sustainable transport: wireless detection of passenger trips on public transport buses. arXiv:0806.0874.


Bluetooth passengers
Avg. Bluetooth passengers
0
1
2
3
4
5
6
7
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour
Tickets validated
Avg. Tickets Validated
0
20
40
60
80
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour

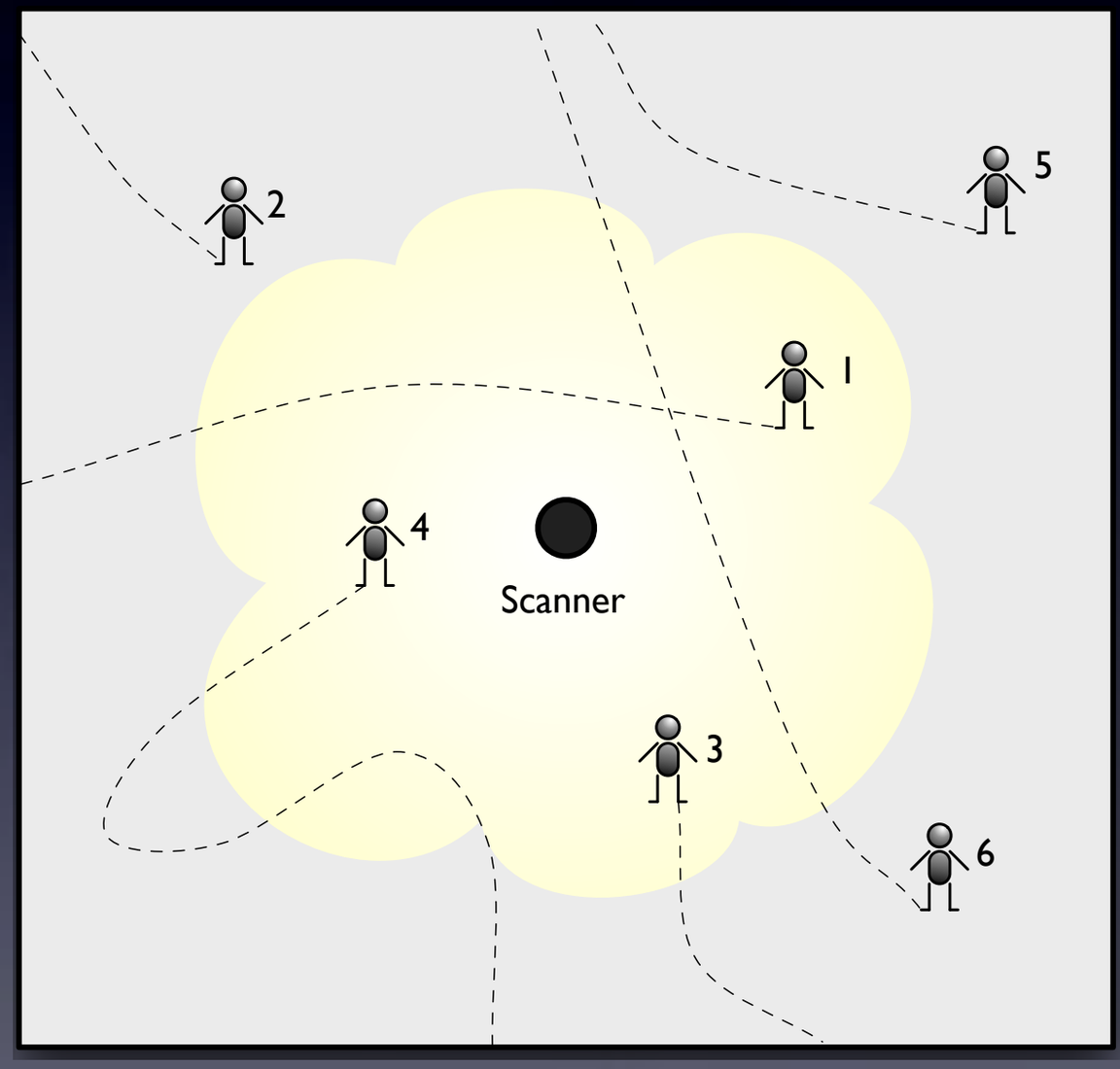

y = 10.261x - 1.3347
80
60
40
20
0
Avg. Tickets Validated
0
1
2
3
4
5
6
7
Avg. Bluetooth Passengers

Waiting for the bus



Making use of the infrastructure

Scanners (inter) connected
Central console issues services
Services are (complex) rules
Scanner reacts to people based on these rules



Examples

- Send <Fred> <the 403 bus schedule> <between 7am-9am>
- Send <Joe> <sports news> <every 30 minutes>
- Send <*> <located downtown> <Happy New Year!>
- Send <Mary, John, Nick> <a voucher> if they wait <together> for <more than 20 minutes>

The end!

- Questions?

- vassilis @ cmu . edu
- http:// www . labuse . org

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