

# IoT, Smart Cities and the Cloud

Rodger Lea,  
Sense Tecnic Systems

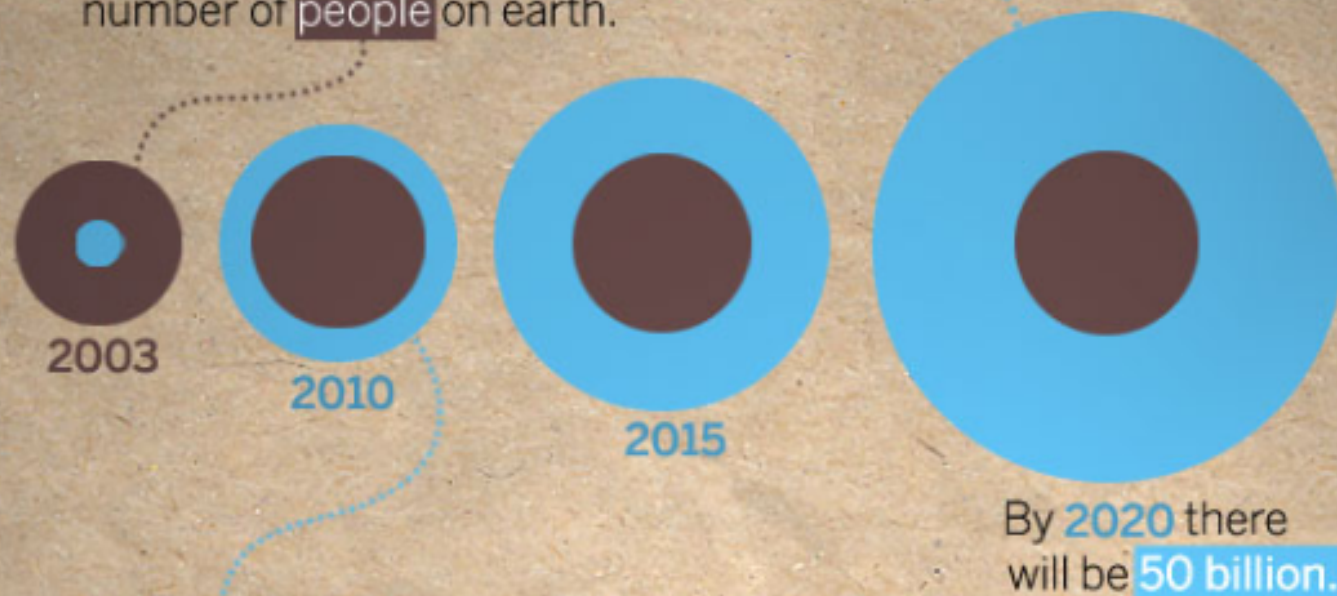
@rodgerlea

# IoT, Smart Cities and the Cloud

- Characteristics of IoT systems
- 2 Smart City projects
  - Urban Opus, Canada
  - Smart Streets, UK
- Platform technologies & evolution
- Lessons
  - IoT's peculiarities
  - Interoperability
  - Application development tools
- Summary

# The INTERNET of THINGS

During 2008, the number of things connected to the Internet exceeded the number of people on earth.



These things are not just smartphones and tablets.

- IBM: Smarter Planet
  - By 2020 24B objects
- Cisco: Planetary Skin
  - By 2020 50B objects
- Intel: IoT Inside
  - By 2020 31B objects

• Myriad technology problems dealing with protocols, scaling, security etc

• But real issue is making sense of all this data:



# Diversity of the IoT





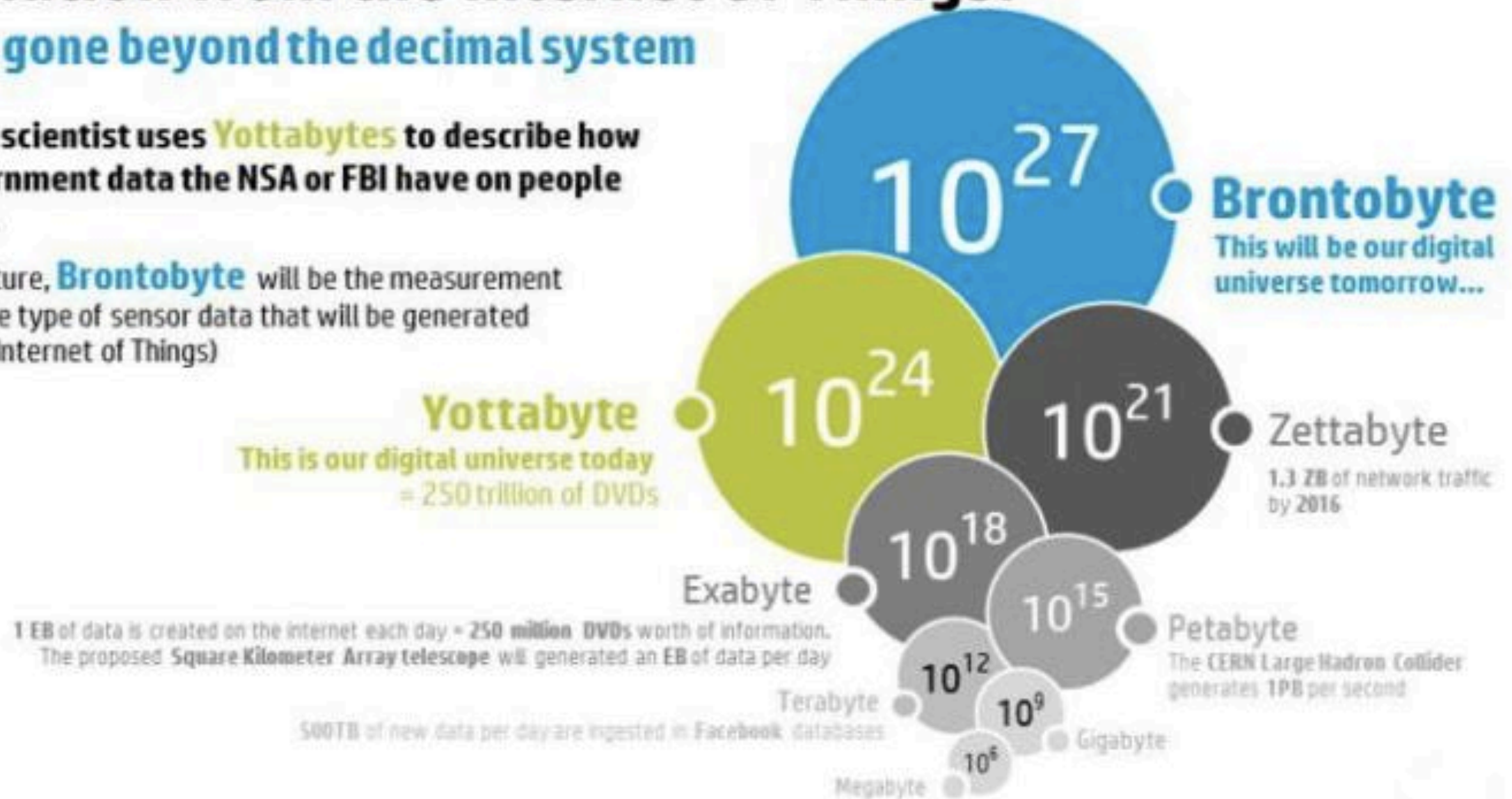
# Volume, Variety & Velocity of data

## Information from the Internet of Things:

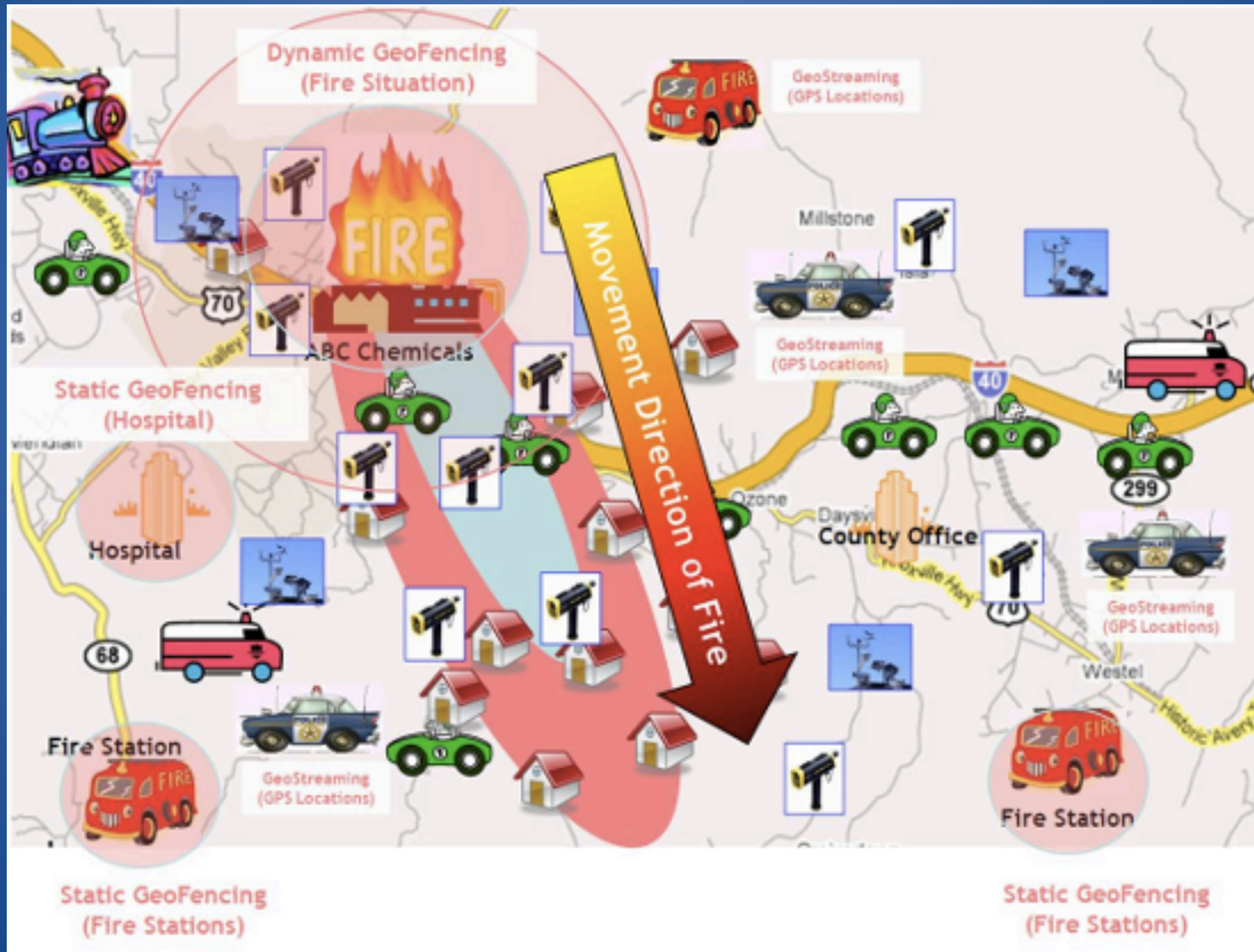
We have gone beyond the decimal system

Today data scientist uses **Yottabytes** to describe how much government data the NSA or FBI have on people altogether.

In the near future, **Brontobyte** will be the measurement to describe the type of sensor data that will be generated from the IoT (Internet of Things)



# Time sensitive data









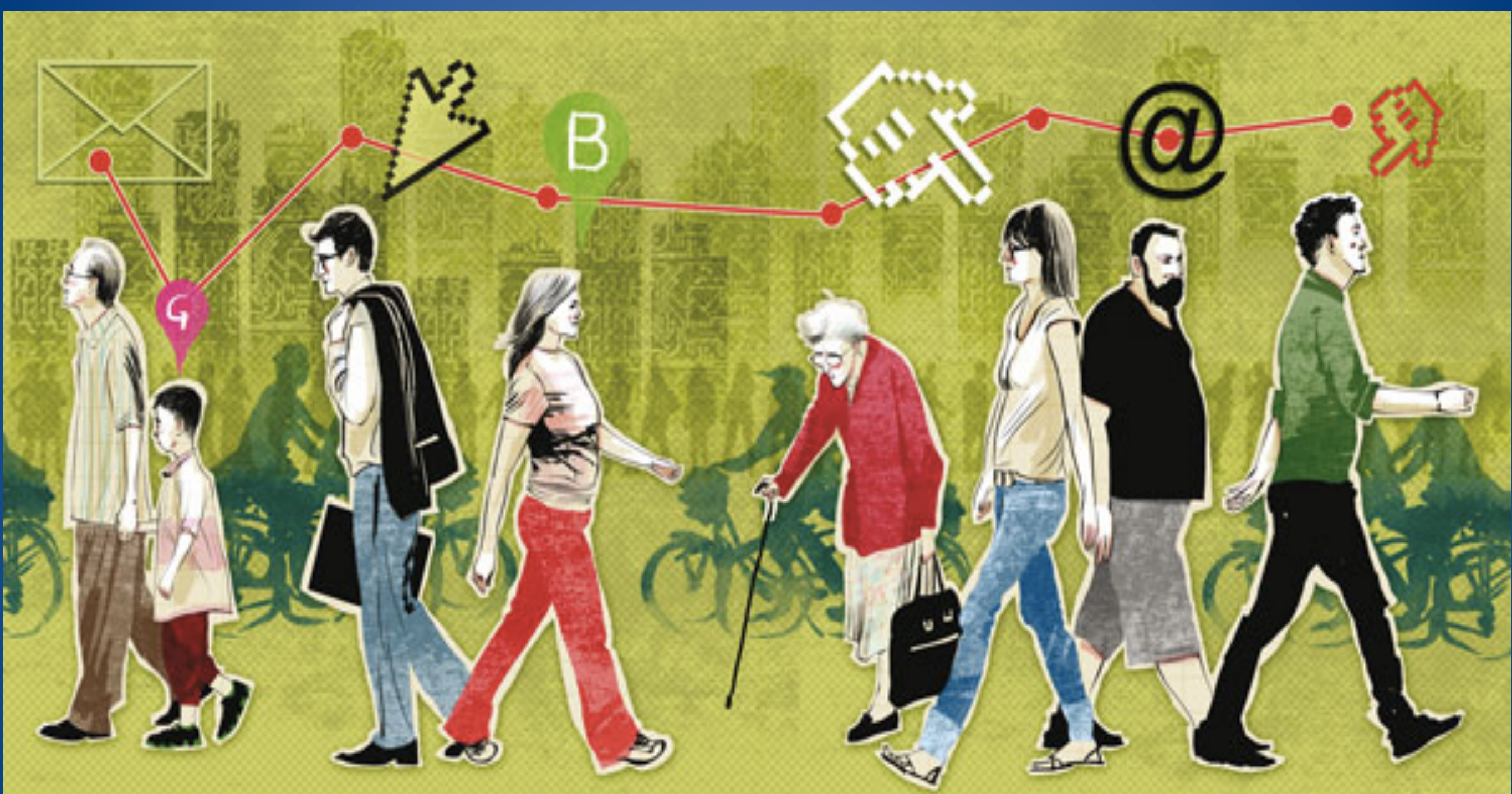
# Wild west out there

## Handbook: Internet of Things Alliances and Consortia



Note : (incomplete view) some fish may be in a wrong tank or skip several tanks







# Smart City: Deployments

## • Smart Streets (UK)

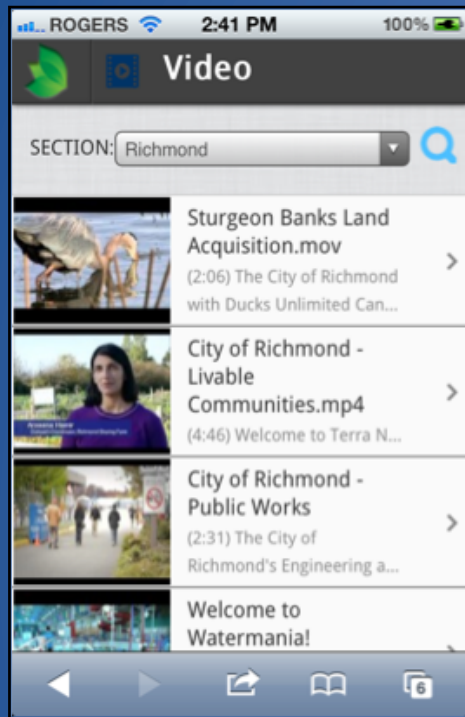
- Highways/Transport focused
- 3 large civil eng partners
- 40k roadside sensor
- Running since spring 2013
- TSB: 8 IoT hubs

## • Urban Opus (Canada)

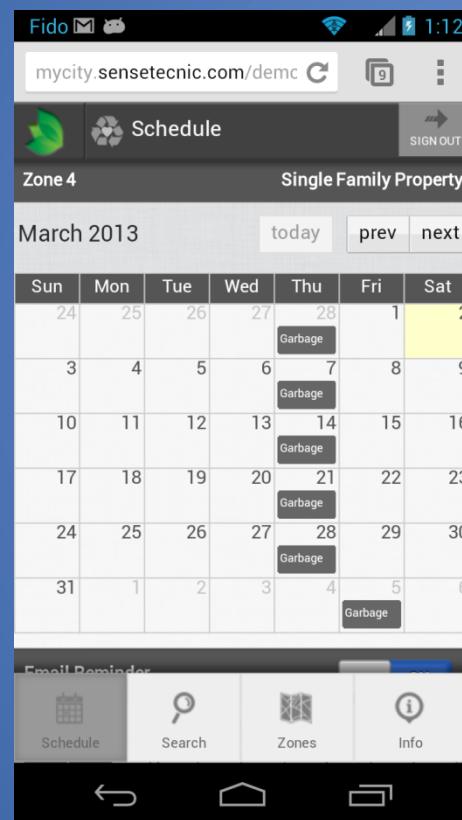
- City wide – citizen focused
- 3 cities, 30+ city orgs
- More open data + citizen data
- Running since spring 2014



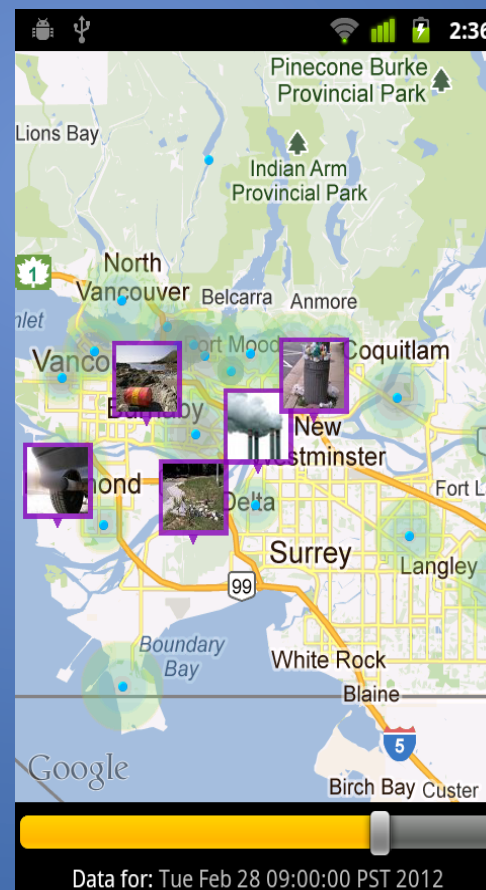
# Citizen centric apps



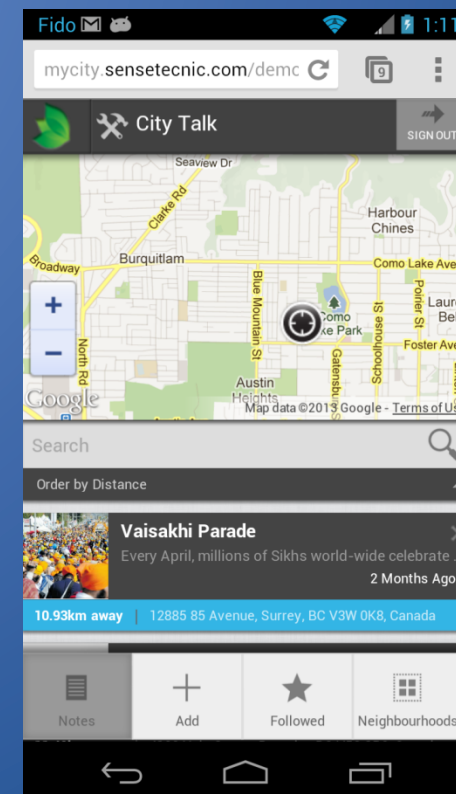
News Events  
Video feeds



Recycle



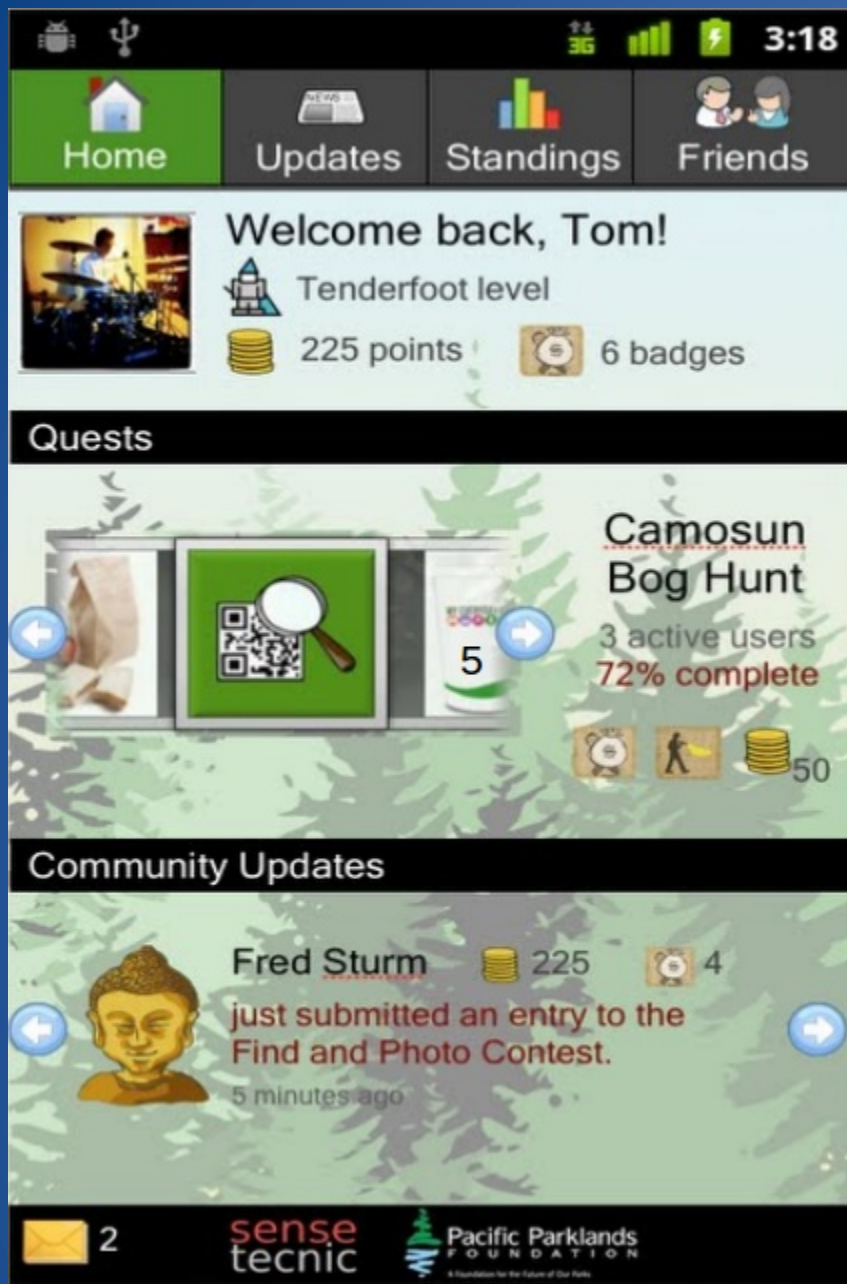
Air Quality



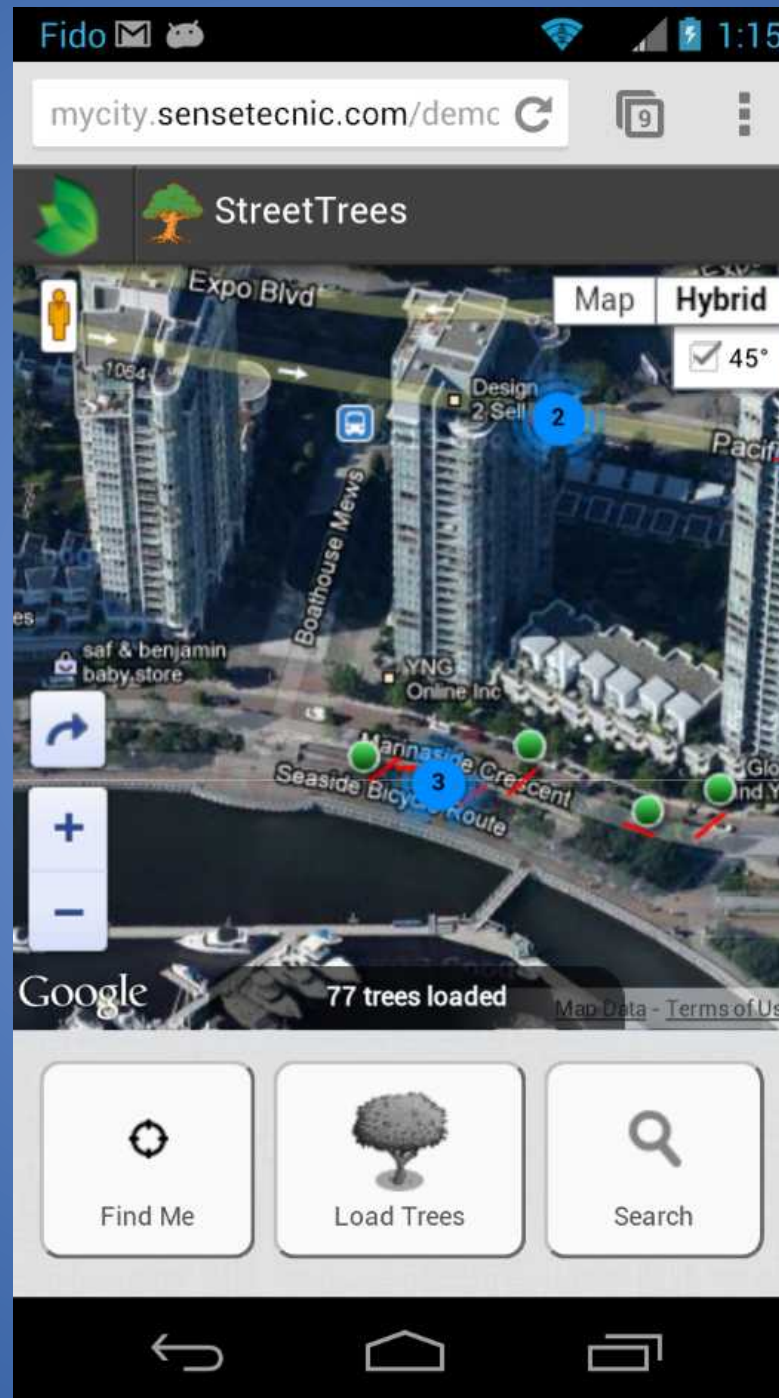
City Talk



# Others

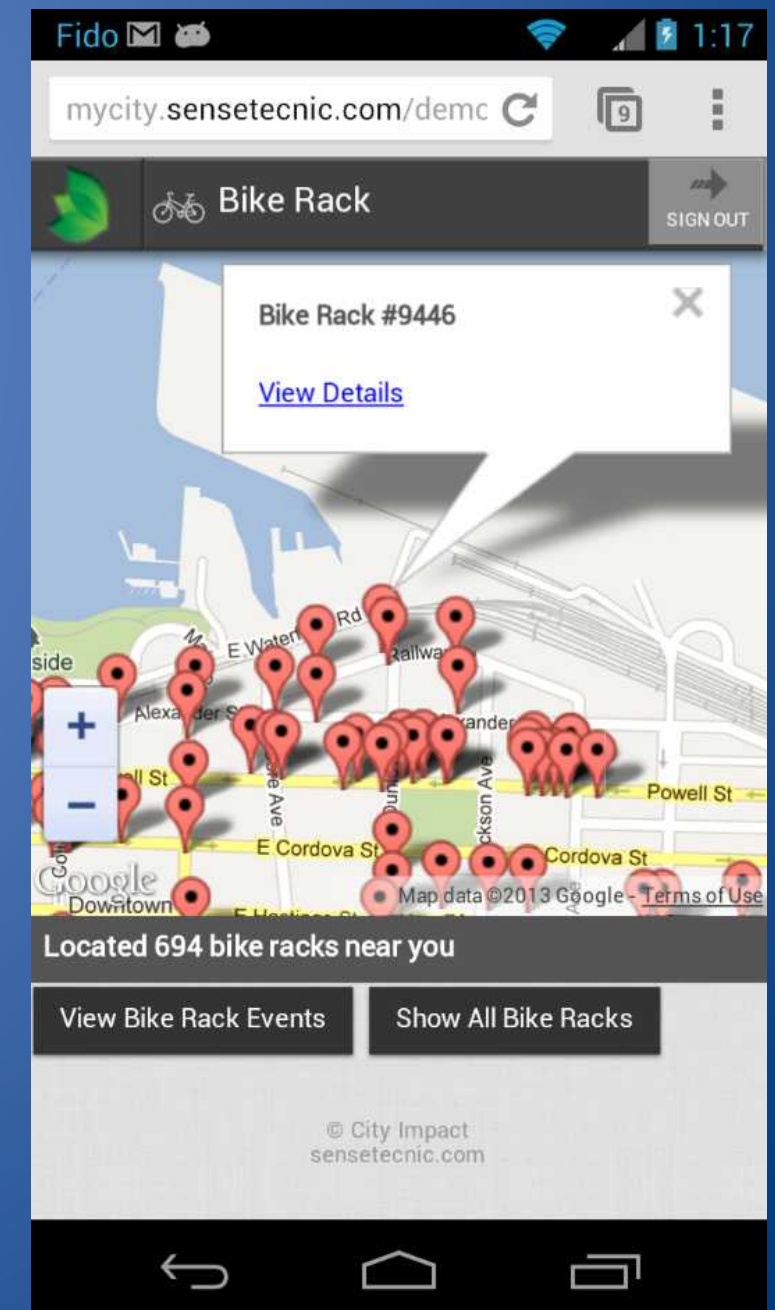


Location based games

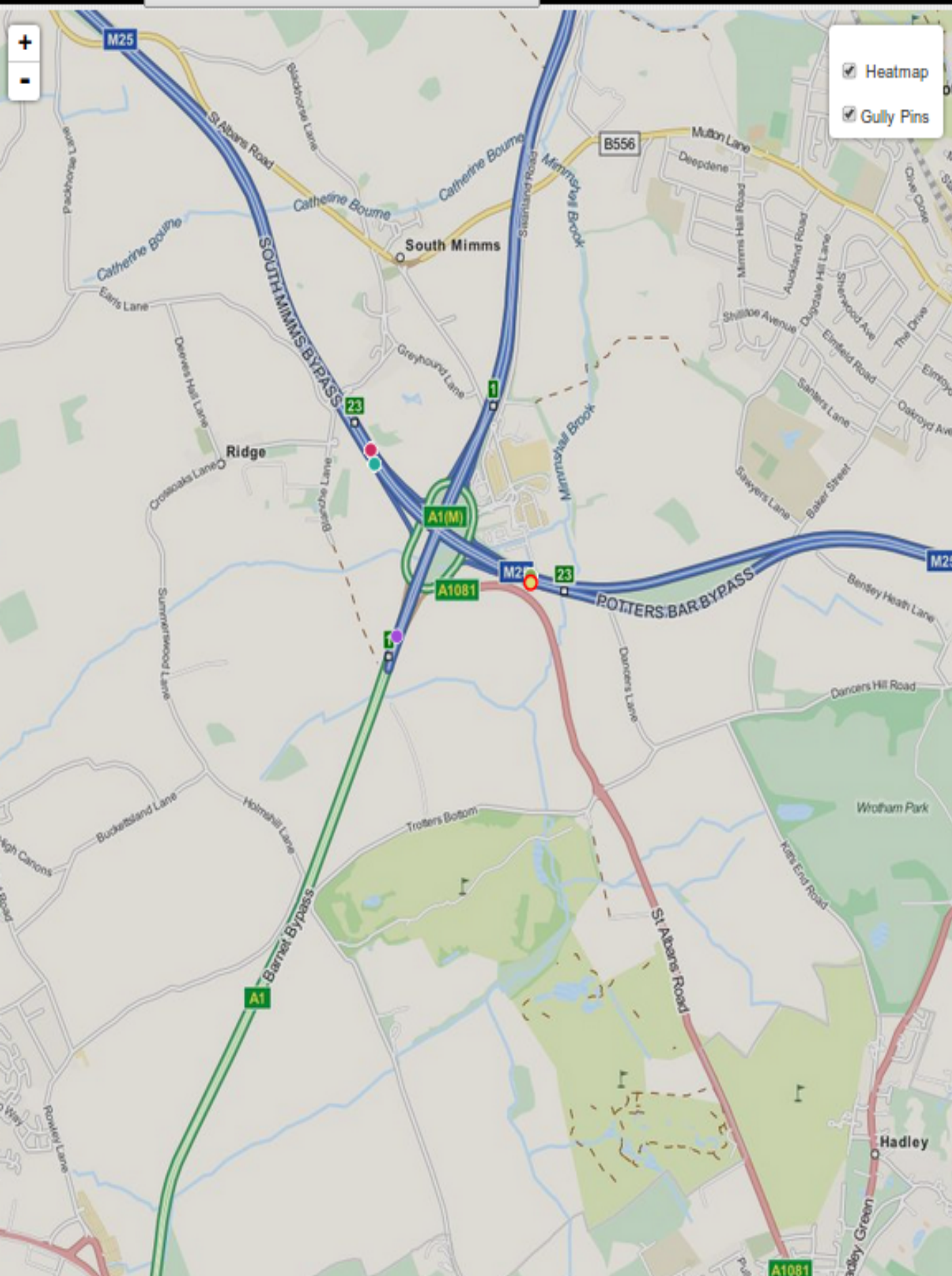


Street trees

# Bike Racks





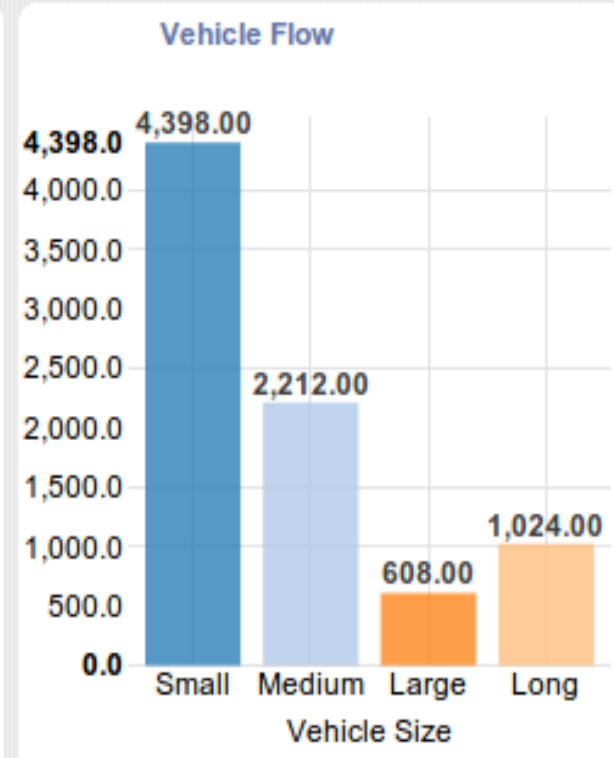


### UK Traffic Flow vs. Travel Time

This interactive demo explores the traffic flow and travel time data to see if there is any correlation between the two. Several regions in UK are sampled. Each region contains multiple highway junctions (color coded differently), of which the traffic flow and travel time data has been mashed up. By selecting a junction point, a scatterplot of traffic flow vs travel time ratio (Actual Travel Time/Ideal Travel Time) is graphed. The goal here is to see if higher traffic flow correlates to a higher travel time ratio of greater than 1.

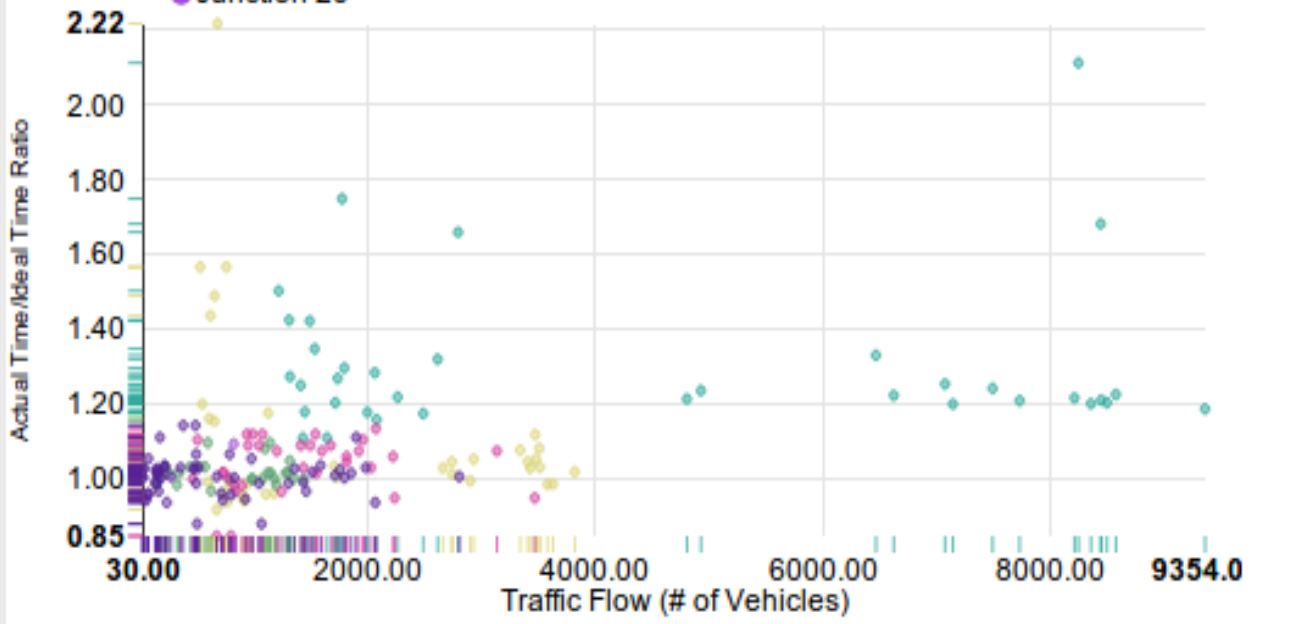
- How to use:**
1. Select a region on map
  2. Select a junction point on map
  3. View scatterplot (each set of data can be filtered using

RESET

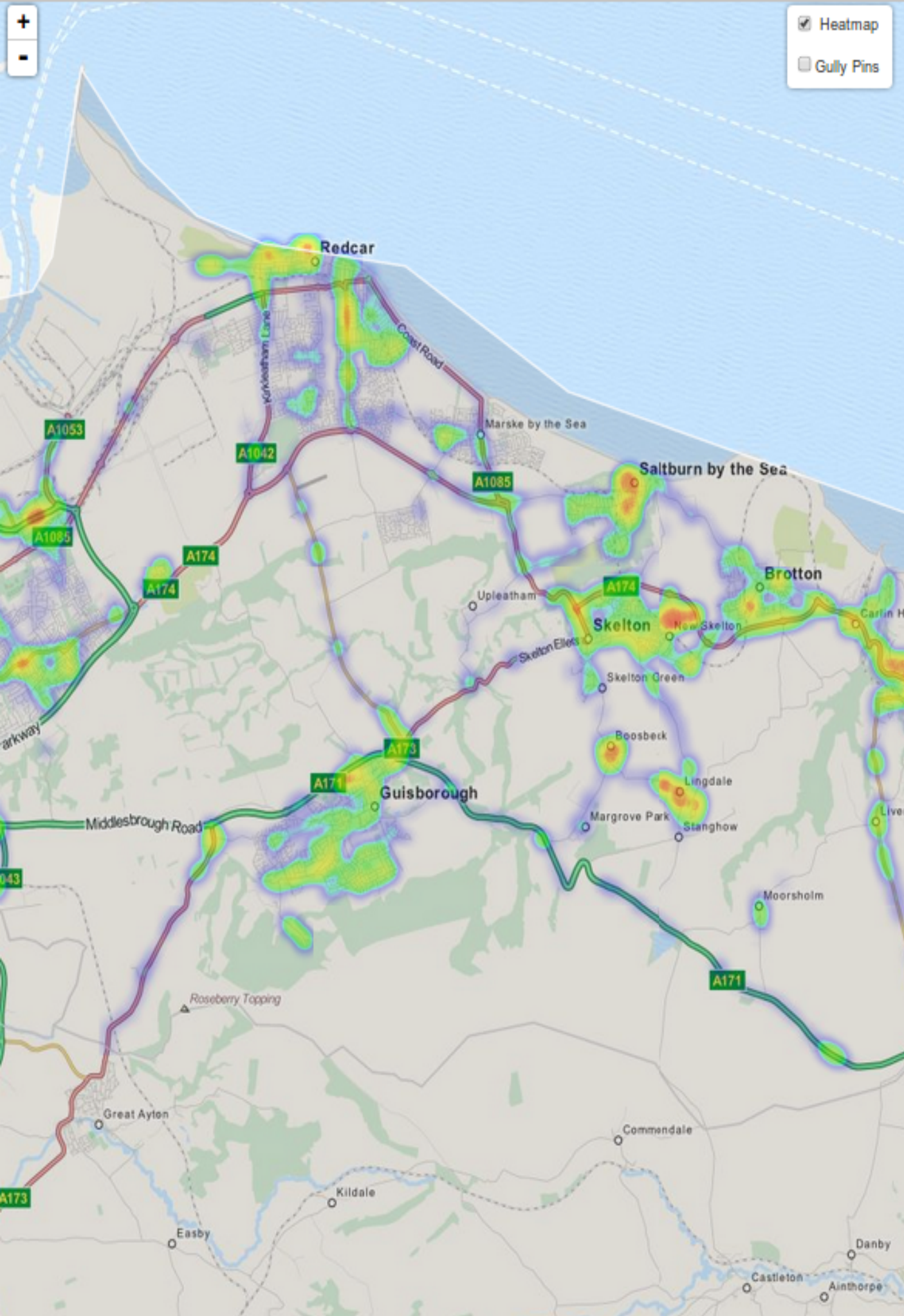


### Traffic Flow vs. Travel Time

- Junction 0
- Junction 1
- Junction 2
- Junction 3
- Junction 4
- Junction 5
- Junction 6
- Junction 7
- Junction 8
- Junction 9
- Junction 10
- Junction 11
- Junction 12
- Junction 13
- Junction 14
- Junction 15
- Junction 16
- Junction 17
- Junction 18
- Junction 19
- Junction 20
- Junction 21
- Junction 22
- Junction 23
- Junction 24
- Junction 25







- Heatmap
- Gully Pins

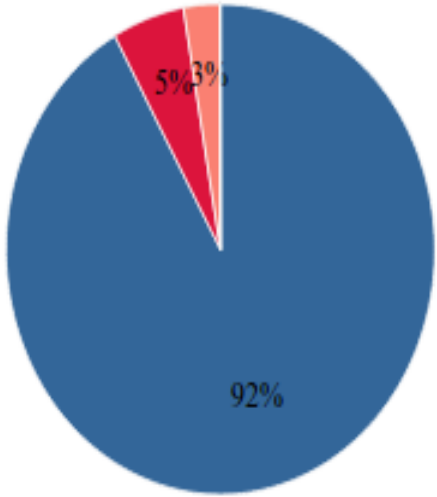
### Gully Status Overview

This is an interactive overview of gullies in Redcar and Cleveland, UK. Explore the data by clicking on the graphs to filter gullies on the map view. The purple dots represent gullies, the larger the dot means the higher the gully silt level. Use the checkbox controls to toggle the gully map pins and heatmap visualisations. To reset the map to show all gully data, click the "RESET" button below.

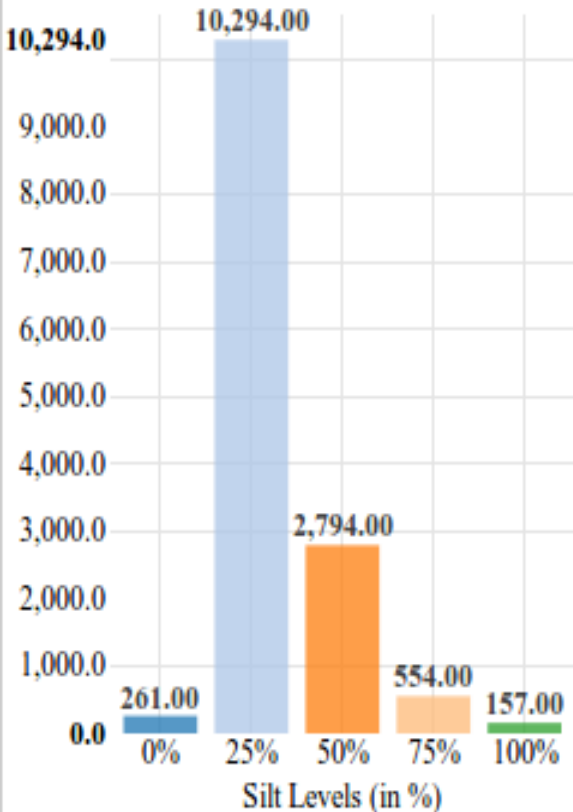
RESET

### Gully Types

- Top Entry
- Side Entry
- Box
- Rod and Eye

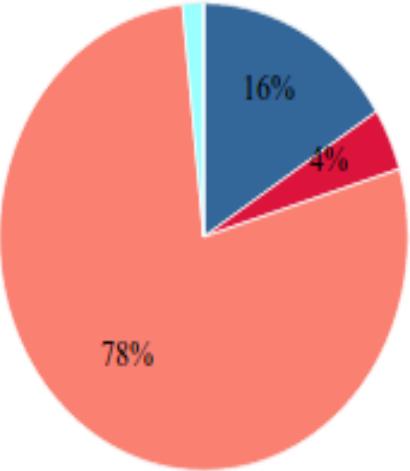


### Gully Silt Levels



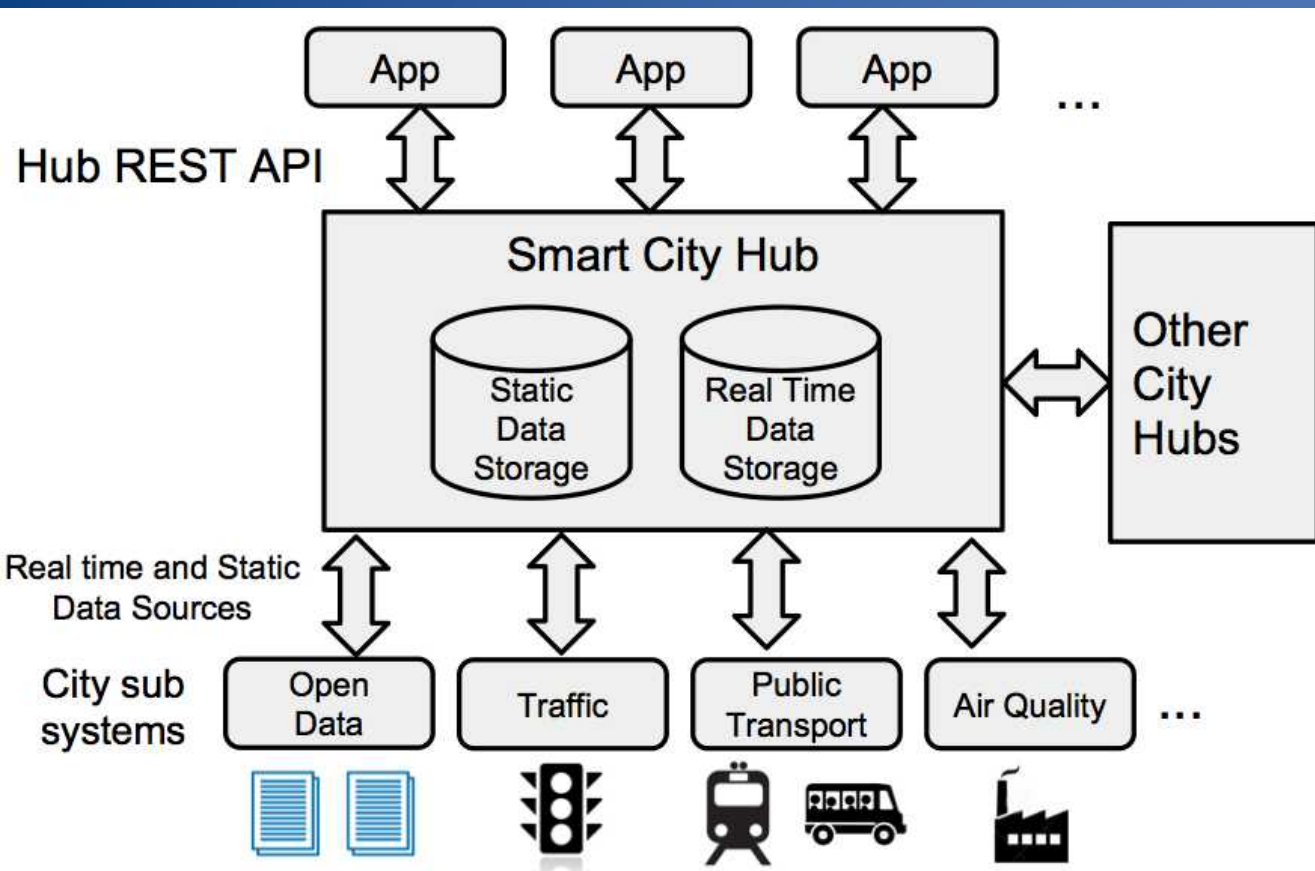
### Gully States

- Clean and Running
- Obstructed
- Blocked And Cleaned
- Cleaned and Not Running
- No Info



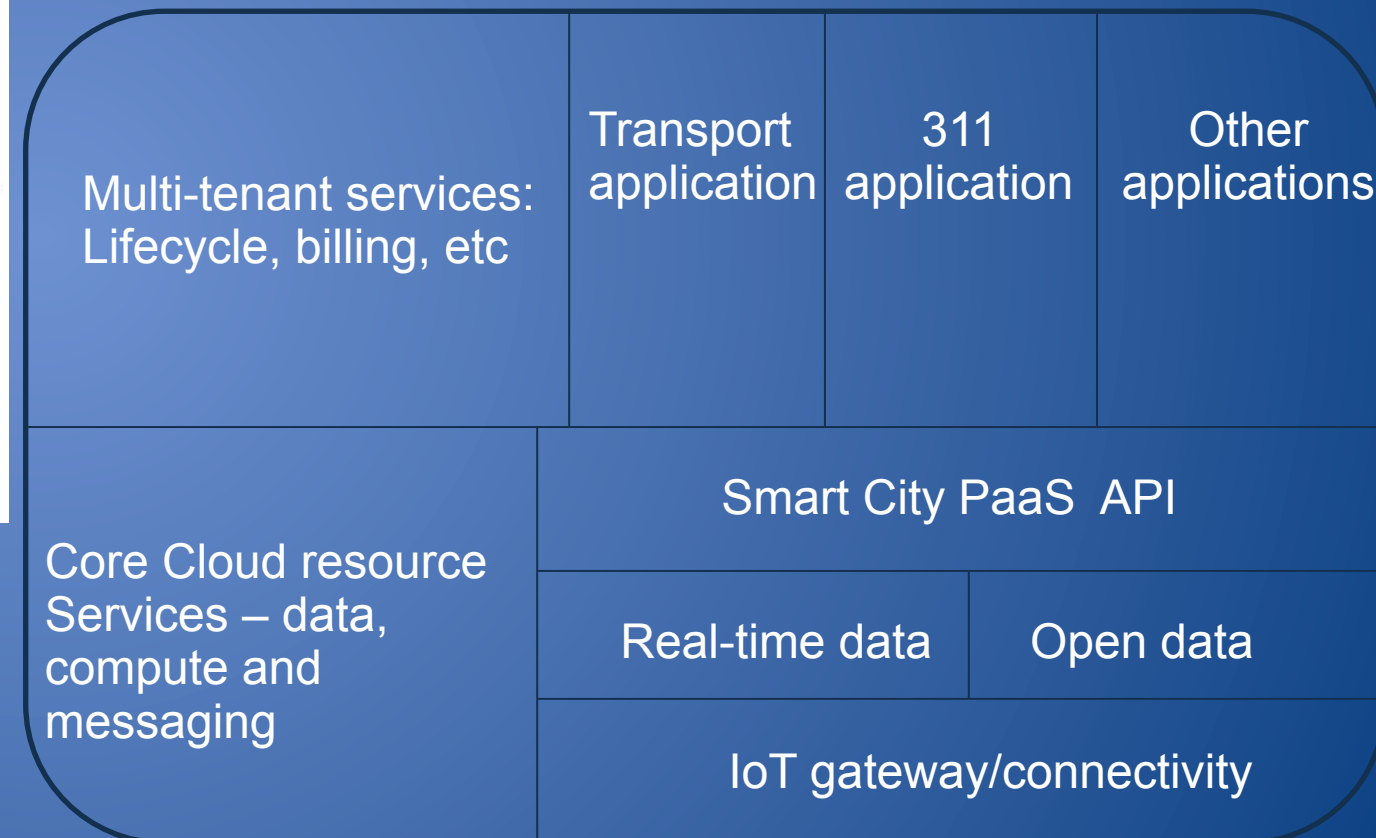


# #4 Organizational Boundaries: Hub Centric Approach



## • Cloud - PaaS

- Implemented as a PaaS
- Lifecycle and resource mngt
- Hub API generalised as part of PaaS
- Framework for city services
- Exposes interoperability API



## • Hub Centric approach

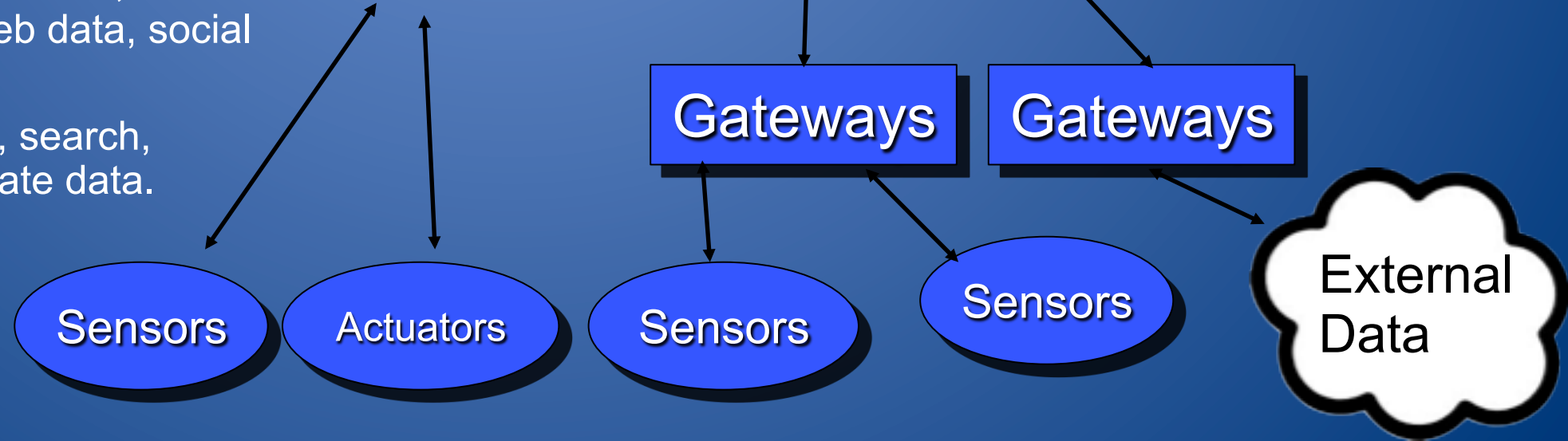
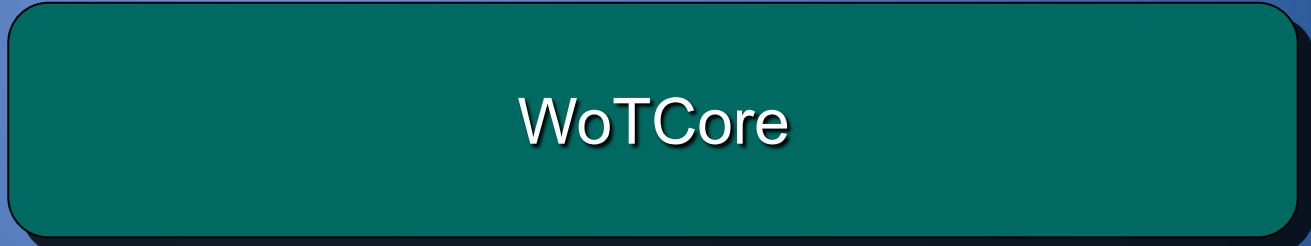
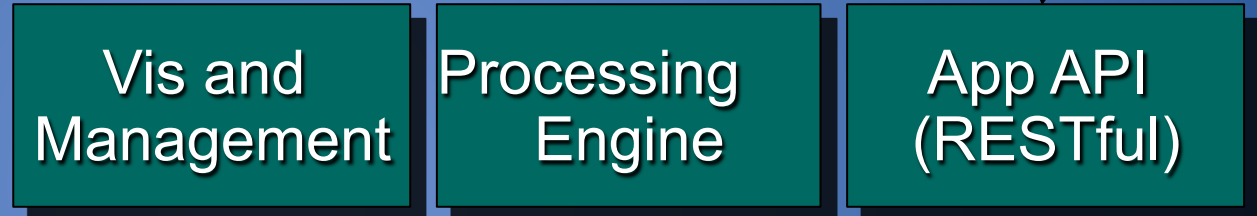
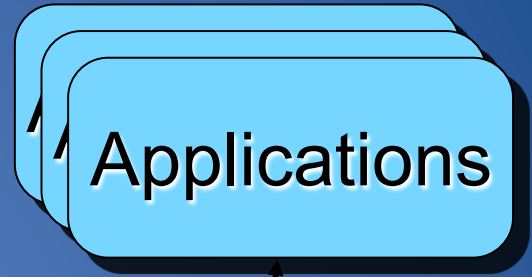
- Hub provides common access
- Well defined data upload & sensor APIs
- Set of user API
- Hub to Hub API (interoperability)

City Infrastructure, Citizen and other data sources

# #3 Time series data: Core IoT platform

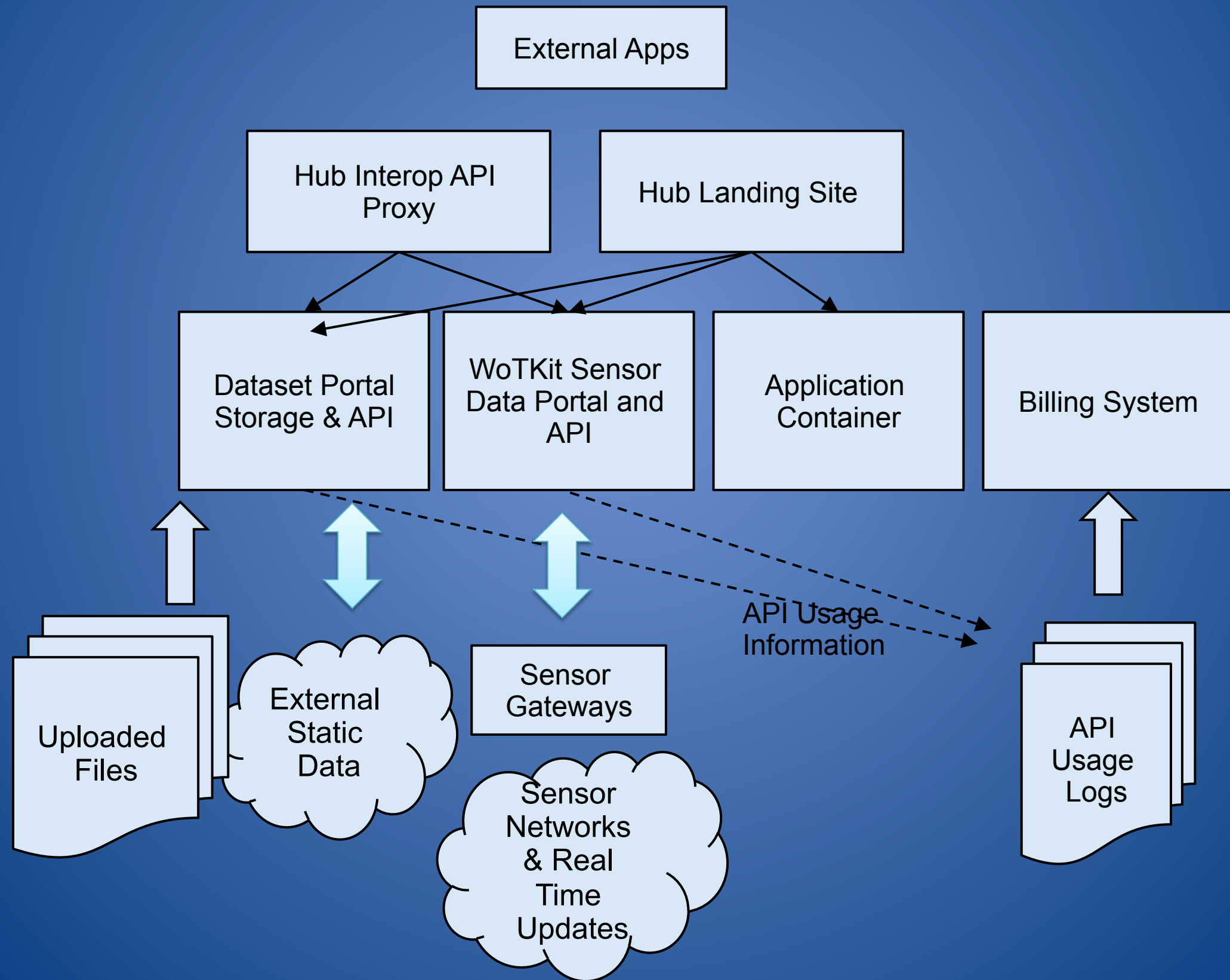


- **Viz, APIs**
  - Web centric toolkit and service for rapid IoT application development
  - Search and visualize raw sensor data
  - User configurable dashboards
  - Mash-up engine for rapid development of IoT applications
  - Web centric – browser based and internet accessible.
- **Time series core**
  - Core platform aggregating data
  - Integration framework aggregating data from multiple sources, physical sources, web data, social network feeds etc
  - Core APIs to submit, search, access and manipulate data.





# #1 Diversity of data: CityHub = IoT platform + OpenData repository



# #5 Interoperability: minimal standardization

- UK project
  - 8 IoT projects funded by UK govt
    - Foci: Transport, health, schools, energy ...
  - Manchester, London, Newcastle, Bristol, IBM, BT, Intel, Carillion, Balfour .....



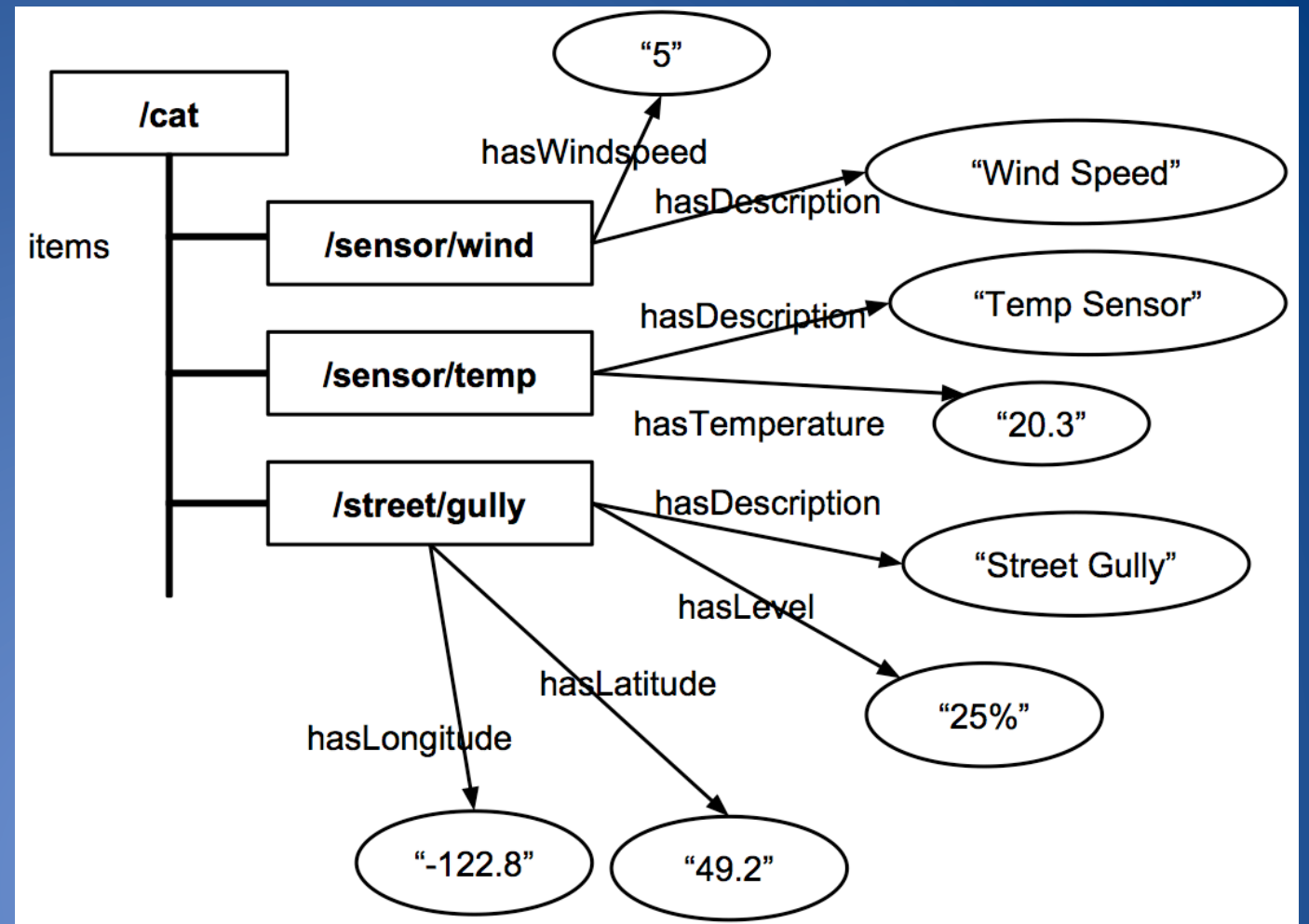
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## •Catalogue

- Catalogue describing hub resources
- Hub resources described as generic set of values and properties
- Exposes interoperability API

```
{
  "metadata":[
    { "rel":"urn:X-tsbiot:rels:isContentType",
      "val":"application/vnd.tsbiot.catalogue+json" },
    { "rel":"urn:X-tsbiot:rels:hasDescription:en",
      "val":"Bare catalogue" }
  ],
  "items":[
    { "href":"http://hub.com/resource1",
      "metadata":
        [
          { "rel":"urn:X-tsbiot:rels:hasDescription:en",
            "val":"The first resource" }
        ]
    },
    { "href":"http://hub.com/resource2",
      "metadata":
        [
          { "rel":"urn:X-tsbiot:rels:hasDescription:en",
            "val":"The second resource"}
        ]
    }
  ]
}
```



## •HyperCat

- JSON-based hypermedia catalogue
- Collection of URIs
- any number of URIs, each with any number of RDF-like triple statements about it.
- Exposes interoperability API
  - Query, search, set etc



# Interoperability: lessons

- Less is more
  - you can't reach agreement on standards, eg APIs, protocols, data format etc
    - So don't try – focus on absolute minimum
    - Ensure it is flexible
    - Allow it to evolve



# Development: lessons

- Time series data – drives a lot of the application issues
- Hub API's across diverse data, but also external systems – connectivity/data message
- Varied set of developer skills
  
- Visual programming tool
- Data flow model

# Implementation: Node-RED based



The screenshot shows the Node-RED interface with a flow titled "WS Tweets". The flow starts with a "sentiment" node connected to a "WS Tweets" input. The output of the "sentiment" node goes to a "Sentiment Split" function node. From the "Sentiment Split" node, the flow branches into three paths: a "debug" node, a function node connected to a "websocket" node, and a "Scroll Message" function node. Below this, there are "Clear Screen" and "Say Hello" nodes connected to an "LED Sign" node.

info debug

Type	sentiment
ID	854f3cdb.7ab0

Properties

name

Analyses the `msg.payload` and adds a `msg.sentiment` object that contains the resulting AFINN-111 sentiment score as `msg.sentiment.score`.

A score greater than zero is positive and less than zero is negative.

The score typically ranges from -5 to +5, but can go higher and lower.

An object of word score overrides can be supplied as `msg.overrides`.

See [the Sentiment docs here](#).



## Lessons recap

- IoT systems are complex ecosystems
  - ‘external’ data hub
  - no one world view will dominate
- Real-time/real-world data
  - Time series capability at core of Hub
- Interoperability – it’s the wild west out there
  - less is more - flexibility is key
- App development framework
  - integration, time series

# DEMISTIFYING THE DATA BROKER

Consumers want to be clued in on data broker activity

✓ 16%  
Consumers who say they have a significant or complete understanding of what information is gathered

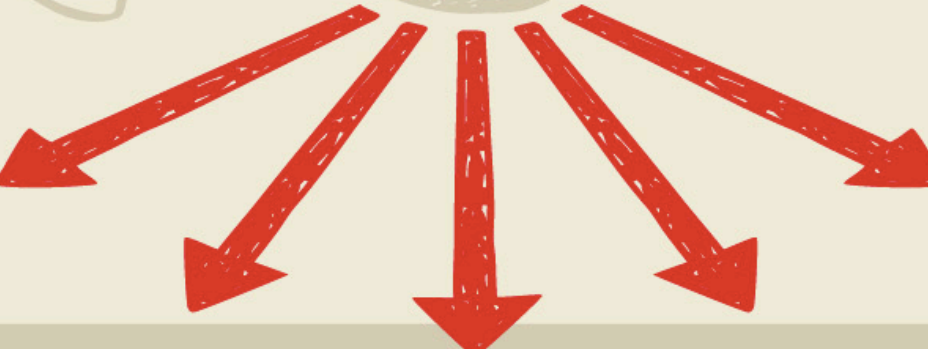


Consumers who have a significant or complete understanding of what data brokers do with acquired data



Consumers who say it is important to be able to make changes to their data obtained by data brokers

71%  
Consumers who believe it is important to be able to see and access collected information



 **EIGHTEEN%**

Consumers who say they have a good grasp of what a data broker is



80% Consumers who say they would like to have a centralized website to manage their data



80% Consumers who want to be able to opt out of the sharing or selling of information or delete acquired data

## Open Issues

- Data brokerage
  - Data contracts: buy and sell data
  - Citizen data – trust models





# Thanks !

- Urban Opus: urbanopus.net
- Node-RED: fred.sensetecnic.com

[rla@sensetecnic.com](mailto:rla@sensetecnic.com)

@rodgerlea

