2016 International Conference on
Geospatial Information Science(ICGIS)

위치기반 IoT와 공간빅데이터 활용

2016.9.2(금) **10:00~17:30**

더케이호텔 거문고BC홀 3F

프로그램 및 목차

시간 (Time)		내용 (Title)	발표자 (Presenter)	쪽수
09:30	30’	등록(Registration)		
10:00	5’	개회사 (Opening Remarks)	국토교통부 주택토지실장 (Deputy Minister of Housing and Land Office, MOLIT)	
10:05	5’	환영사 (Welcoming Address)	국토연구원장 (President of KRIHS)	
기조연설 (Keynote Speech)				
10:10	40’	소비자 행위기반 공간시각화 (Geovisualization of consumer behaviour: the work of the Consumer Data Research Centre)	폴 롱리 (Paul Longley)	p.5
10:50	10’	휴식 (Coffee Break)		
세션 1: Geo-IoT 비전과 동향 (Session1 : Trends and Vision of Geo-IoT)				
11:00	30’	Geo-IoT의 미래 동향과 비전 (Geo-IoT Trends and Vision in the Future)	스티브 리앵 (Steve Liang)	p.29
11:30	30’	IoT기반 센서네트워크 커뮤니티 구축 (IoT for Everyone - Building a Global Sensor Network Community)	다니엘 카스틀 (Daniel Kastl)	p.57
12:00	30’	초연결 시대를 위한 공간정보 정책방향 (Policy Direction of Geospatial Information for Hyper-Connected Society)	사공호상 (Ho-Sang Sakong)	p.71
12:30	90’	점심 (Luncheon)		
세션 2: 공간분석과 활용 (Session2 : Geospatial Analytics and Applications)				
14:00	30’	공간빅데이터 유통을 위한 오픈소스 기반의 공간정보플랫폼 개발 (Distribution of Open/Big Geospatial Data: The Construction of Opensource based Geospatial Platform)	토시카즈 세토 (Toshikazu Seto)	p.89
14:30	30’	빅데이터를 활용한 통행자분석 시스템 개발 (Development of Activity-BAsed Traveler Analyzer (ABATA) system using big data)	이광섭 (Kwang-Sub Lee)	p.107
15:00	30’	빅데이터와 지능형 위치정보에 대한 심층 분석(A Deep Dive into Big Data and Location Intelligence)	페르난도 카라스코 (Fernando Carrasco)	p.123
15:30	20’	휴식 (Coffee Break)		
세션 3: 패널 토론 (Session3: Panel Discussion)				
15:50	100’	**주제(Agenda)**: IoT와 빅데이터 시대의 공간정보 미래 (The Future of Geospatial Data in the Era of IoT and Big Data) **좌장(Moderator)**: 김은형(Eunhyung Kim) 가천대 교수 **토론자(Discussants)**: 김형석(Hyungseok Kim) 국토부 과장, 전철민(Chulmin Jun) 서울시립대 교수 이동옥(Dongok Lee) SK텔레콤 부장, 이재용(Jaeyong Lee) 국토연구원 연구위원		
폐회 (Closing)				

Geovisualization of consumer behaviour: the work of the Consumer Data Research Centre

Paul Longley
p.longley@ucl.ac.uk
University College London, UK

Abstract

This presentation will begin with a selective overview of the key changes in geospatial technology and geovisualisation that have characterized the first years of the 21st Century, as captured in four editions of an advanced student textbook on Geographic Information Science and Systems. (This book has sold c. 100,000 copies in four languages, including Korean.)

We then consider the range of geospatial data that are available to measure and monitor the city. We present the three tier data service of the Consumer Data Research Centre, and the novel web mapping intergace that is used to communicate the message of consumer data sources.

An important distinction is drawn between (a) comprehensive 'framework' data sources relating to physical infrastructure and population distributions, and (b) the increasing range of Big Data sources that are used to provide depth and detail about the behaviours of city populations. Big Data sources dwarf conventional inventory management systems and population surveys in the volume of data that are produced and the rapidity with which they are updated, but have some less widely acknowledged characteristics in terms of content and coverage. These are not always fully understood in the analysis of city systems, and geovisualisation provides an important medium for evaluating trends in data, as well as identifying outliers and anomalies.

We develop particular focus upon 'consumer data' that are routinely collected as a consequence of the purchase of goods and services, and arise out of activities such as retail transactions, travel behaviour or energy consumption. Such sources are almost invariably partial, since few organisations have monopoly power in consumer led markets. Moreover, they are usually incomplete in other, sometimes subtle, respects, since database creation and maintenance is more directly aligned with organizational functions that are separate from research and development. Used alone or in combination with other sources, they nevertheless contribute towards rich representation and visualization of citizen activity patterns that are difficult to assemble from other sources. The re-use of consumer data for such purposes also raises a number of important ethical issues of data re-use and linkage, based upon anonymisation, aggregation and profile matching.

We develop a series of illustrative examples with respect to usage of social media, energy consumption and purchasing behaviour. This analytical work has implications beyond retailing, particularly in developing better understanding of health-related behaviours. We will develop particular focus on the use of sensor technologies to collect data on pedestrian movements in cities and to model flows across them.

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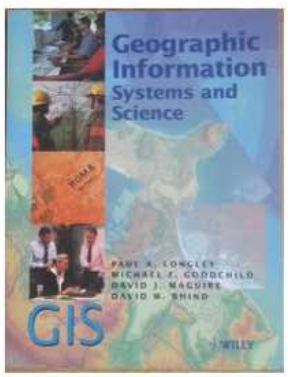
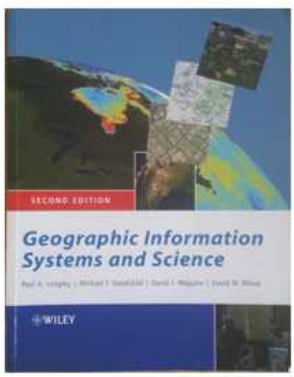
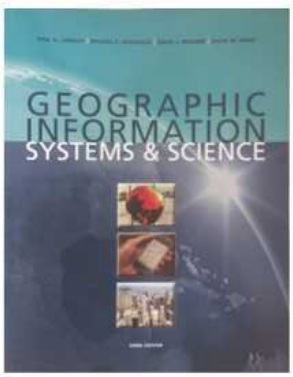
Geovisualization of consumer behaviour: the work of the Consumer Data Research Centre

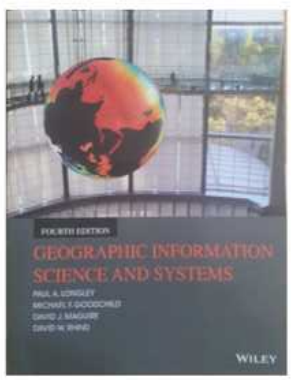
Paul Longley and colleagues, CDRC and University College London

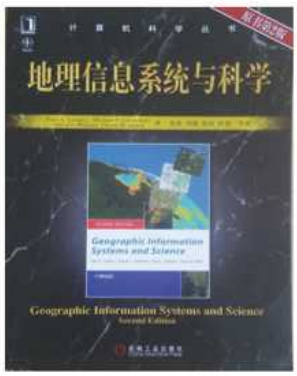
UCL

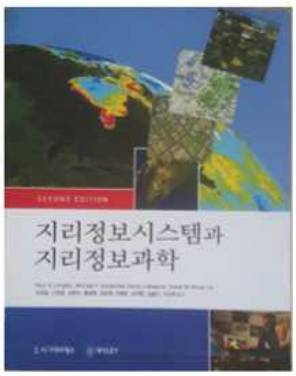












Applications Box 17.2

Managing Land Information in Korea through GIS

In South Korea, a complex and rapidly changing society, local government authorities administer the public land through assessment of land prices, management of land transactions, land-use planning and management, and civil services. In many cases, more than one department of a local government authority produces and manages the same or similar land and property information, this has led to discrepancies in the information held across local government. With the large number of public land administration responsibilities and the control of each given to the local authorities, many problems arose in the past. This led to the decision to develop a GIS-based method for sharing the information produced or required for administering land in the public and private sectors (Figure 17.8B). The Korean Land Management Information System (LMIS) was established in 1998. The purpose of this GIS is to provide land information, increase productivity in public land administration, and support the operation of the land planning policies of the Korean Ministry of Construction and Transportation (MOCT). The LMIS database includes many spatial data such as topographic, cadastral, and land-use district maps.

Hyunrai Kim, vice director of the Land Management Division of Seoul Metropolitan City, summarizes the advantages of this system thus: "By means of the Internet-based Land Information Service System, citizens can get land information easily at home. They don't have to visit the office, which may be located far from their homes." The system has also resulted in time and cost savings. With the development of the Korean Land Price Management System, it is also possible to compute land prices directly and produce maps of variations in land price. Initially, the focus was mainly on the administrative aspects of data management and system development; however, attention then turned to the expansion and development of a decision support system using various data analyses. It is intended that the Land Legal Information Service System will also be able to inform land users of regulations on land use. In essence, LMIS is becoming a crucial element of e-government. This case study highlights the role that GIS can play beyond the obvious one of information management, analysis and dissemination. It highlights the value of GIS in enabling organizational integration and the reality of generating benefits through improved staff productivity.

Figure 17.8 (A) Seoul by night. (B) Land information map for part of Seoul. (Reproduced by permission of Corbis) (© David Bull/© Corbis)

rotating GIS analysts through posts, and setting the right (high) level of expectation in the performance of all staff. Managers can learn much by taking a turn in the hot seat of a customer support role!

17.3.3.2 Operations Support

Operations support includes system administration, maintenance, security, backups, technology acquisitions, and many other support functions. In small projects, everyone is charged with some aspects of system administration and operations support. But as projects grow beyond five or more staff, it is worthwhile designating someone specifically to fulfill what becomes a core, even crucial, role. As projects become larger, this grows into a full-time function. System administration is a highly technical and mission-critical task requiring a dedicated, properly trained, and paid person.

Perhaps more than in any other role, clear written descriptions are required for this function to ensure that a high level of service is maintained. For example, large, expensive databases will require a well-organized security and backup plan to ensure that they are never lost or corrupted. Part of this plan should be a disaster recovery strategy. What would happen, for example, if there were a fire in the building housing the database server or some other major problem?

17.3.3.3 Data Management Support

The concept that geographic data are an important part of an organization's critical infrastructure is becoming widely accepted. Large, multiuser geographic databases use DBMS software to allocate resources, control access, and ensure long-term usability (see Chapter 10). DBMS can be sophisticated and complicated, requiring skilled system administrators for this critical function.

A database administrator (DBA) is a person responsible for ensuring that all data meet all of the standards of accuracy, integrity, and compatibility required by the organization. A DBA will also typically be tasked with planning future data resource requirements—derived from continuing interaction with current and potential customers—and the technology necessary to store and manage them. Similar comments to those outlined above for system administrators also apply to this position.

17.3.3.4 Application Development and Support

Although a considerable amount of application development is usual at the onset of a project, it is also likely that there will be an ongoing requirement for this type of work. Sources of application development work include improvements/enhancements to existing applications, as well as new users and new project areas starting to adopt GIS.

Software development tools and methodologies are constantly in a state of flux, and GIS managers must invest appropriately in training and new software tools. The choice of which language to use for GIS application development is often a difficult one. Consistent with the general movement away from proprietary GIS languages, wherever possible GIS managers should try to use mainstream, open languages that are likely to have a long lifetime (see Chapter 7).

Biographical Box 21.2

Dr Young-Pyo Kim, Korean Pioneer of NGIS

After a successful career in the Korea Marine Corps, Young-Pyo Kim (Figure 21.6) joined the Korea Research Institute for Human Settlements (KRIHS) in 1979. Over the next decade, he defined the concept and method of Land Assessment in Korea and focused upon a range of land planning and policy issues. In 1986, he became director of the Computing Center in KRIHS, and a champion of using GIS to devise more efficient and effective measures for land planning and policy. Implementing this in a country that, at the time, had little GIS expertise was far from straightforward, and strenuous efforts were necessary to introduce the technology and build capacity. In 1993, Dr Kim organized an official government meeting to establish policy directions for GIS development in Korea. This meeting brought the National GIS project in Korea into being, and he subsequently played a key role in making it happen.

Figure 21.6 Young-Pyo Kim, Korean Pioneer of NGIS

Today Young-Pyo Kim is director of the GIS Center in KRIHS, where he also acts as a coordinator of the Korean National GIS (NGIS) Steering Committee. His leading role in the National GIS project is fundamentally pragmatic, but he believes that GIS is much more than a toolbox. Speaking of the social and philosophical ramifications of GIS he says: 'All things in the universe are restricted by the axes of time and space, and these are recognized by humans. In Eastern classical philosophy, space, time, and humans have been called the three fundamental elements of the universe. These elements cannot be completely integrated in the real world because of the constraints of time and space. However, human construction of three-dimensional cyber-geospace can overcome the separation of time and space and create movement towards a more ubiquitous world. GIS will be a foundation technology in this project.'

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We are an academic led, multi-institution laboratory which discovers, mines, analyses and synthesises consumer-related datasets from around the UK. The CDRC is an ESRC Data Investment.

CDRC-Public
Access retail, consumer and contextual information through our free public data and mapping portal.

CDRC-Stakeholder/Archive
A download service for retail / consumer data for use in academic research.

CDRC-Secure
Access anonymised consumer / retail data from our secure on-site facilities.

cdrc.ac.uk

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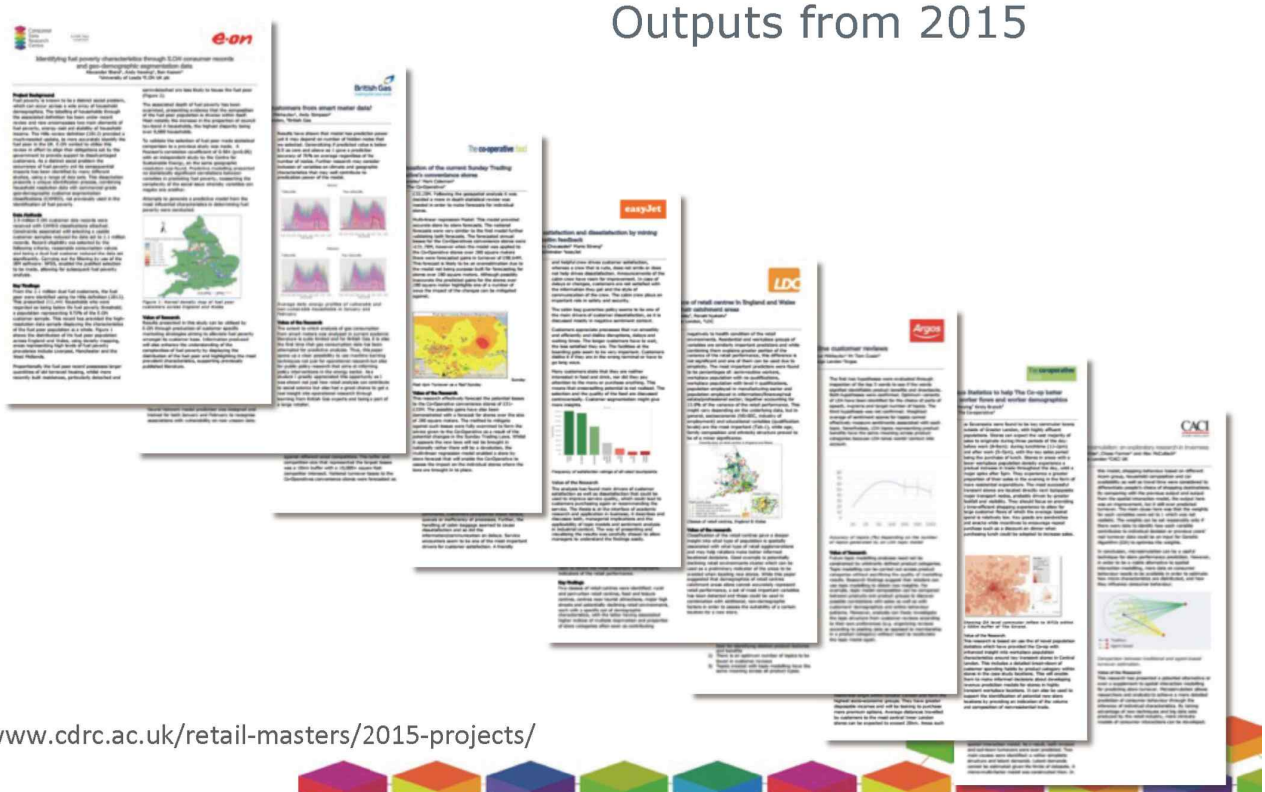
Research Dissertation Programme Outputs from 2015



www.cdrc.ac.uk/retail-masters/2015-projects/

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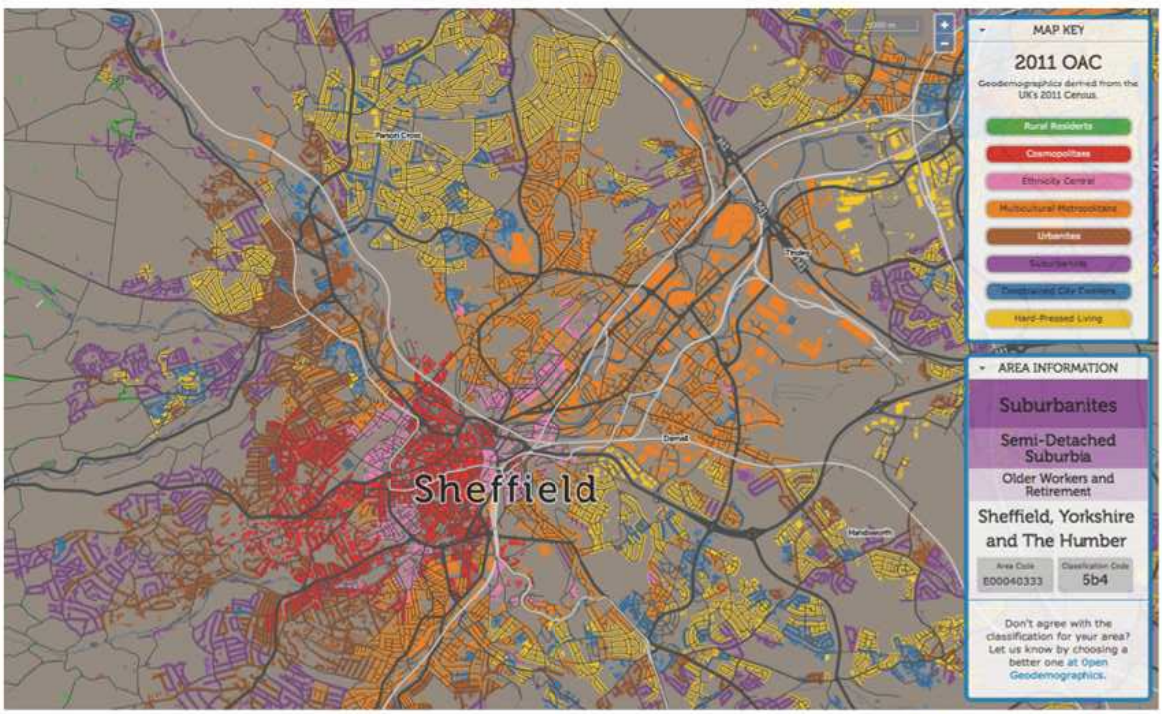
CDRC Maps Geodemographic Classification: OAC



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CDRC Maps Modal Dwelling Age Group

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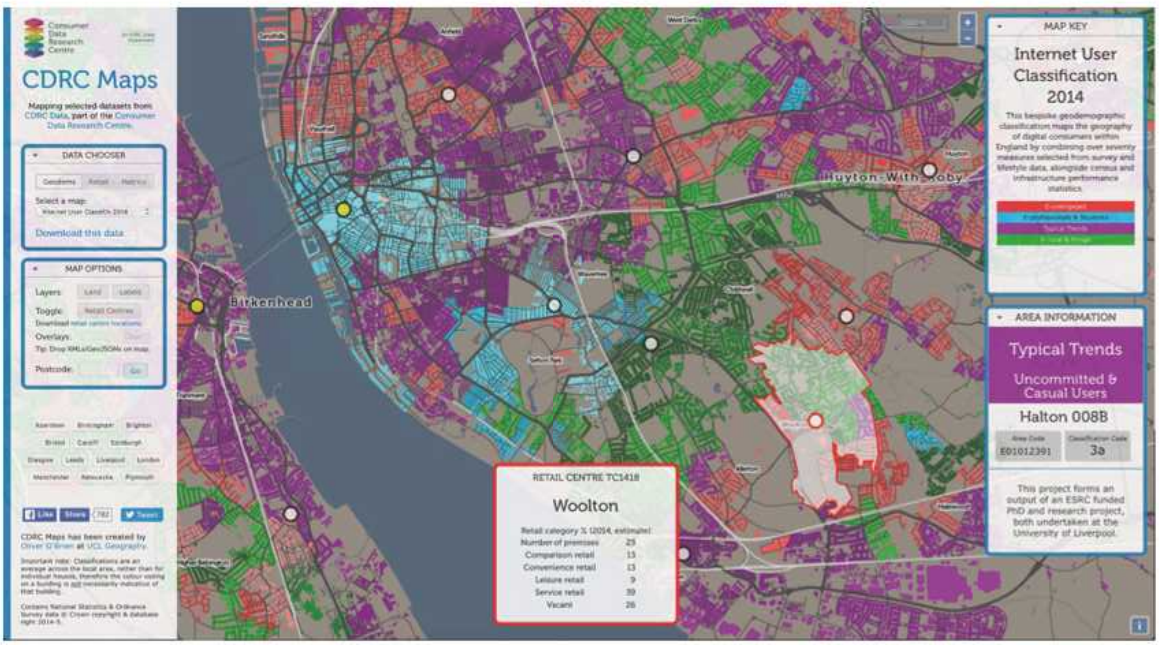
Internet User Classification



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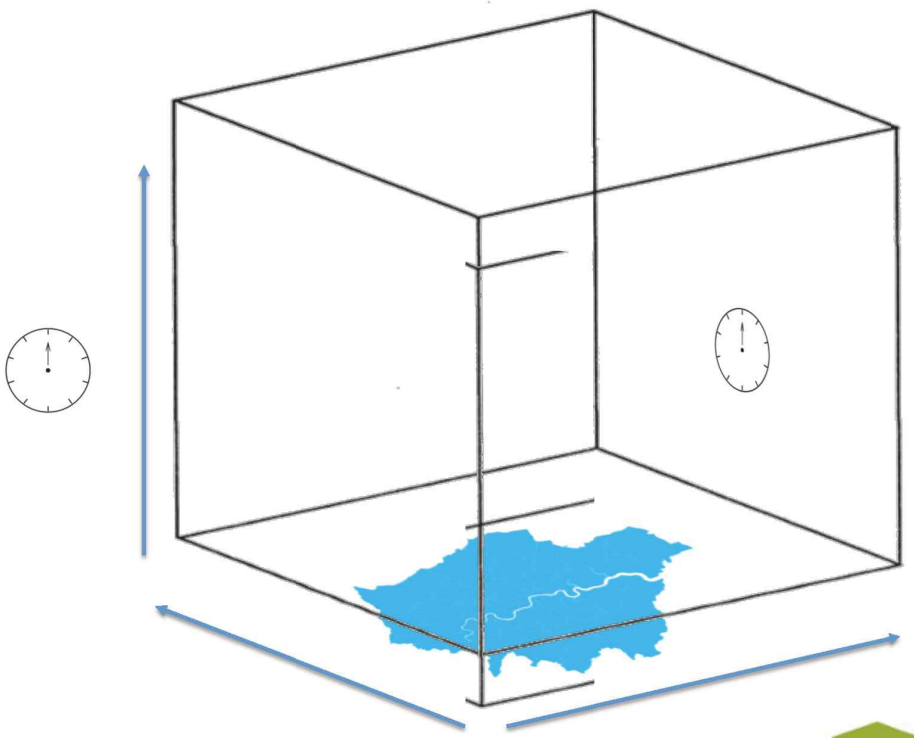

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Towards the 'Smart Census'

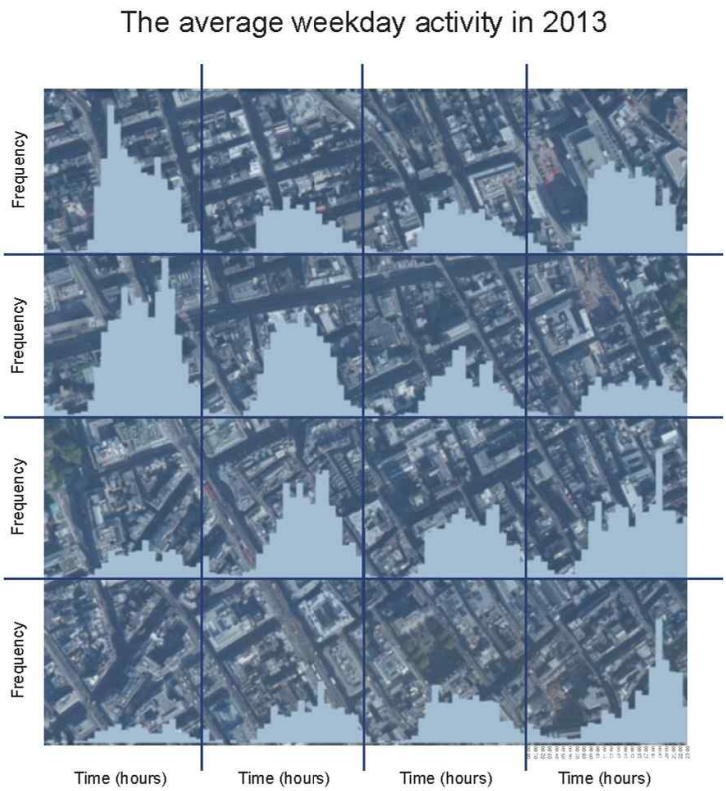
- Context of better use of existing data resources, e.g. workplace statistics
- Activity patterns associated with consumption
- Big Data as 'exhaust' (Harford): no research 'design'
- 'Horses for courses' approach to data creation, maintenance and linkage

Data available through the Twitter API

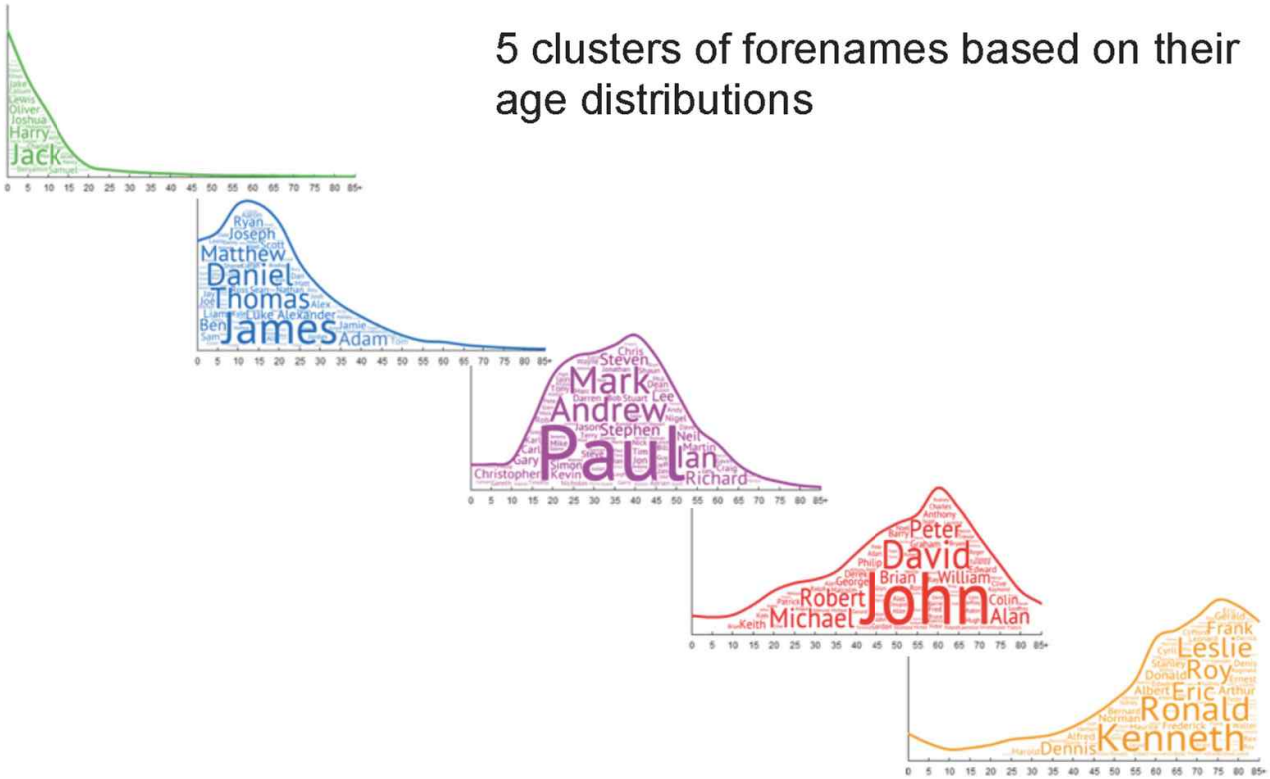
- User Creation Date
- Followers
- Friends
- User ID
- Language
- Location
- Name
- Screen Name
- Time Zone
- Geo Enabled
- Latitude
- Longitude
- Tweet date and time
- Tweet text

Twitter estimated footfall in Soho

- The frequency of geotagged Tweets across space and time can tell us a lot about the dynamics of a city



Forenames – Age (Males)



5 clusters of forenames based on their age distributions

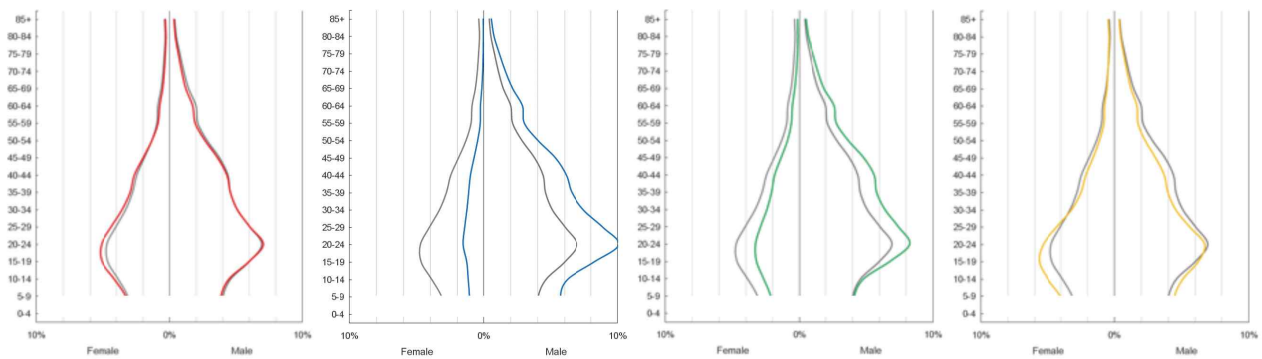
Inferred demographic structure of Tweeters

The O2 Arena

The Emirates stadium

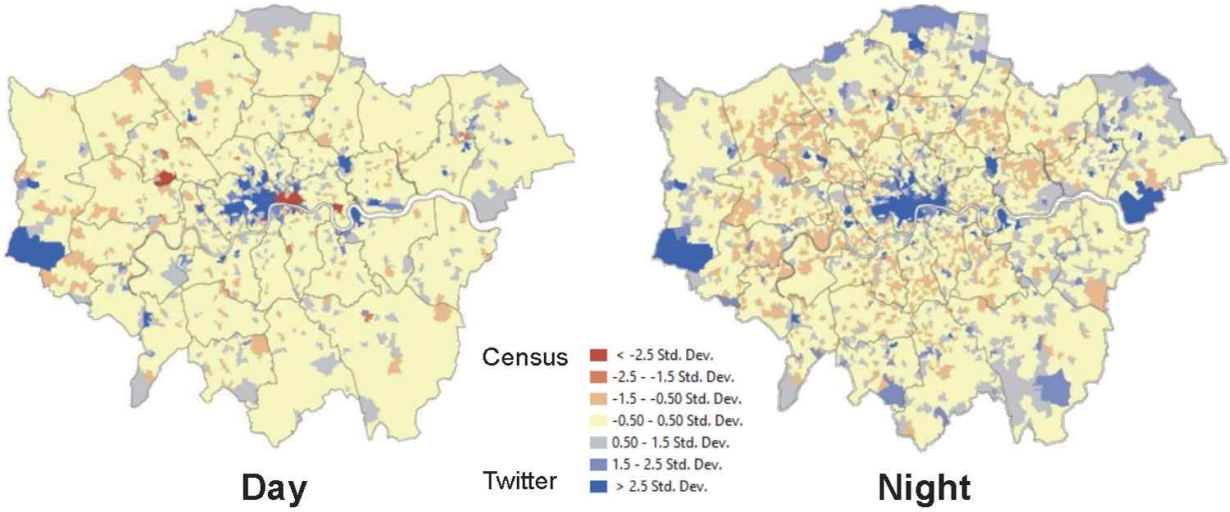
Canary Wharf

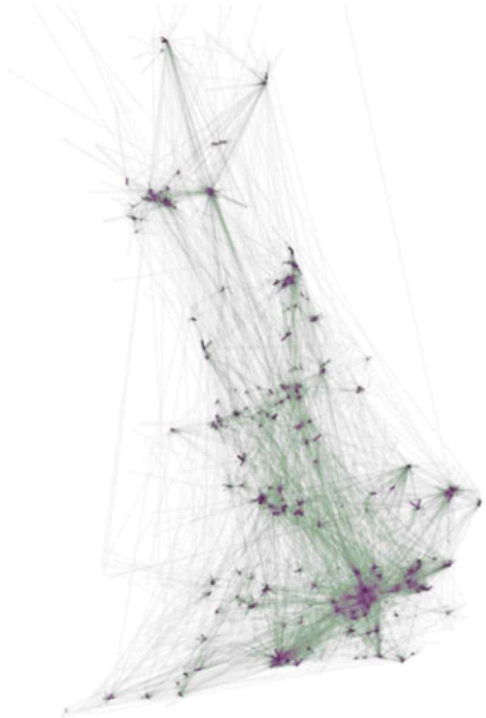
Westfield Stratford



Twitter vs the Census (courtesy: Guy Lansley)

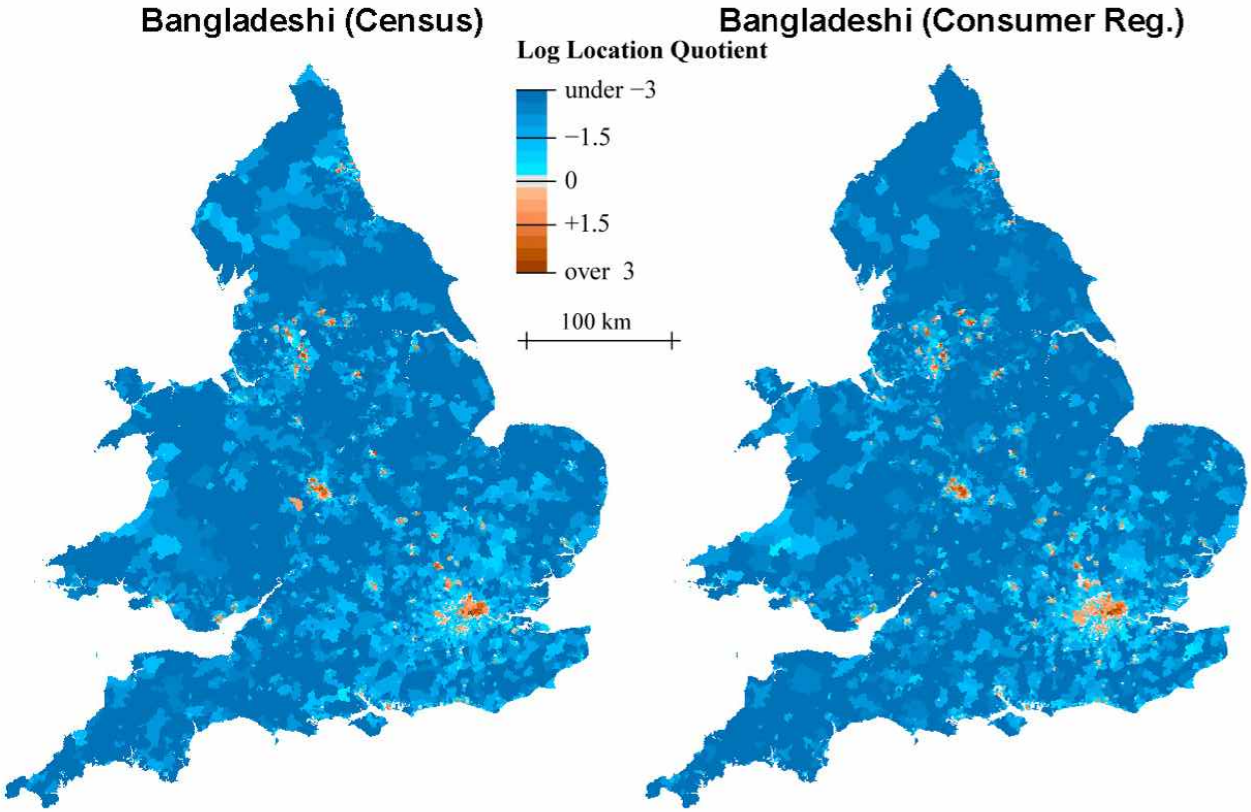
- Lower Super Output Area level
- Census work day statistics vs Tweets from 10:00 – 16:00
- Census residential population vs Tweets from 19:00 – 7:00



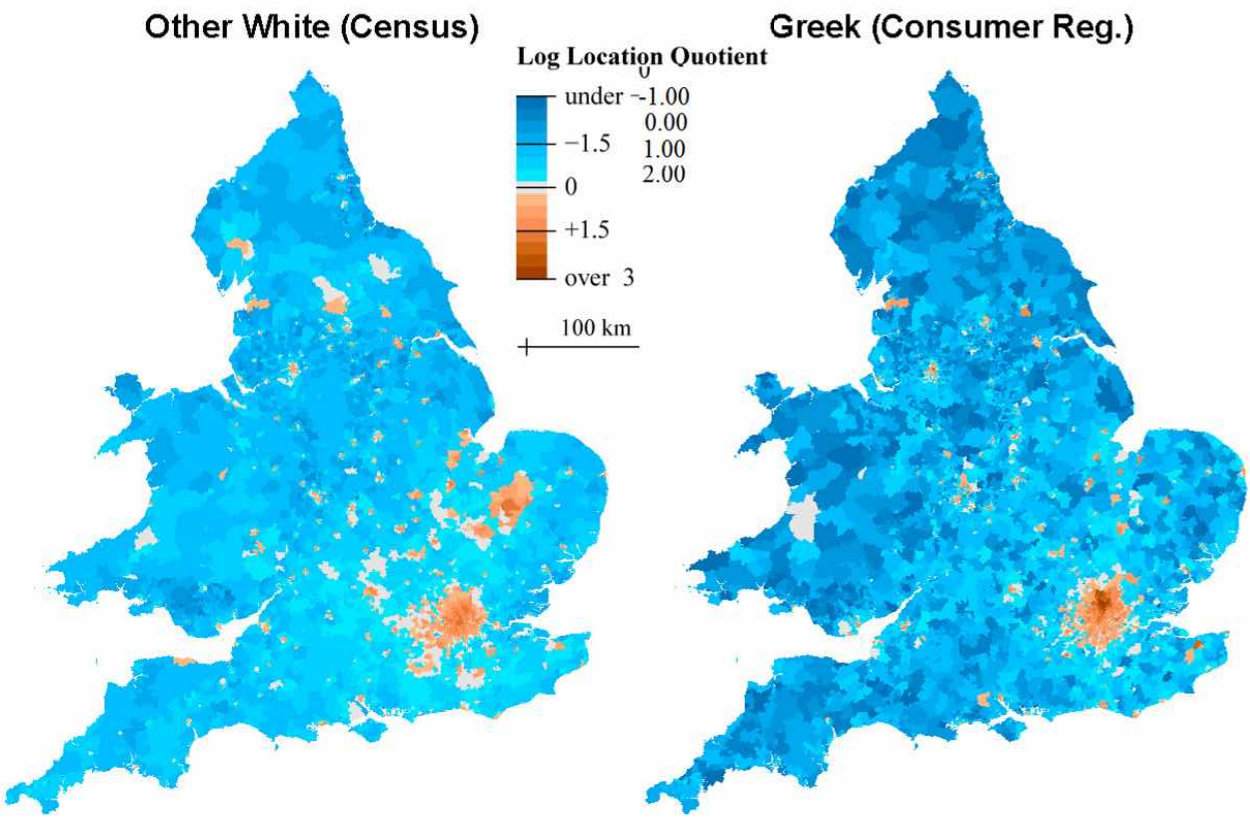


Customers most frequently visited store outside MSOA of residence
[Courtesy: Alyson Lloyd)

SPATIAL DISTRIBUTION OF ETHNIC GROUPS

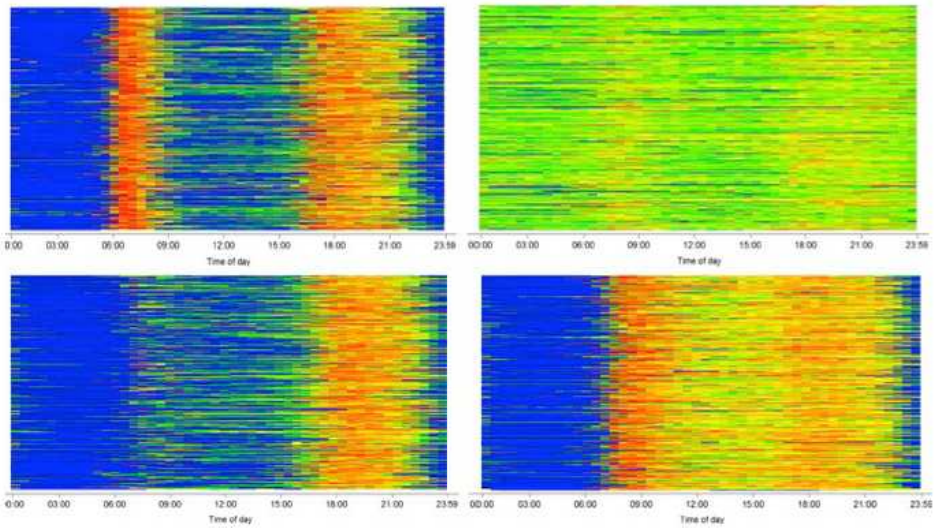


SPATIAL DISTRIBUTION OF ETHNIC GROUPS



Smart Meter Data

4 clusters of smart meters based on typical daily energy profiles



From: Samson, N., Lansley, G. and Simpson, A. (2014) Using smart meter data to determine energy efficiency of customers' homes. PopFest 2014. 4th – 6th August. University College London, UK.

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Smart Sensors

- Co-production of Big Data

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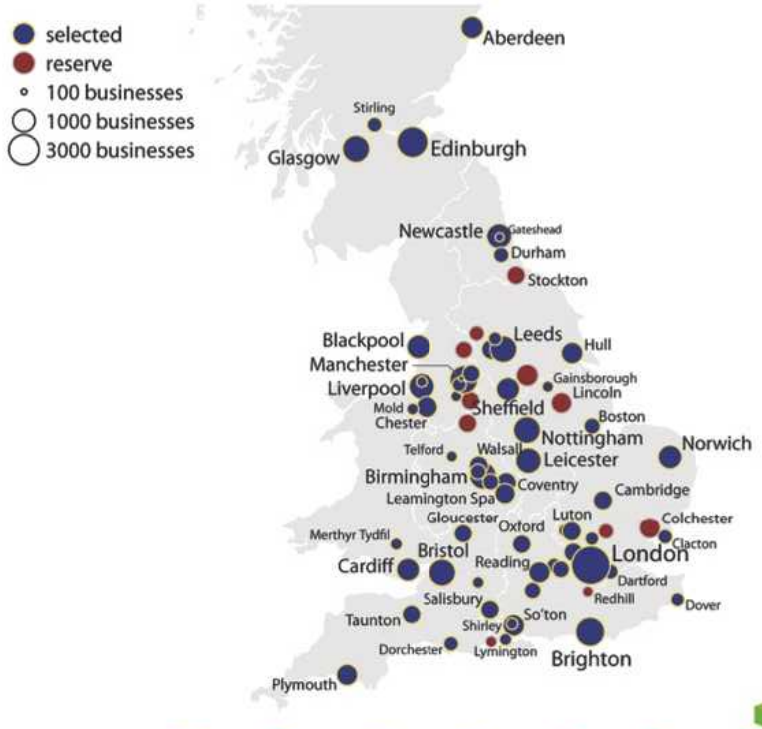
Sample High Streets

total

67.5k businesses

17.5m residents



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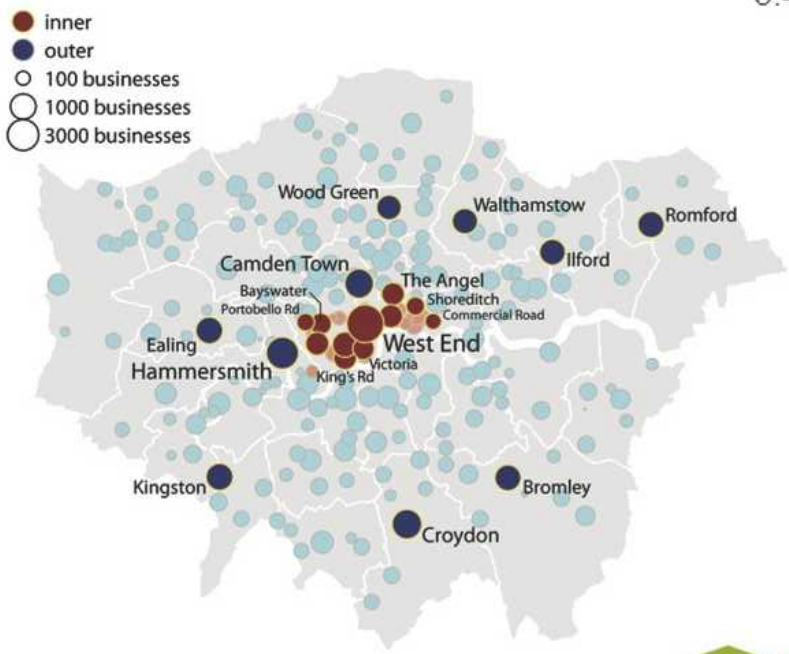
Sample High Streets

total

17.5k businesses

3.4m residents



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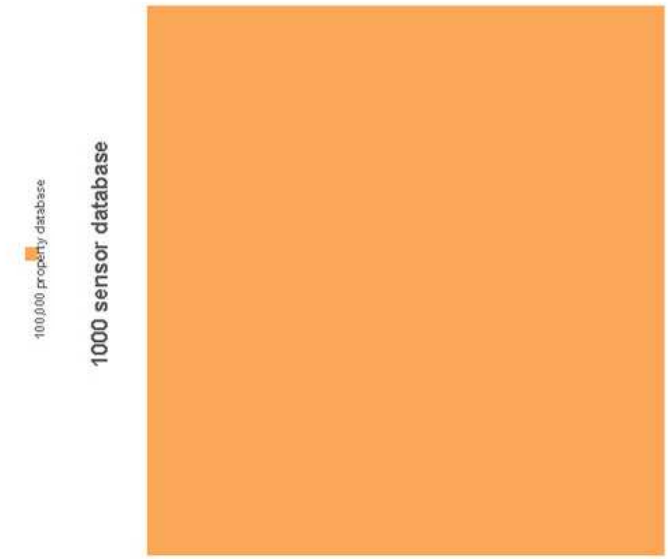
Size of the data

- 1000 sensors generate approximately 1.5 GB of data every day. This equals approximately 5-10m records every day.
- Compared to this, tracking 100,000 properties with 50 parameters updated every month generate 2 GB of data in 10 years.



Comparison of data generated by the sensors to a retail property database in a year

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Complexity of visualisation

- Footfall counts
- Trends
- Hourly footfall
- Hourly trends
- Relationship between the sensors

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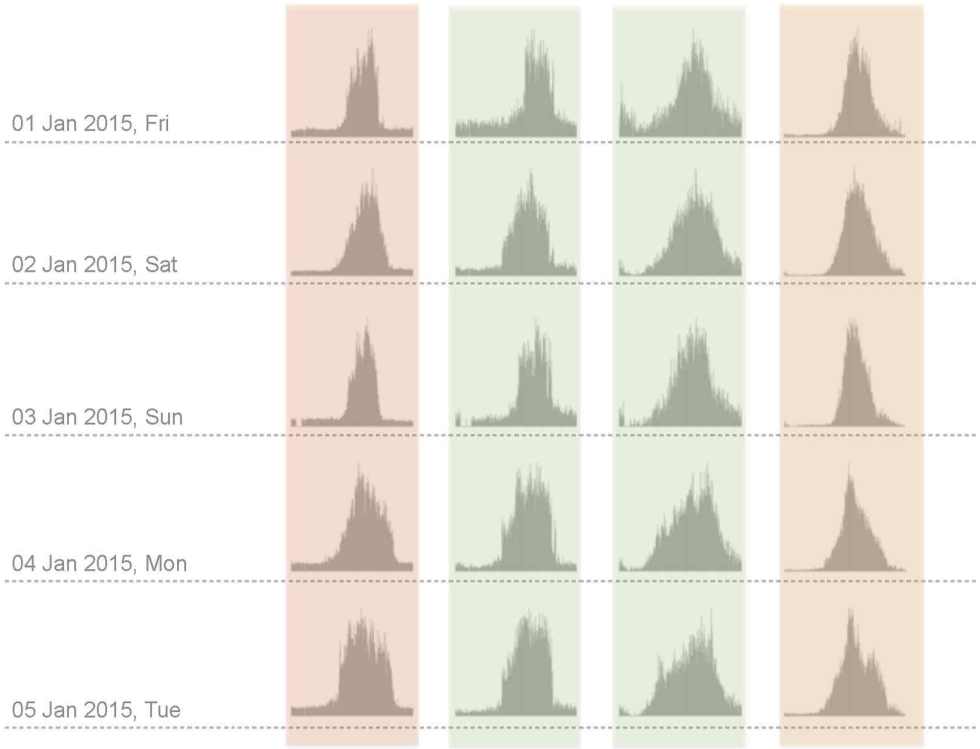
Classification



* from sensors at Market Harborough

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Classification

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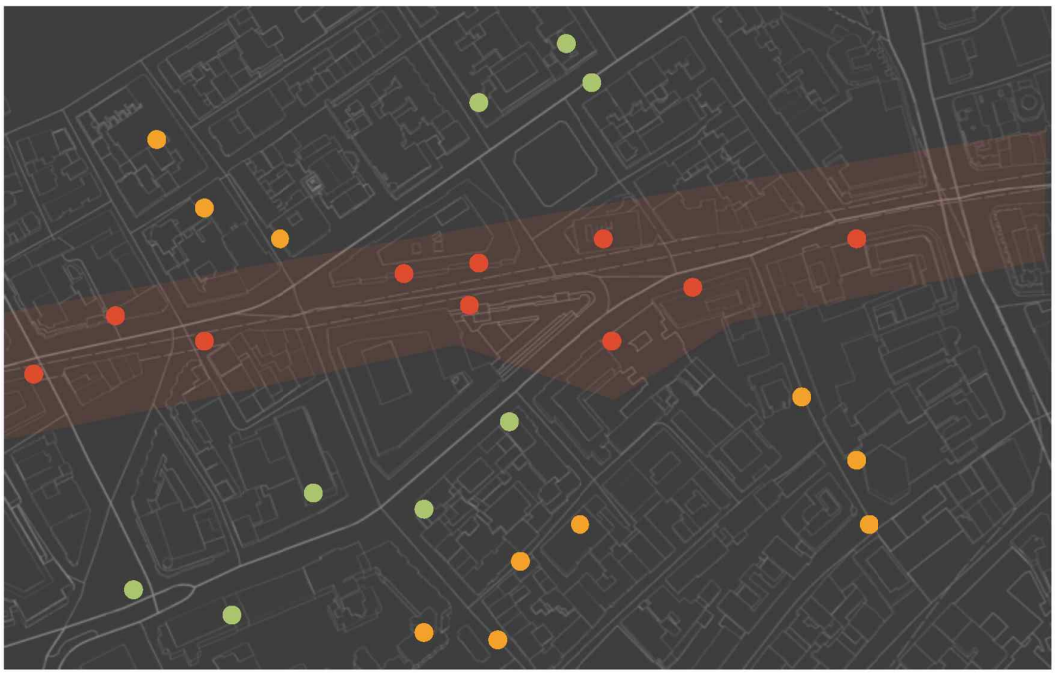
Classification



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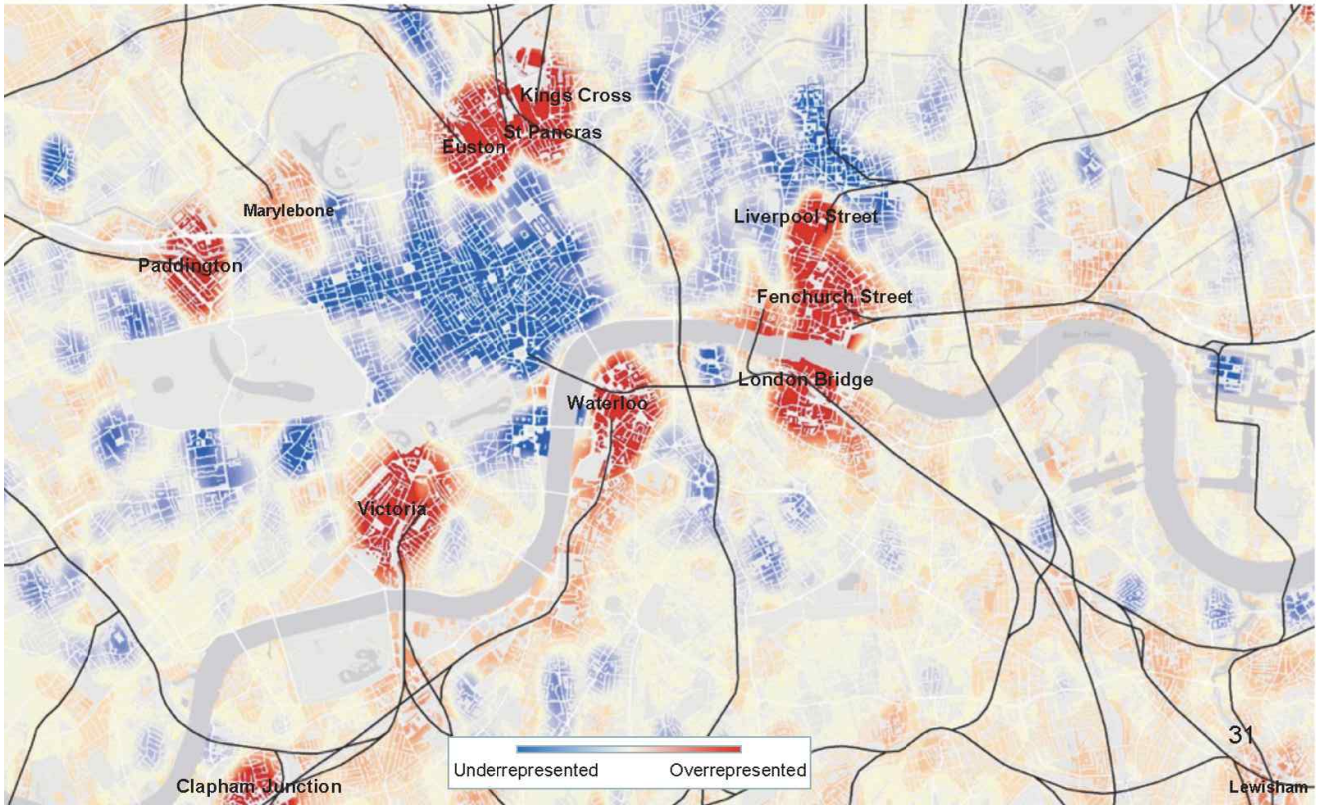
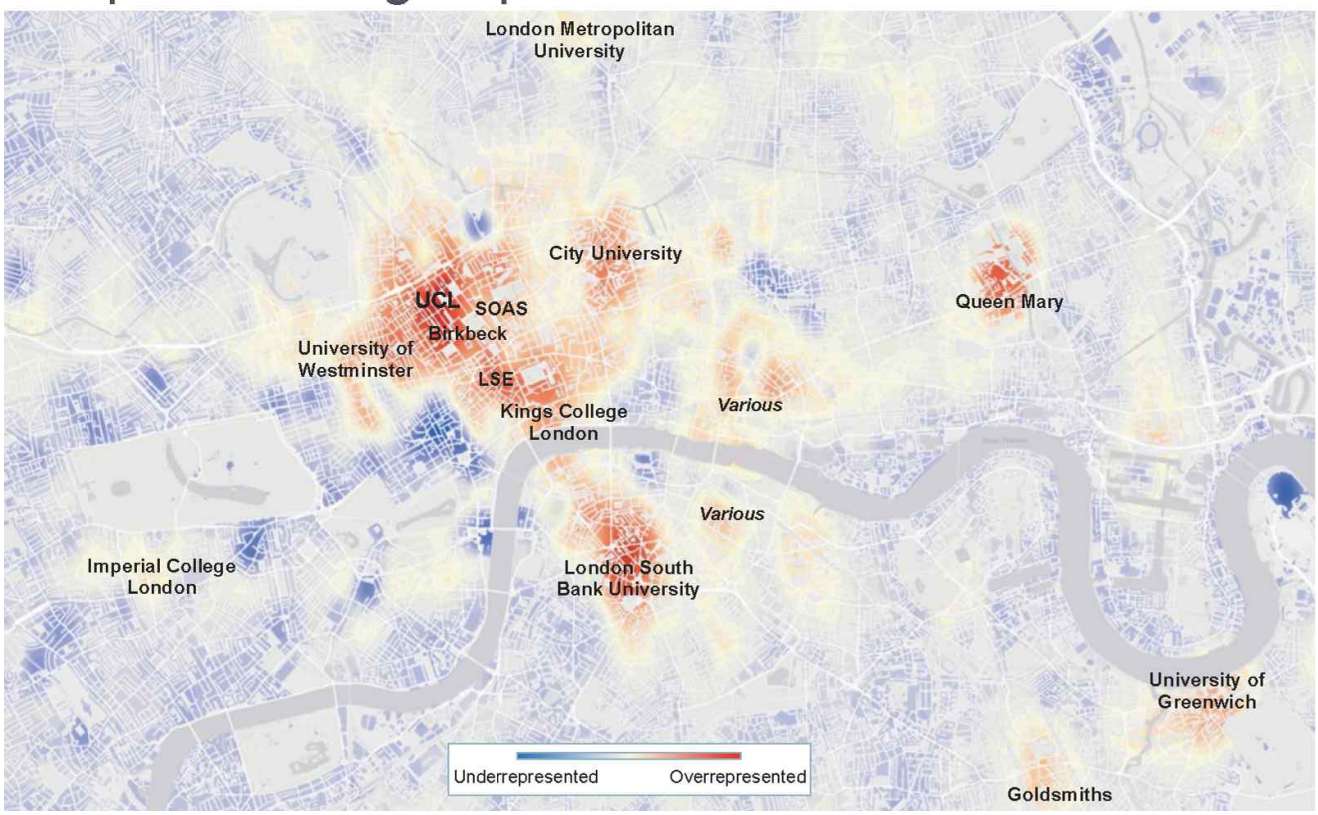
Some prospects

Topic 6 Subgroup B – Trains and Delays



Topic 13 Subgroup D – Education



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Some prospects

- Rethinking 'place' as the **measurable** accumulated effects of slow and fast dynamics

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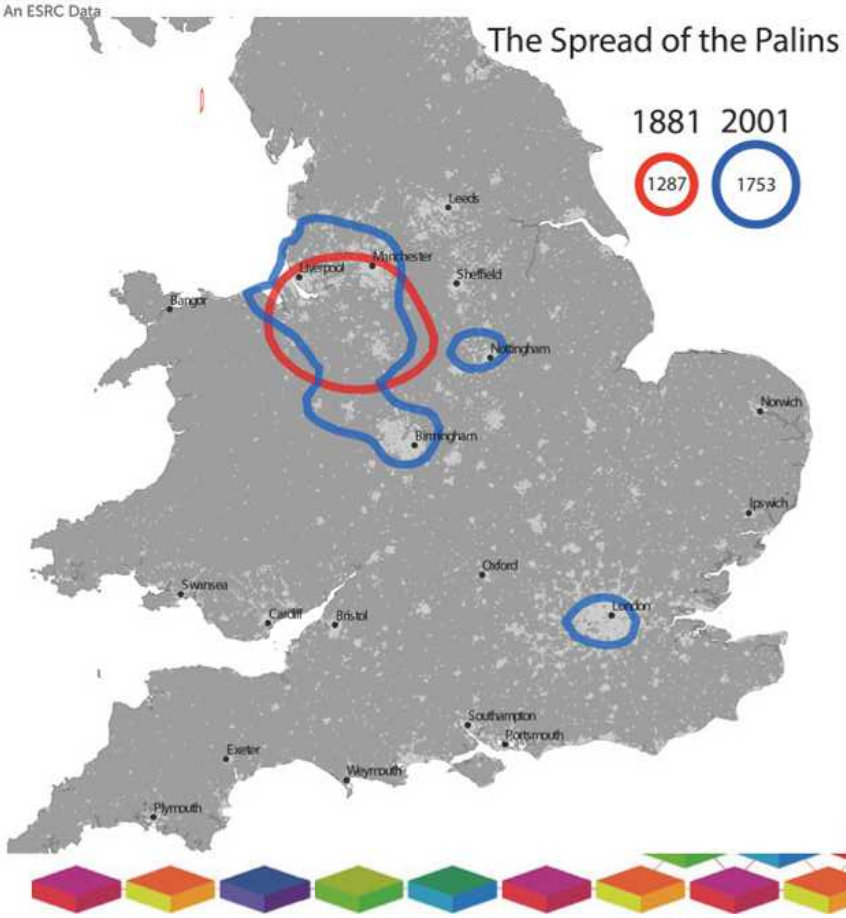

Courtesy: James Cheshire

Consumer Data Research C

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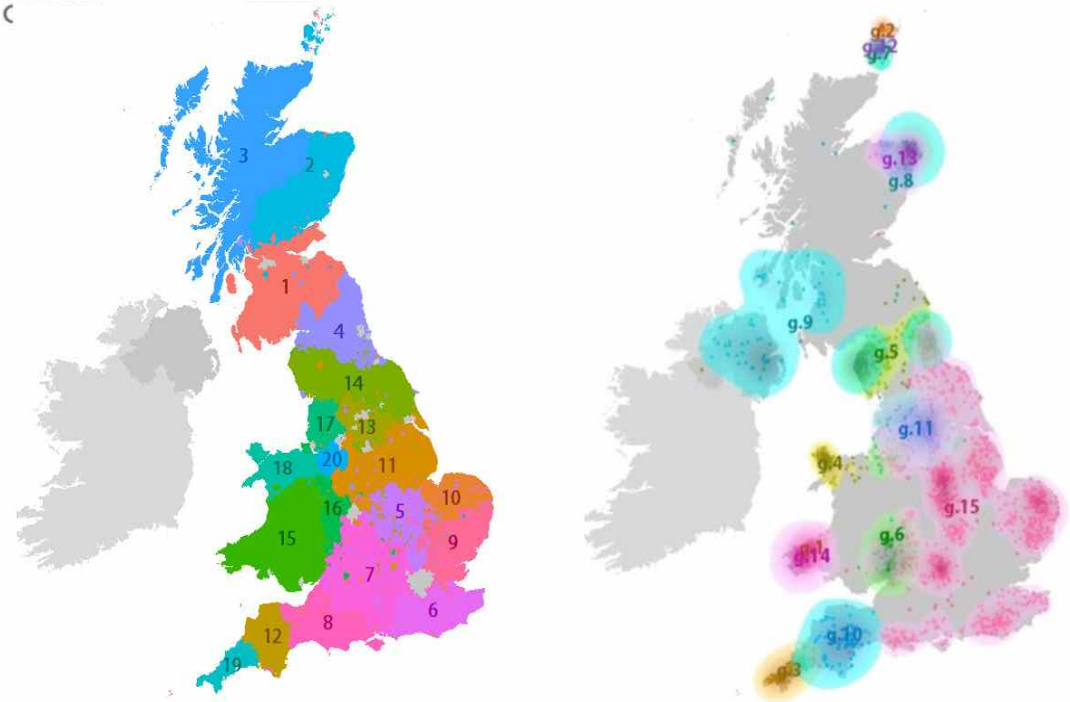


Isonymy groups (left) and the geographic distribution of genotypes (right) [courtesy Jens Kandt]

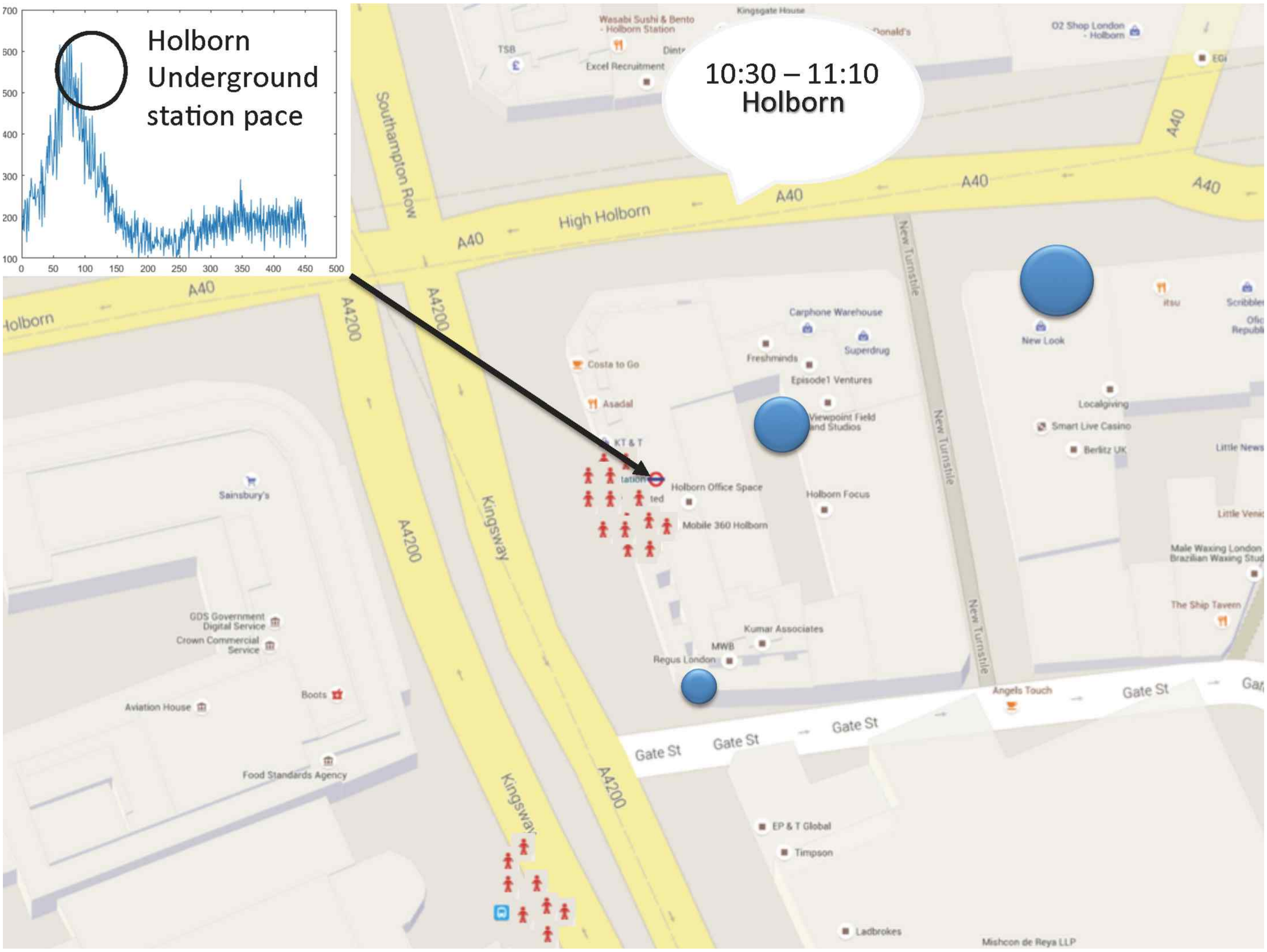
UCL

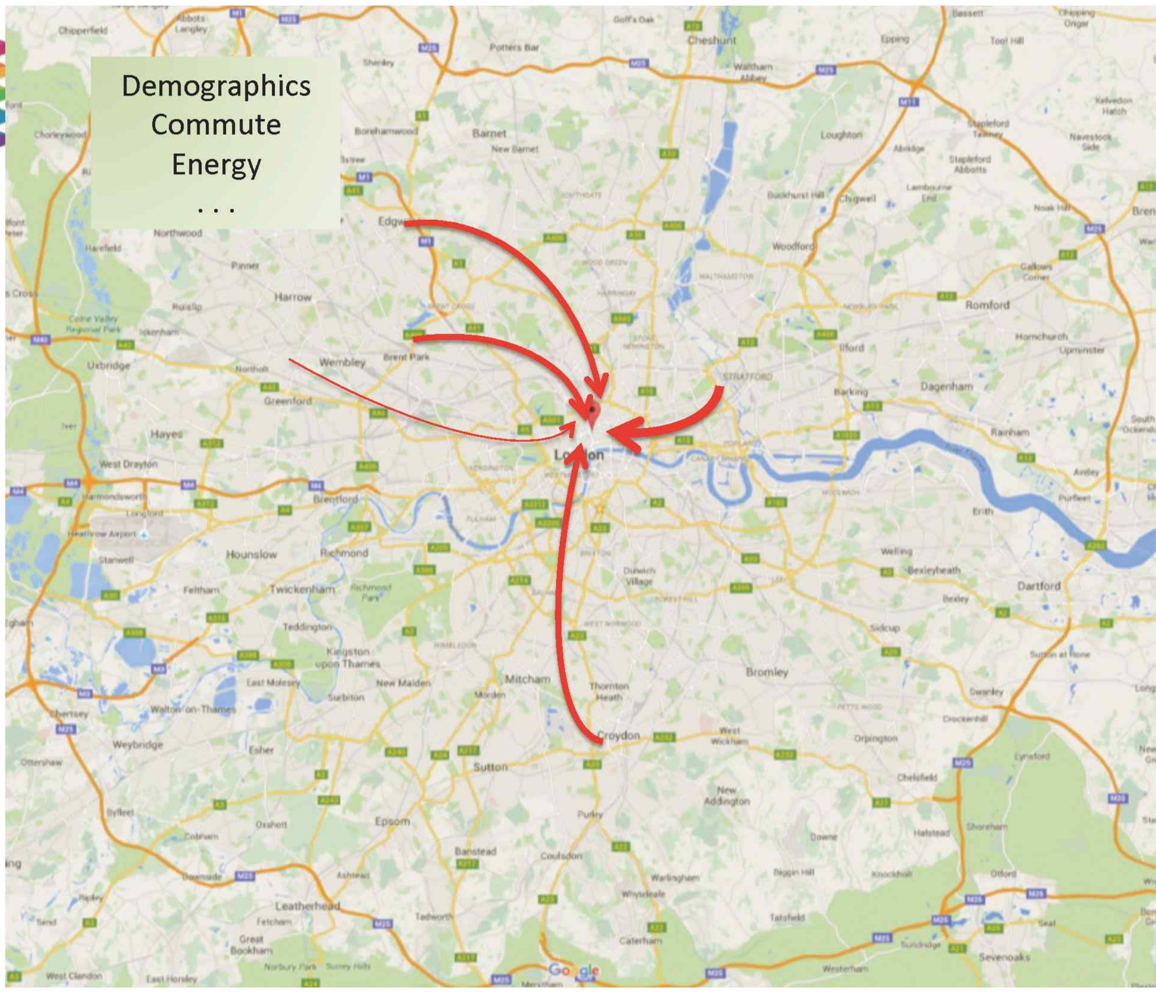
Socio-economics

- There is an association between names and socio-economics and geodemographics
  - E.g. Top 5 forenames for each 2011 OAC Supergroup

Rural Residents	Cosmopolitans	Ethnicity Central	Multicultural Metropolitans
PENELOPE	TOM	MOHAMED	MOHAMMED
HUGH	NICK	AHMED	MUHAMMAD
ALASTAIR	HARRIET	ALI	MOHAMMAD
ROSEMARY	MAX	JOSE	ABDUL
PHILIPPA	ALEX	ABDUL	AHMED
Urbanites	**Suburbanites**	**Constrained City Dwellers**	**Hard-Pressed Living**
TOBY	HILARY	LILLIAN	KAYLEIGH
PHILIPPA	GEOFFREY	MAY	LEANNE
JEREMY	KATHRYN	ETHEL	LYNDSEY
KATHERINE	JILL	KAYLEIGH	STACEY
DUNCAN	GILLIAN	ELSIE	KYLE

Data: 2011 Enhanced Electoral Roll (CACI UK Ltd)


Holborn
Underground
station pace
10:30 – 11:10
Holborn


Demographics
Commute
Energy
. . .

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Some prospects

- Rethinking 'place' as the **measurable** accumulated effects of slow and fast dynamics
- New ways of framing research questions, e.g. segregation, health outcomes

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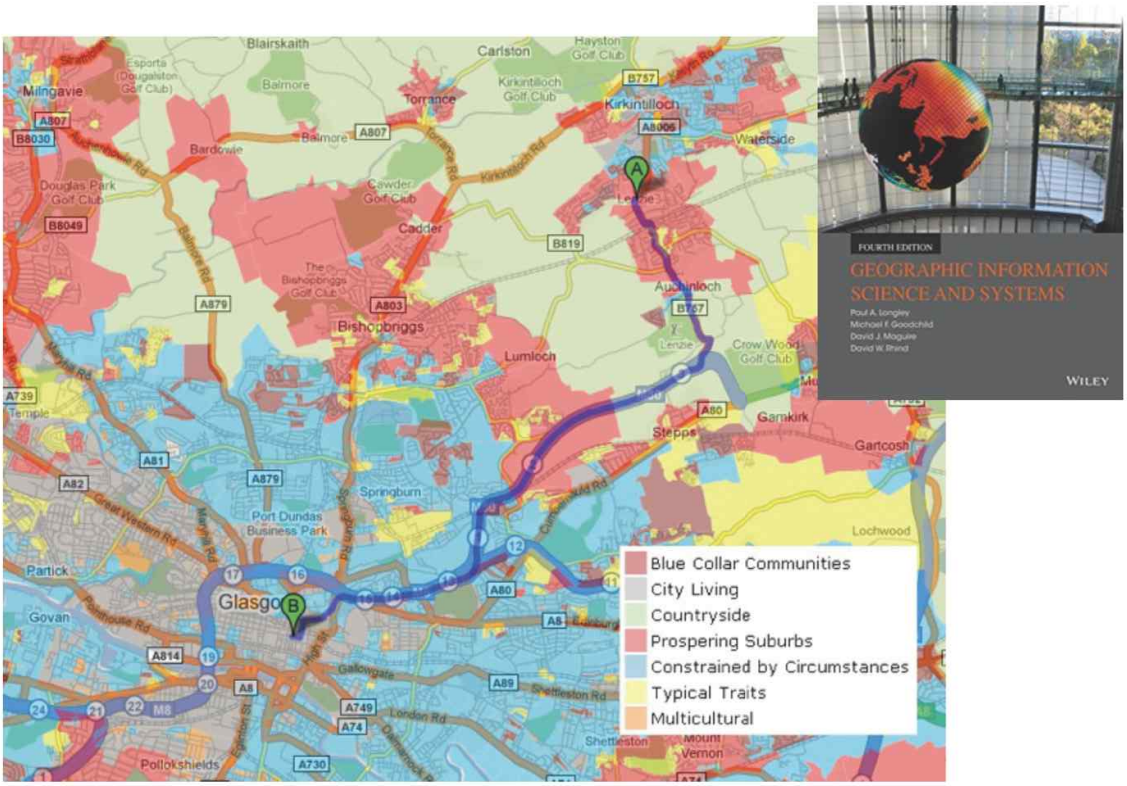

The local geodemography of Glasgow, showing the 7.8 mile route that links communities with life expectancies of 54 and 82 [courtesy Alex Singleton]

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Thank you.

p.longley@ucl.ac.uk

Geo-IoT Trends and Vision in the Future

Steve Liang
liangs@ucalgary.ca
University of Calgary

Abstract

In the near future, millions to billions of small sensors and actuators will be embedded in real-world objects and connected to the Internet forming the Internet of Things (IoT). The basic premise of the IoT is that everyday objects or devices can sense their environment, collect information, and communicate and interact with each other. The changing nature of smart, connected "things" is disrupting value chains and will force organizations to rethink and retool nearly everything they do internally in order to stay competitive. In this talk, Dr. Liang will present his view on the trend and vision of Geo-IoT in the future. Dr. Liang will firstly introduce the Internet of Things from a data perspective, its value chain, its potential applications, its opportunities and challenges, and its vision and trend in the future.

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About Dr. Steve Liang

- Associate Professor, Geomatics Engineering, Uni. Calgary
- AITF-Microsoft Industry Research Chair on Open Sensor Web (2011~2014)
- Chair OGC SensorThings API Standard Working Group
- Rapporteur, ITU-T SG12/11 on Internet of Things Test Specifications
- Founder and CEO, SensorUp Inc
- Calgary's Top 40 Under 40

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Your Shirt

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Your Drink

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Your Parking

Every sensor in the ground is in constant communication with nearby relays.

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Your Baby

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Your Pacifier

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Your Cat Poop

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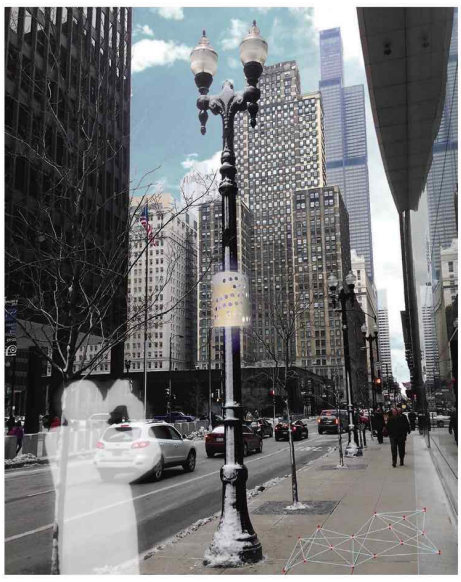
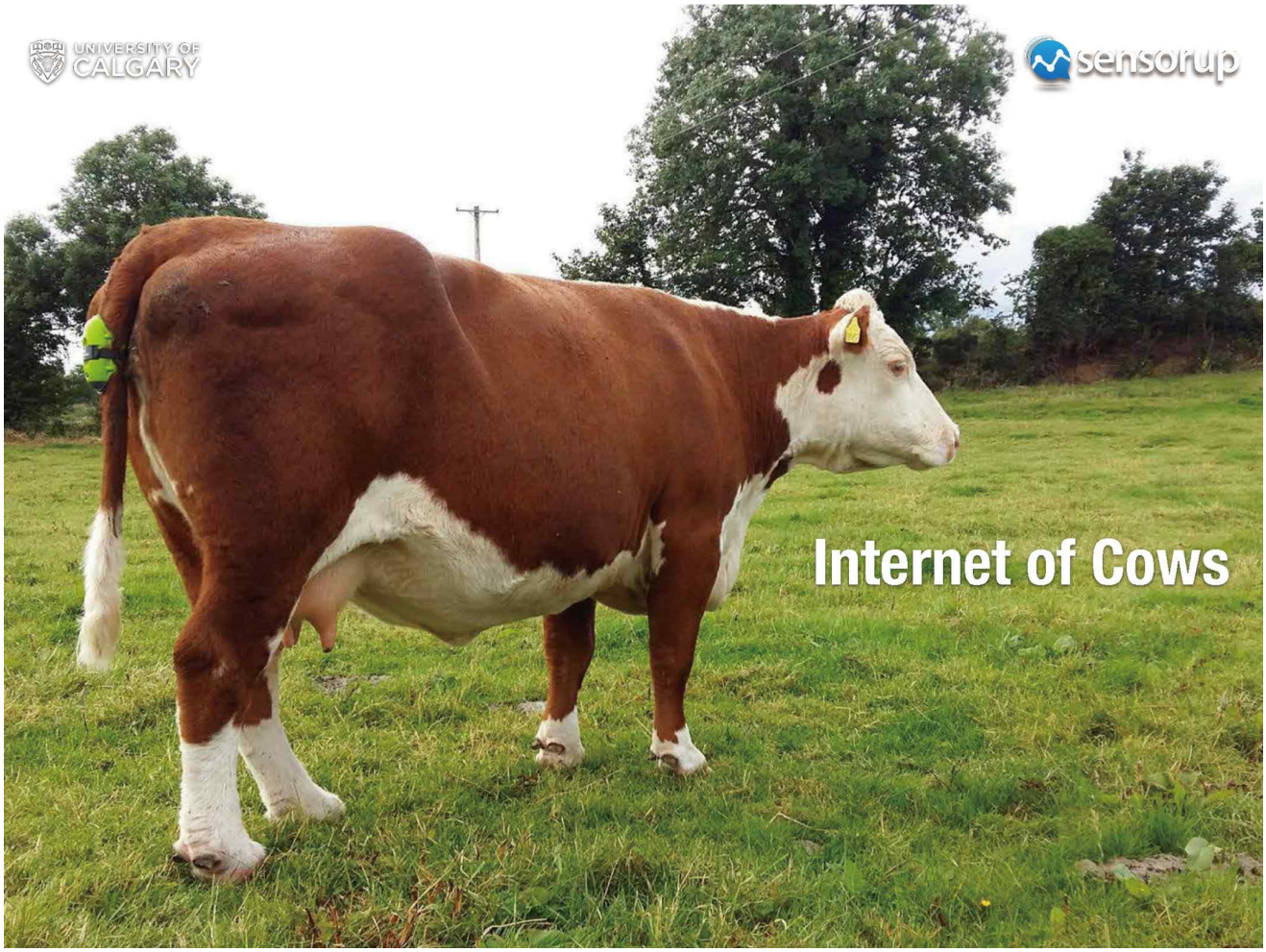
Your Light Posts





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Vision and Trend #1

Everything that can be connected to the Internet will be connected

Dark Assets

13

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Vision and Trend #2

IoT will reveal actionable insights and change the way organizations compete.

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Why Locations matter?

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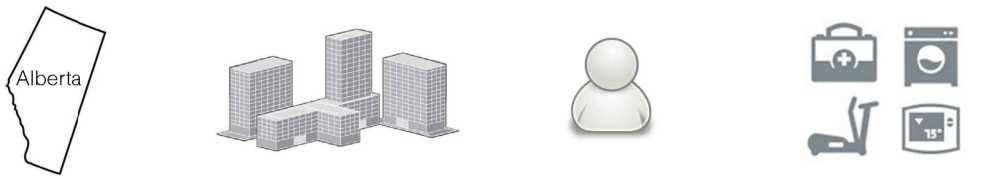
Location technology evolution



Region-Centric Geospatial Information	→	Feature-Centric Geospatial Information	→	Human-Centric Geospatial Information	→	Device-Centric Geospatial Information
1980s		1990s		2000s		2010s

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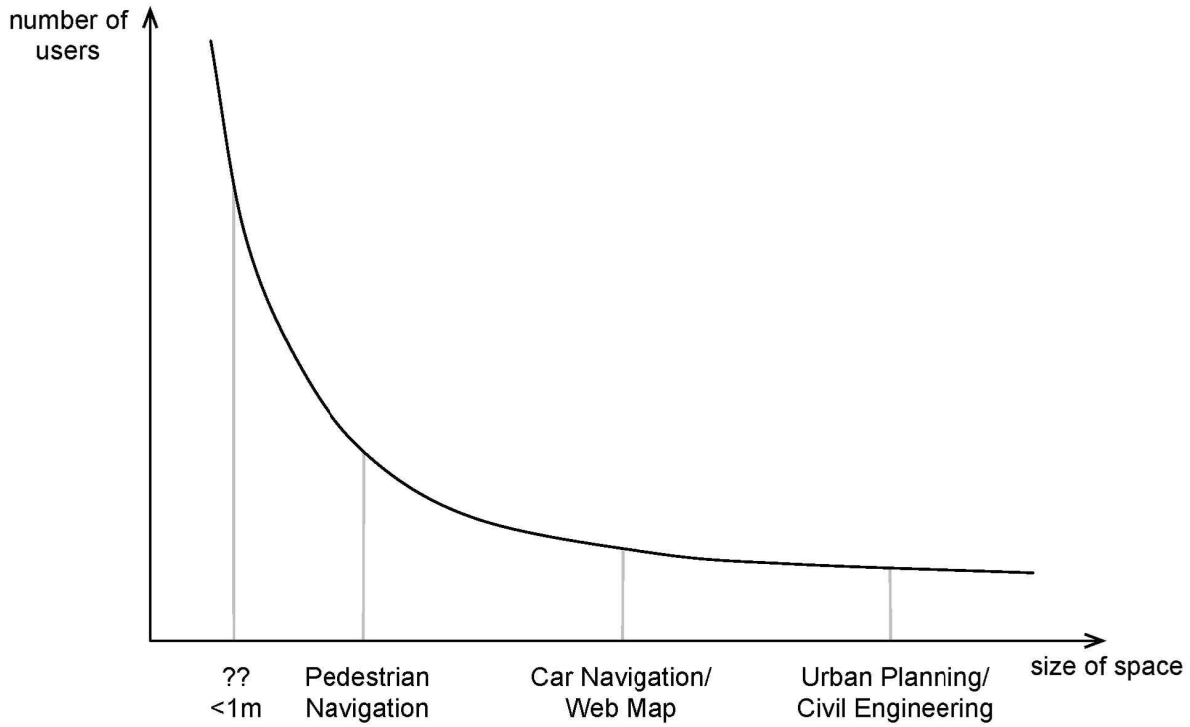
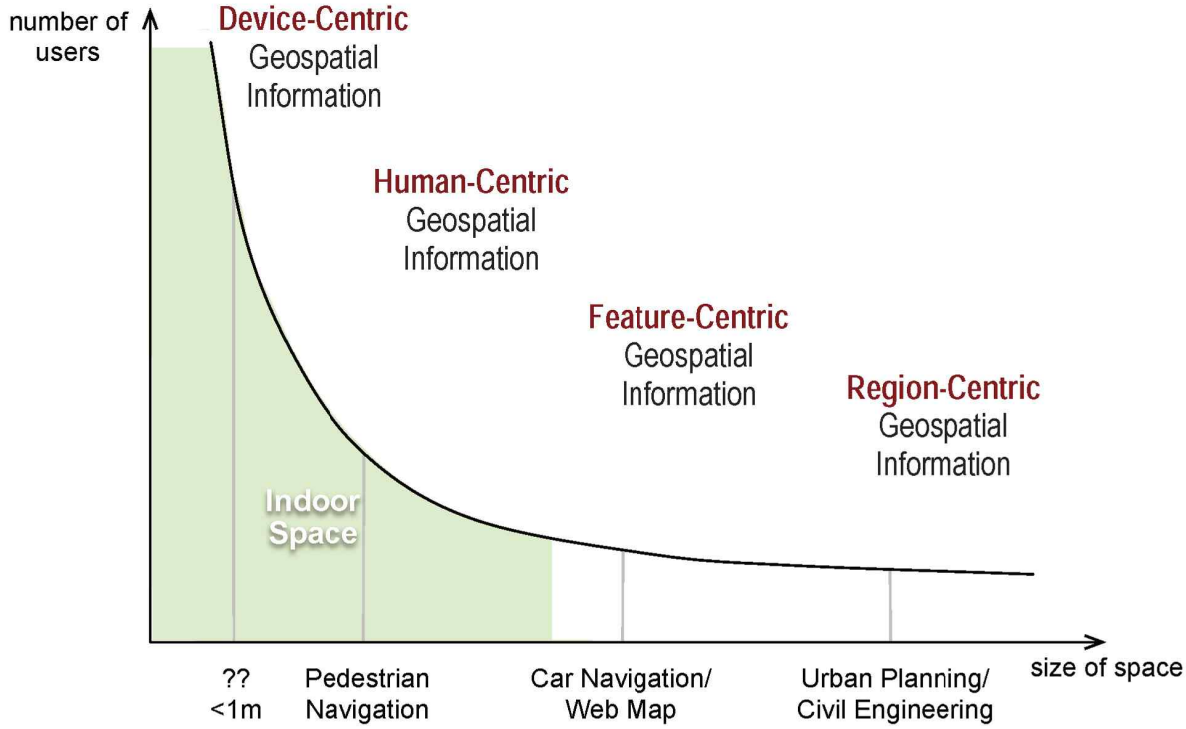
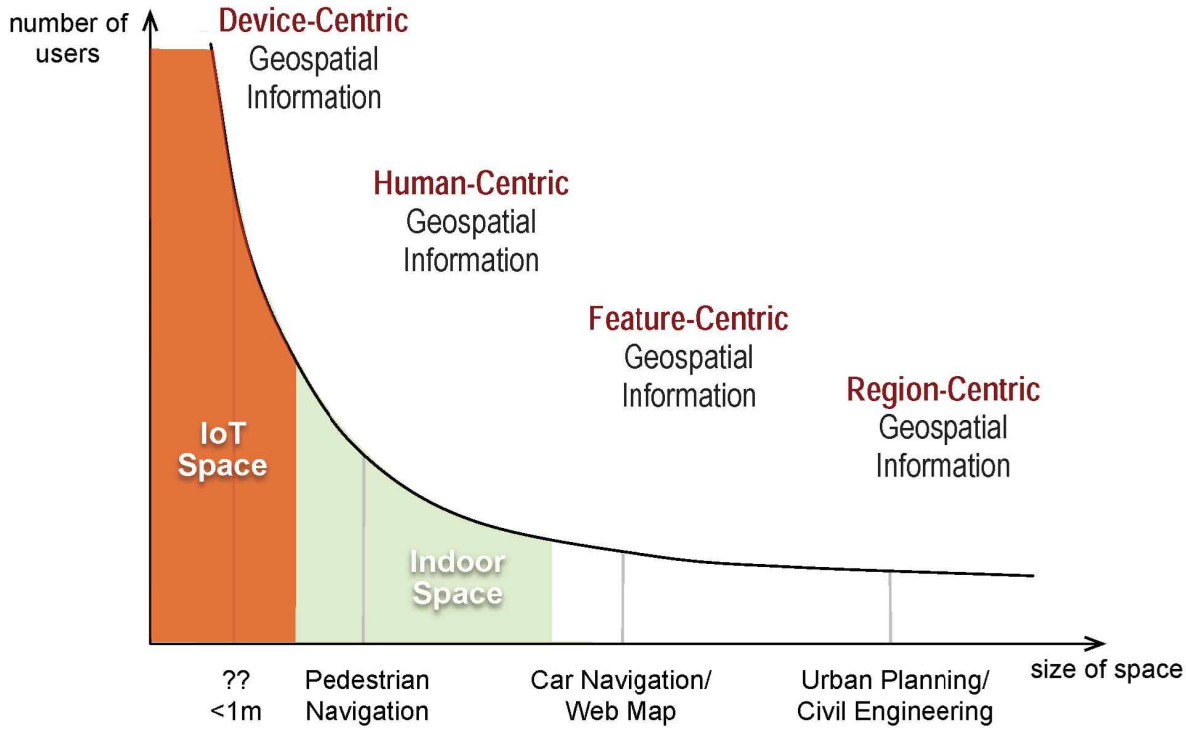



number of users
Device-Centric Geospatial Information
Human-Centric Geospatial Information
Feature-Centric Geospatial Information
Region-Centric Geospatial Information
Indoor Space
size of space
?? <1m
Pedestrian Navigation
Car Navigation/ Web Map
Urban Planning/ Civil Engineering


number of users
Device-Centric Geospatial Information
Human-Centric Geospatial Information
Feature-Centric Geospatial Information
Region-Centric Geospatial Information
IoT Space
Indoor Space
size of space
?? <1m
Pedestrian Navigation
Car Navigation/ Web Map
Urban Planning/ Civil Engineering

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Vision and Trend #3

Location is the first class citizen for IoT

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What can we learn from AOL?

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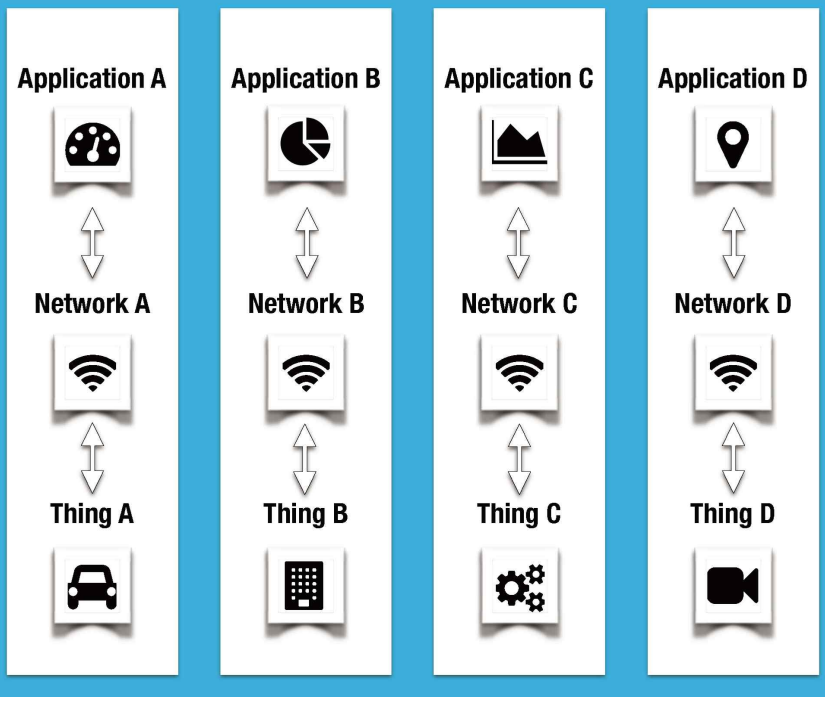
Today's IoT Silos



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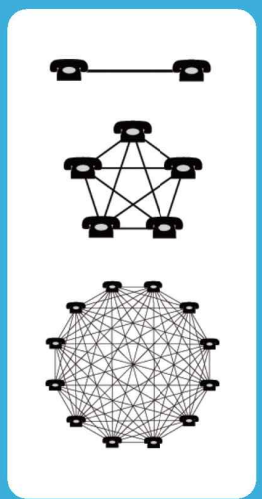
System of Systems

- The real potential of the Internet of Things



Network Effect:
The value of a network is proportional to the square of the number of users of the system (n^2).

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“

*“77% of surveyed IoT experts claimed that **Interoperability** is the biggest challenge currently facing the Internet of Things”*

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“

Which hardware will Google choose to intentionally brick next?

“

the guardian

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What is IoT Interoperability?

- (IEEE) Interoperability is the ability of two or more (IoT) systems or components to ***exchange*** information and to ***use*** the information that has been exchanged.
- (Brodie, 1993) Two components X and Y can interoperate (are interoperable) if X can send requests R for services to Y, based on a ***mutual understanding*** of R by X and Y, and if Y can similarly ***return mutually understandable*** responses S to X.

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Vision and Trend #4

The true value of IoT depends on system of systems

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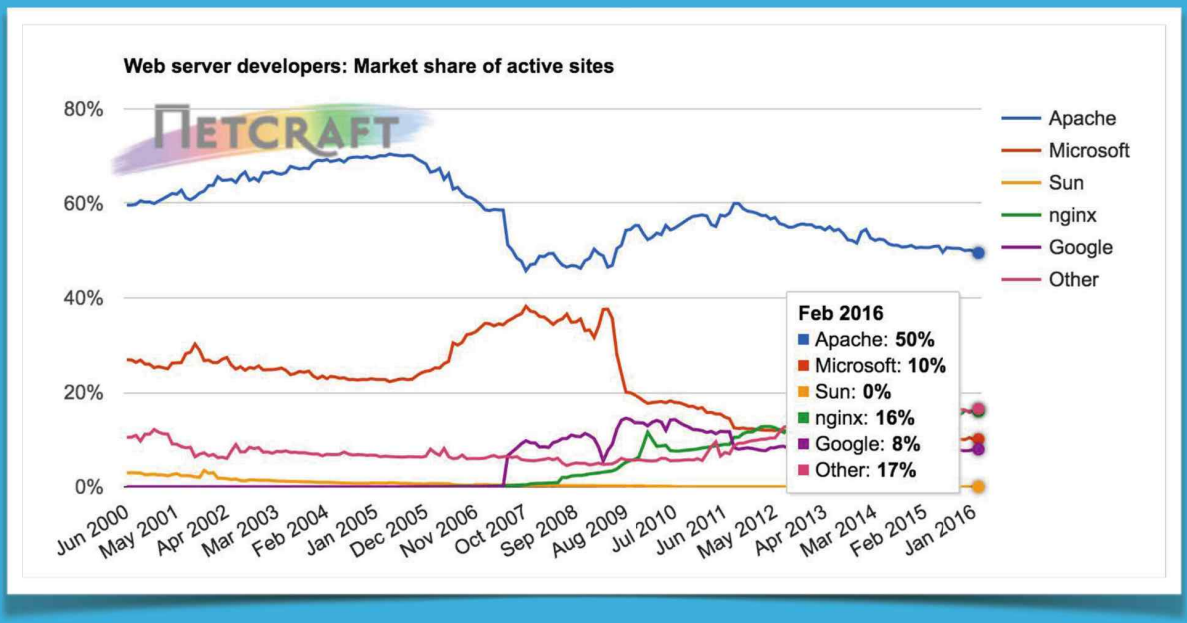
Web Server Market Share



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OSGeo
Your Open Source Compass

OGC®
Making location count.

LocationTech

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Ask your IoT solution provider

- Is your solution Open Standards **Compliance Certified**?
- Open Standards means standards from recognized Standard Development Organizations (SDOs).

OGC® Making location count.

ISO International Organization for Standardization

OASIS

W3C

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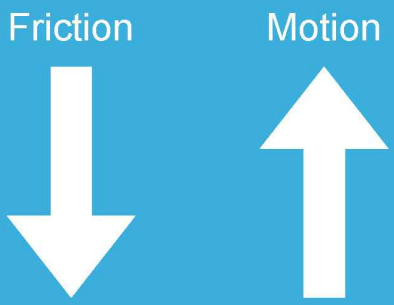
How Smart is Your City?

- depends on how **interconnected** are your systems



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Vision and Trend #5

Open standards and open source will play critical roles to build IoT and smart cities.

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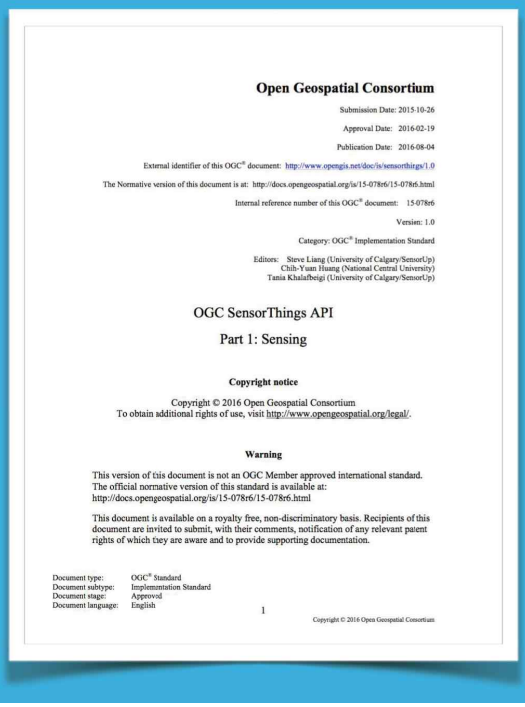
OGC SensorThings API



Open Geospatial Consortium

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Publication Date: 2016-08-04

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Internal reference number of this OGC® document: 15-078r6

Version: 1.0

Category: OGC® Implementation Standard

Editors: Steve Liang (University of Calgary/SensorUp)
Chih-Yuan Huang (National Central University)
Tania Khalafbeigi (University of Calgary/SensorUp)

OGC SensorThings API

Part 1: Sensing

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Document type: OGC® Standard
Document subtype: Implementation Standard
Document stage: Approved
Document language: English

1

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E110
Case Study #1


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heart beat, breathing rate
wearable cam
location, acceleration, headings
equipment status

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OGC Incident Management Information Sharing Internet of Things (IoT) Pilot

IJIS Institute

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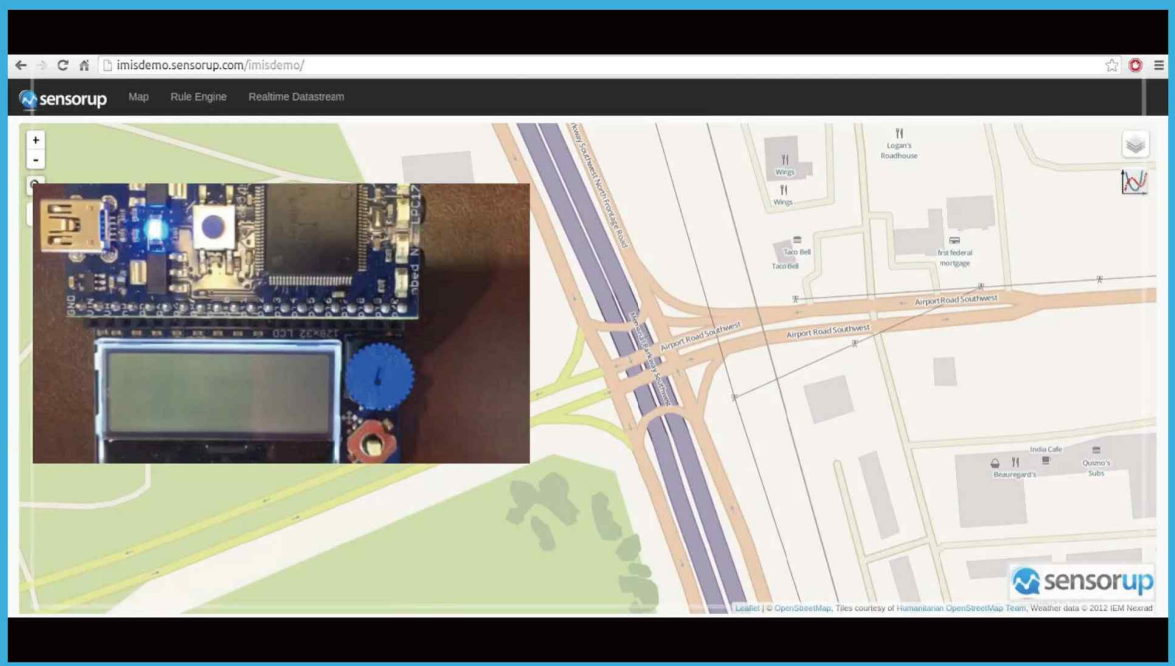
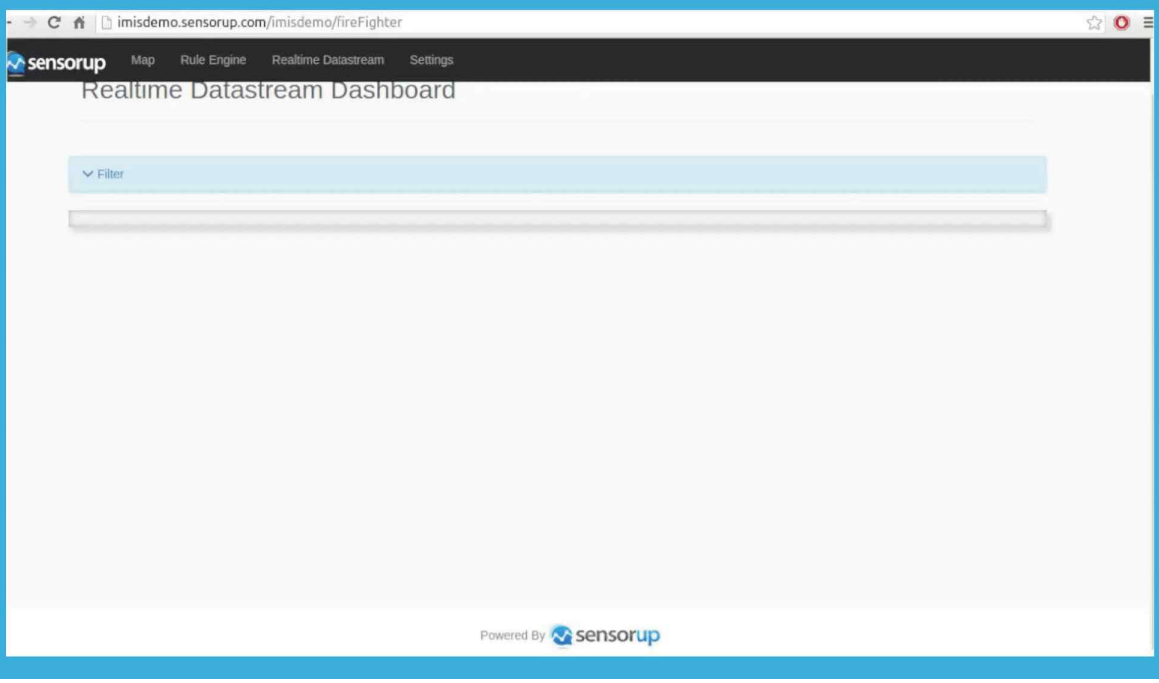
Sensors come online

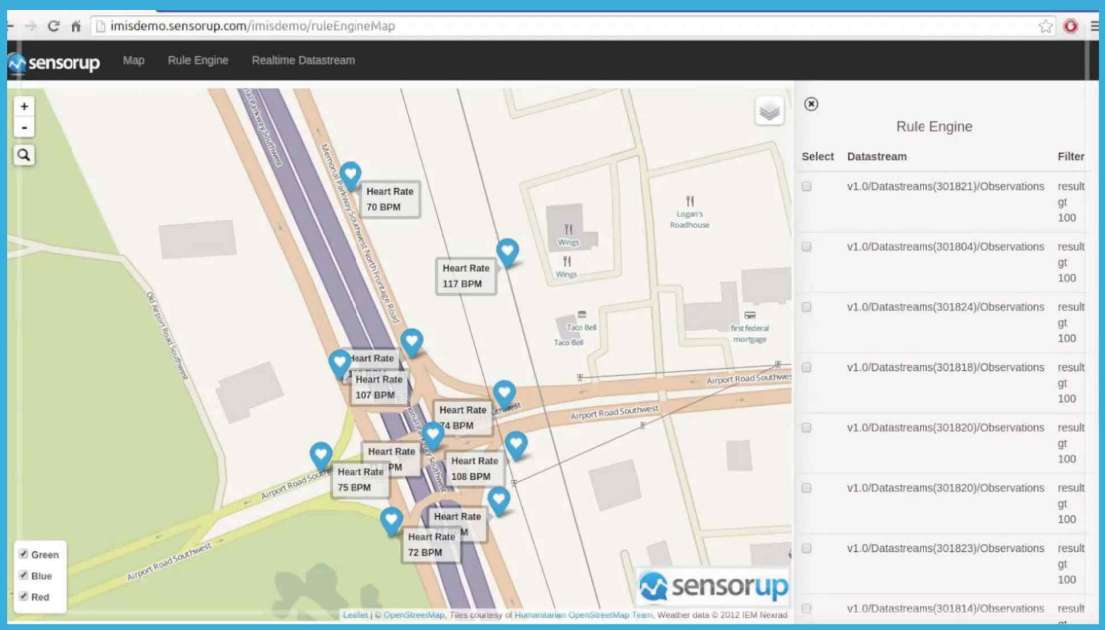


Smart Shirt and Wearable Cam

https://www.youtube.com/watch?v=Xn7FTUs2qOE



Event Notifications



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*“I was impressed with the ‘**state of the practical**’ where these various industry sensors can be integrated today using open standards that remove the stovepipe limitations of one-off technologies.”*

Dr. Reginald Brothers
Under Secretary for Science and Technology

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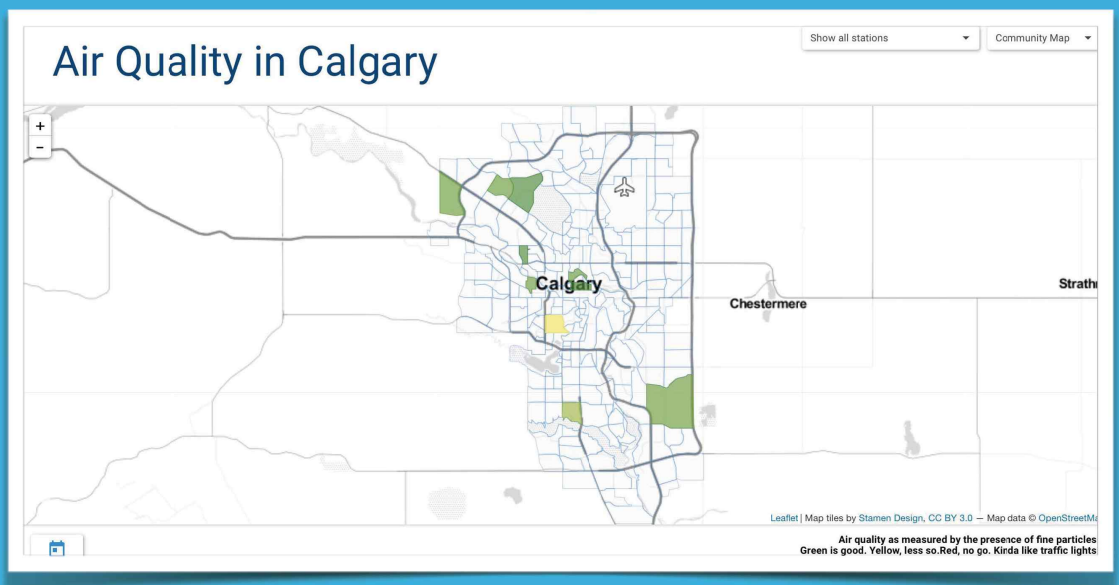
Case Study #2 - Smart Citizens for Smart Cities



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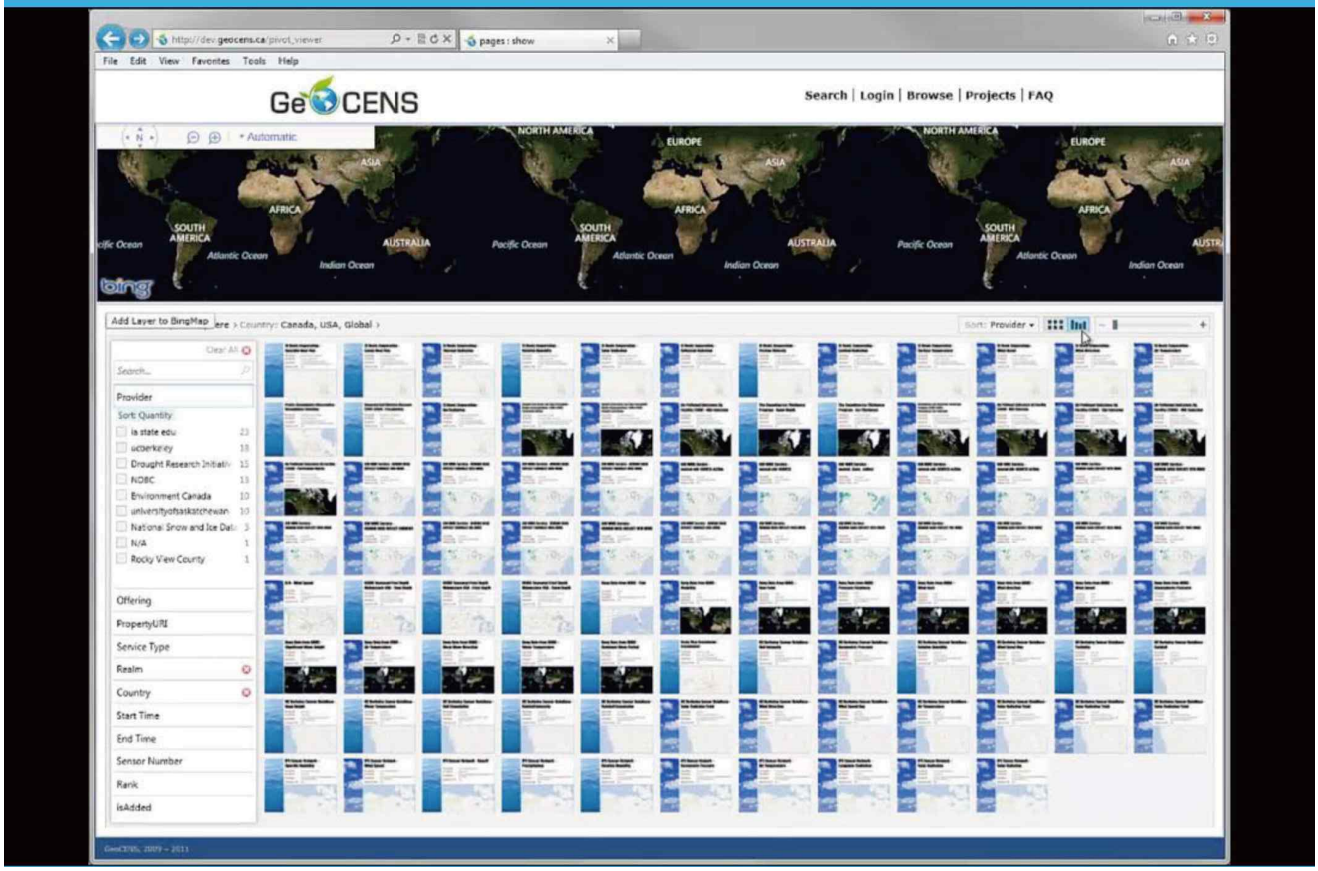

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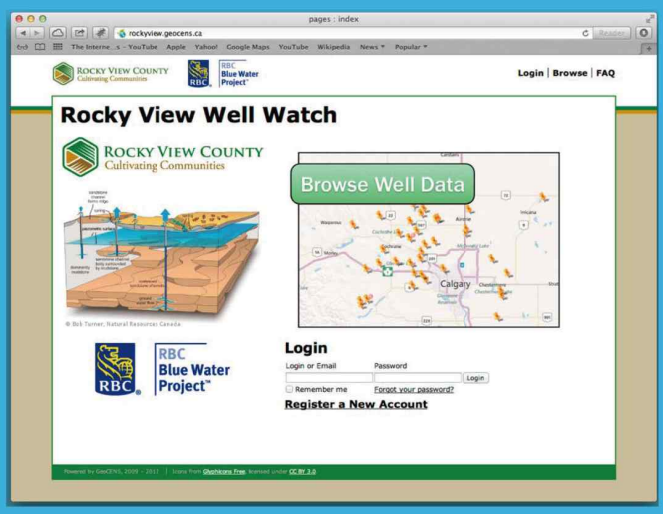
Rockyview WellWatch

- More than 40 participants
- High quality data since 2008



Little, K. E., M. Hayashi, and S. H. L. Liang (2015), "Community-based groundwater monitoring network using a citizen-science approach", Groundwater

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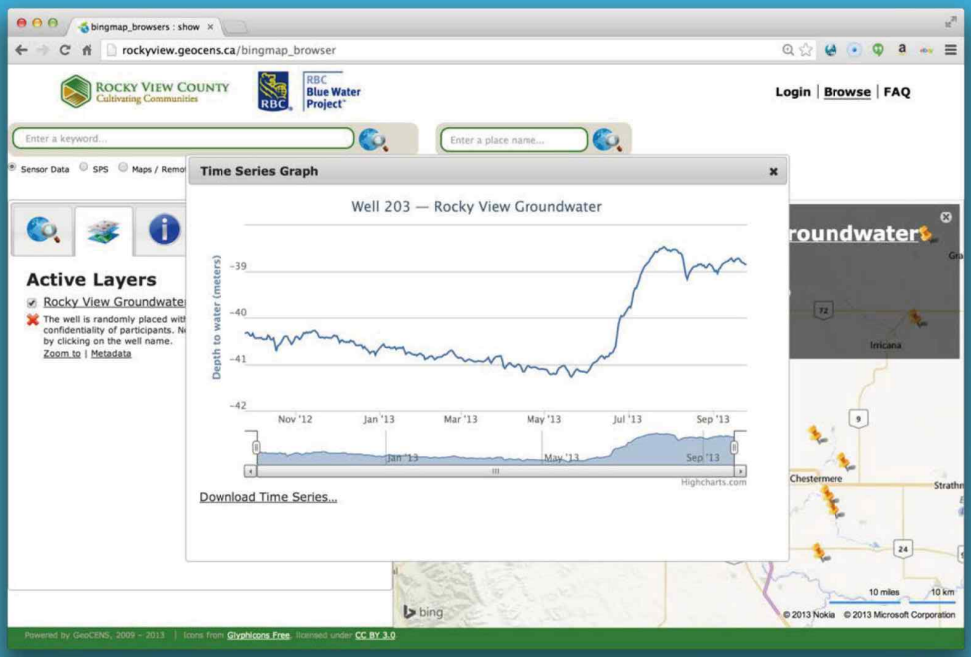
Calgary Flood 2013



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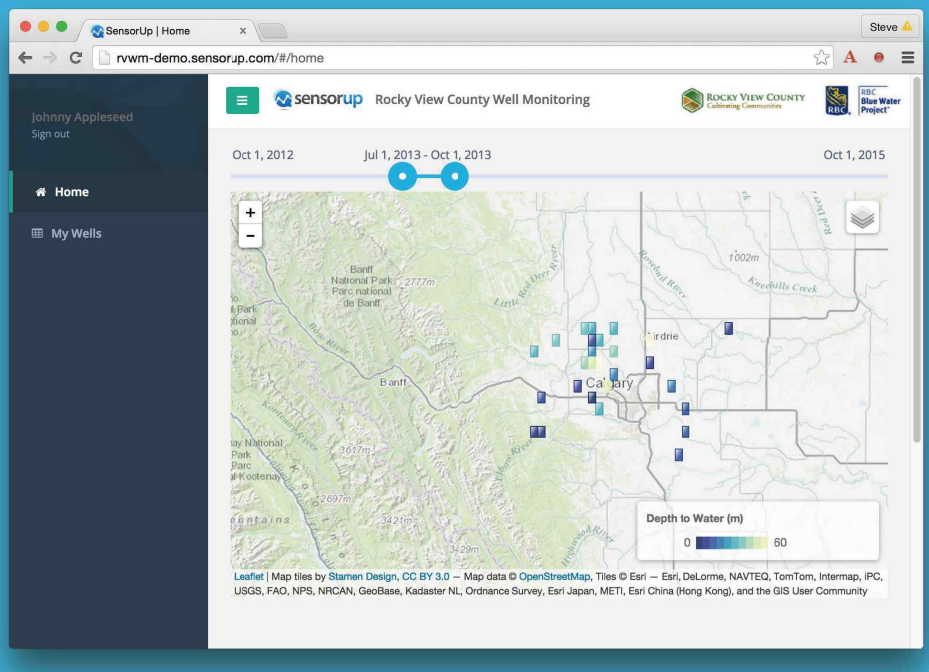
Rockyview WellWatch 2.0



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Conclusions

- IoT is **here** and time to act is **now**.
- What are the **Dark Data** in your organization?
- IoT's real value is **system of systems**.
- Stop building **silos**.
- Ask your IoT solution providers: is your solution open standard **compliance certified**?

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Learn more about OGC SensorThings API

- Youtube - SensorUp Channel
- Our tutorials: http://www.sensorup.com/tutorial/
- GitHub: https://github.com/SensorUp/Webinars
- Our webinars, again, visit SensorUp web site.

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Acknowledgement

Alberta Innovates Technology Futures

ARC-CARC

TECTERRA

Natural Resources Canada | Ressources naturelles Canada

Canada

IoT for Everyone - Building a global sensor network community

Daniel Kastl

daniel.kastl@georepublic.de

Georepublic UG & Georepublic Japan

Abstract

A common definition of Smart Cities is, that "a smart city is an urban development vision to integrate multiple information and communication technology (ICT) and Internet of Things (IoT) solutions in a secure fashion to manage a city's assets"[1]. This is to improve the quality of life in cities, ensure sustainability and guarantee efficiency by using modern information technologies and connected devices.

One key role in this field play sensors. A sensor is an object whose purpose is to detect events or changes in its environment, and then provide a corresponding output[2]. Sensors are one, maybe the most important component, to make a city smart. Sensors provide the senses, that tell how a city feels. They are critical to know and understand the present situation and react accordingly. The collected data builds the basis for improvements.

Since hardware sensors are physical devices, often mounted at specific locations, they have by default a geospatial component. This location information can be added as another attribute to the data collected by a sensor.

While there is not much new about sensors, the average citizen in general only owns one "smart" and "connected" sensor device: the smartphone. Beside that, typical homes and buildings are usually not as "smart" as they could be. The lifetime of city infrastructure, mostly buildings, is rather long. The price for Smart Homes still seems to involve a significant additional cost, so even today new houses are mostly built without the technology that would be available already.

From a citizen perspective everything you love, everything you care about, everything that depends on you is in your home: your family, your children, your pet, everything you work for is at home. Our home is very import for us. It makes us feel safe and relief. But have you thought about, that we spend more than half of our time outside of homes?

Sometimes bad things happen, regardless of what we are trying to prevent. Accidents happen every day, every hour. And there are so many types of accidents. Some you can't really predict and prevent, others you just can't do anything about. But there is one thing you can always do! And that is to KNOW! You can always know what caused an accident.

The question is HOW. And the answer is "with sensors". What if you had a "box", like an airplane's "black box" or a drive recorder, that captures all the type of sensing information you may want to know: air pressure, seismic information, CO and CO2, noise, gas, motion, light, temperature, humidity, location, ...

We have an answer to the issues raised before, and how to provide IoT for everyone: it's a sensor box for your safety, a sensing data recorder for your home (or for any other type of building). It is a single device for a reasonable price,

[1] Wikipedia: https://en.wikipedia.org/wiki/Smart_city

[2] Wikipedia: https://en.wikipedia.org/wiki/Sensor

containing a collection of sensors, that only needs to be switched on and connect to the internet. Collected data is send to the cloud to provide enhanced services, and there will be an option to make this data available as Open Data to the public. Thanks to the rapidly falling prices of sensor hardware, the cost for building IoT devices has become lower year by year. And this trend is likely to continue. This makes it possible to offer products for reasonable prices, that make such technology affordable for everyone.

This project is committed to bring smart sensor technology and IoT services to the 3 billion people, who don't have them. The project uses innovative sensor hardware and next generation network technology to monitor entire homes remotely and address safety and security issues in a user-friendly and visually appealing fashion. Easy to install, easy to use. Put yourself in control of your home, wherever you are, and get informed when something isn’t normal.

But it is even more than that: because once you have one box, and your friends have one, and everyone else has one, this is the basis to build a community. A connected community, that we can really know how the world is and feels like, anytime. You can know if the earthquake near your hometown, you can check the air quality in the area you wanted to move to, and you can know all that because we live in a day of social media, where people like to share such information.

IoT for Everyone

Building a global sensor network community

Georepublic

About me

Geographer, Mapper, Software Developer

Maintainer of the pgRouting Project

Founder of Georepublic

Living in Germany and Japan

Enjoy Open Source FOSS4G and OSM

Recently started an IoT venture

Smart Cities

“A smart city is an urban development vision to integrate multiple information and communication technology (ICT) and Internet of Things (IoT) solutions in a secure fashion to manage a city’s assets”

[Wikipedia: https://en.wikipedia.org/wiki/Smart_city]

Goals

- Quality of life
- Sustainability
- Efficiency

With modern information technologies and connected devices.

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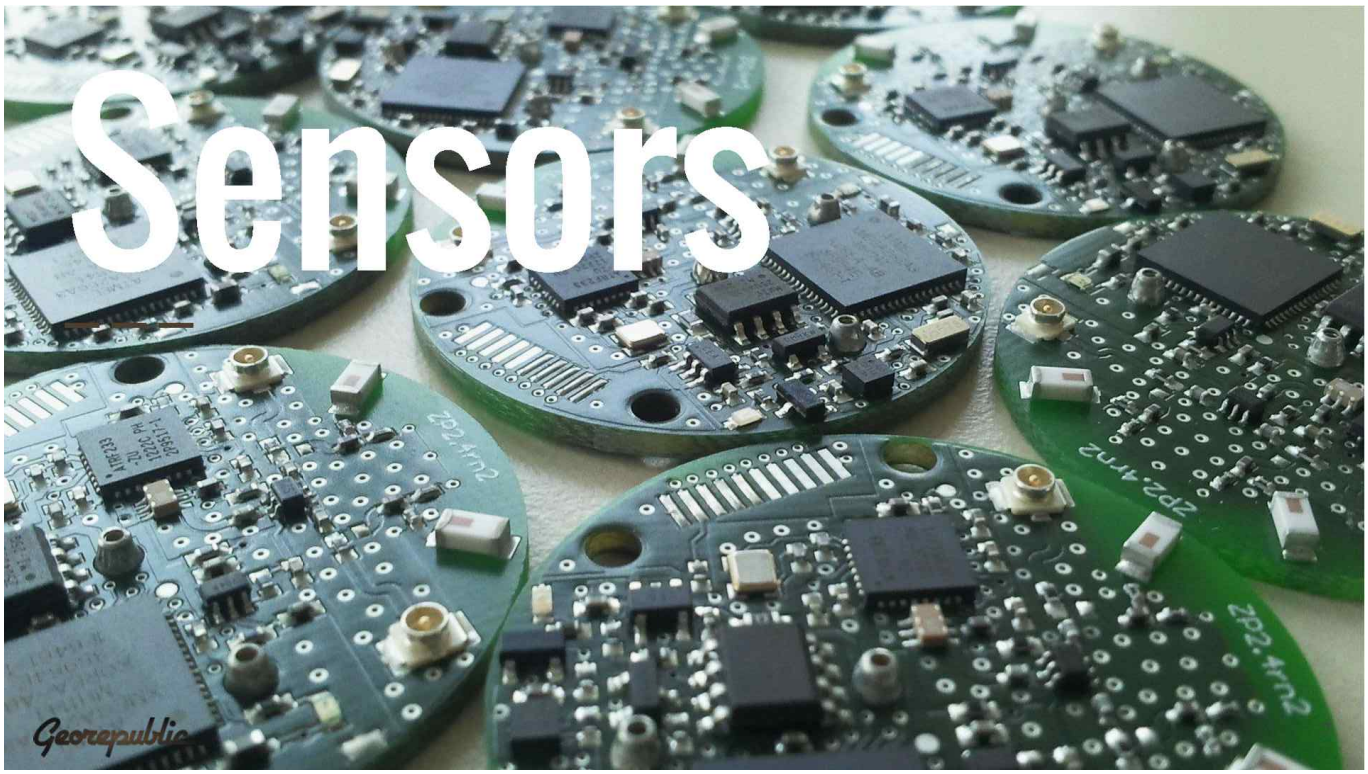
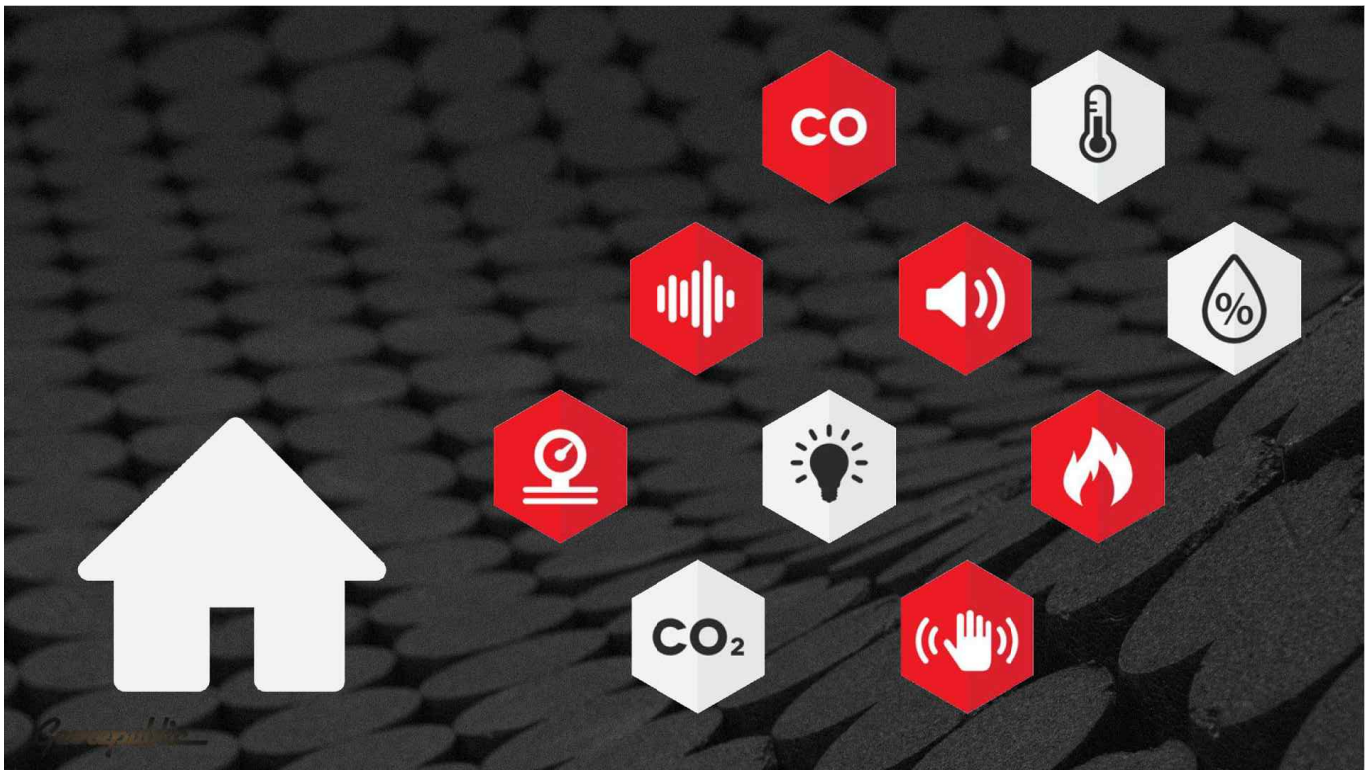


How does my city feel?

"A sensor is an object whose purpose is to detect events or changes in its environment, and then provide a corresponding output."

[Wikipedia: https://en.wikipedia.org/wiki/Smart_city]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あんぜん箱
THE SENSING DATA RECORDER

Sensor Box

- All sensors in a single device:
  Temperature, humidity, motion, light, noise, seismic activity, gas, co2, etc..
- Measure and record just everything you want to know is going on at home.
- Easy to setup and easy to use.
- “Black Box” recorder

14 bn Connected Devices I Bosch SI

50 bn Connected Devices I Cisco

309 bn IoT Supplier Revenue I Gartner

1.9 tn IoT Economic Value Add I Gartner

7.1 tn IoT Solutions Revenue I IDC

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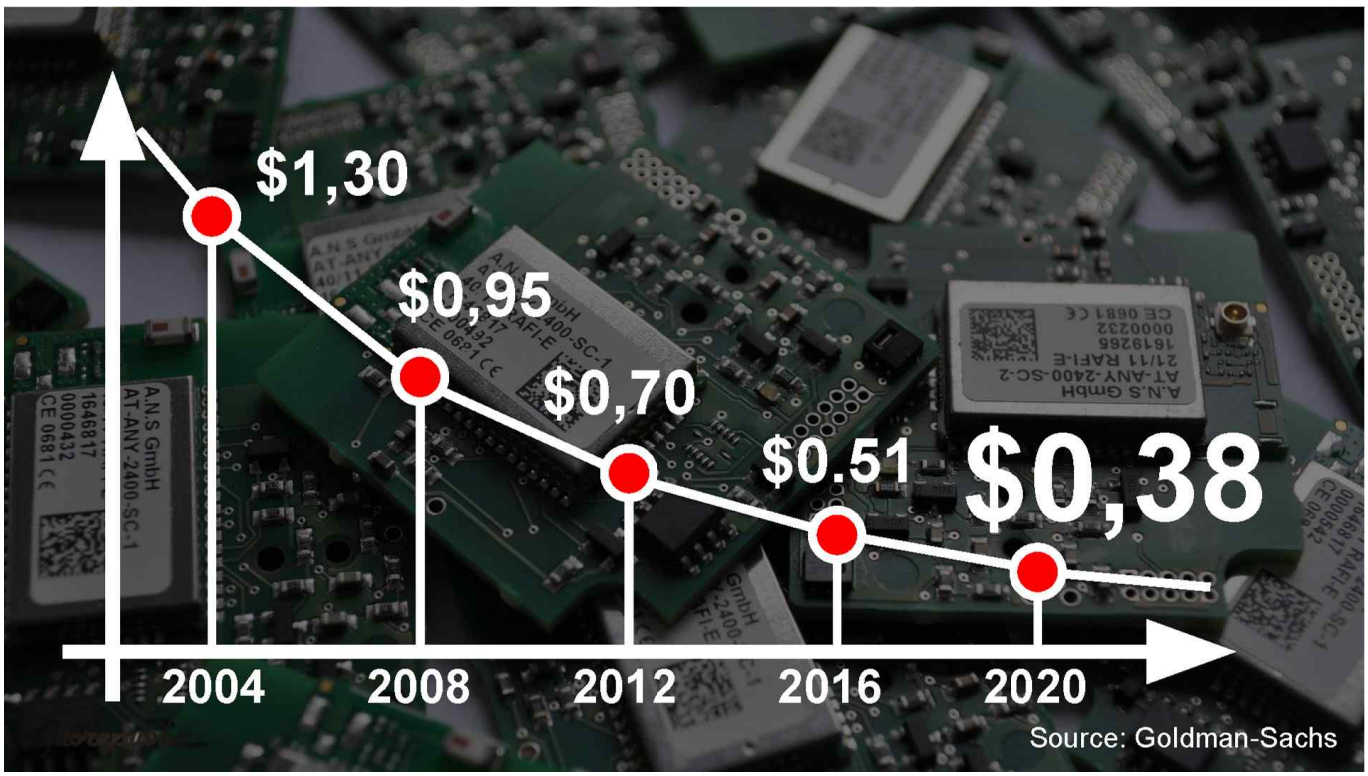
Peter Middleton, Gartner:
By 2020, component costs will have come down to the point that connectivity will become a standard feature, even for processors costing less than

$1

13



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CLOUD CHRONICLES

By Brandon Butler | Follow

About

Cloud Chronicles is written by Network World Senior Writer Brandon Butler, who tracks the ins and outs of the cloud computing industry.

OPINION

Google: The cost of hardware is falling at a faster rate than the price of cloud

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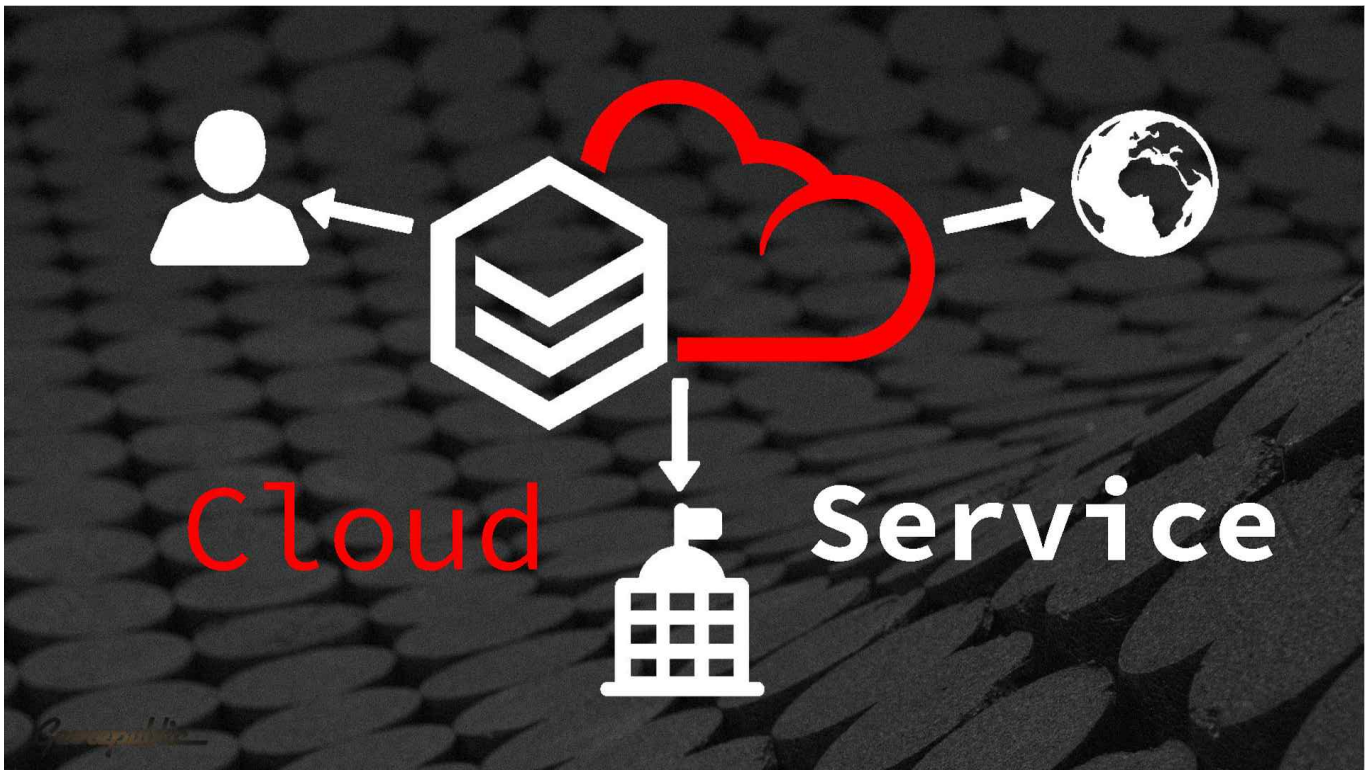
Connectivity

- Smart sensor network technology
- Connectivity is the key to get the most of your data.
- Notifications
- Sharing information with your community.
- IoT for your home and for the public!



Open Data

With Open API access.

500 Sensors

- “Smart City Kit”
- Big corporations
- Government bodies
- Sponsors
- Partners

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Interested?

Project: https://anzenbako.net

Website: https://georepublic.info

Email: daniel@georepublic.de

Thank you!

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Policy Direction of Spatial Information for Hyper-connected Society

Hosang Sakong
hssa@krihs.re.kr
Korea Research Institute for Human Settlements(KRIHS)

Abstract

Due to the Internet of Things (IoT) technology, our society is rapidly transitioning from the digital society to the hyper-connected society. Gartner, Inc. forecasts that 6.4 billion connected things will be in use worldwide in 2016, up 30 percent from 2015, and will reach 20.8 billion by 2020. In 2016, 5.5 million new things are connected every day.

The fourth industrial revolution discussed at Davos Forum 2016 is the convergence industry based on the IoT technologies. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. Fourth industry is expected to lead to a new industrial revolution, the ruling system, and the way of life through the application of artificial intelligence robots, IoT, mobile, 3D printer, self-driving car, and nano-biotechnology.

Proactive policies and strategies are needed to cope with the core technology, IoT for the hyper-connected society. To create new job and new service through the IoT, Ministry of Science, ICT and future planning (MSIFP), Ministry of Trade, Industry and Energy are pursuing IoT policy. In order to respond effectively to hyper-connected society the MSIFP has been announced the "Master Plan for Building the Internet of Things" in May 2014. Governments must invest in the IoT technologies such as network, sensor, user interface, and service platform in order to develop the IoT infrastructure. In addition, it is also urgent to develop the technologies and policies related to the IoT such as artificial intelligence, virtual reality, and spatial context awareness.

Spatial information is closely related to the IoT because all things are located in somewhere. Users can obtain a more accurate and detailed information through the integration between a sensed data and the spatial information. Positions of all objects can be displayed on the map. Thus the spatial data is very important for the IoT services. The advanced spatial information, the high-accuracy location information, indoor positioning system, three-dimensional map are required. These spatial information are used in the various industry and services such as self-driving car, smart home, smart building, smart city, drones, and robots.

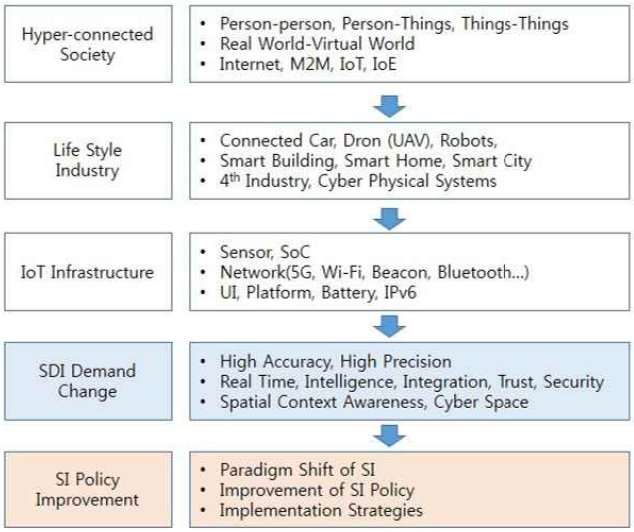
It needs to analyze the demand and utilization of spatial information technology changes are expected in the hyper-connected society. Based on this, we need to seek the spatial information policy that can effectively respond to the environments caused by IoT.

Policy Direction of Spatial Information for Hyper-connected Society

Sakong, Hosang
Korea Research Institute for Human Settlements(KRIHS)
hssa@krihs.re.kr

I. IoT meets Spatial Information

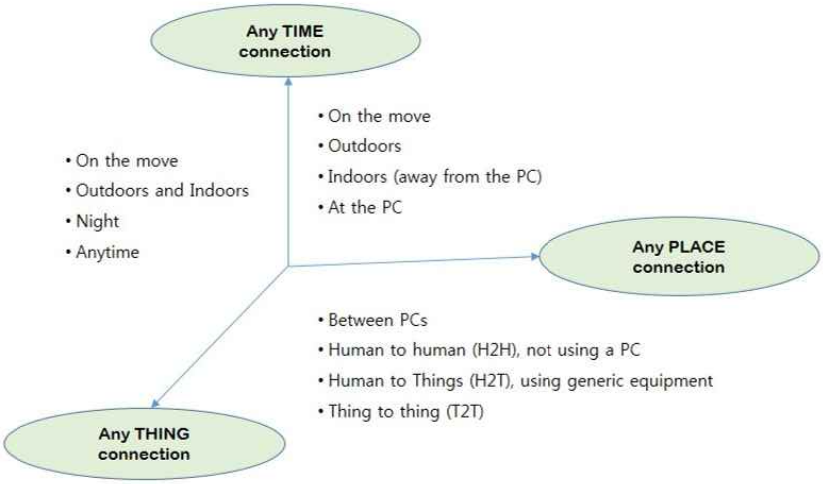
❖ Background of SI policy change



❖ What needs to be understood?

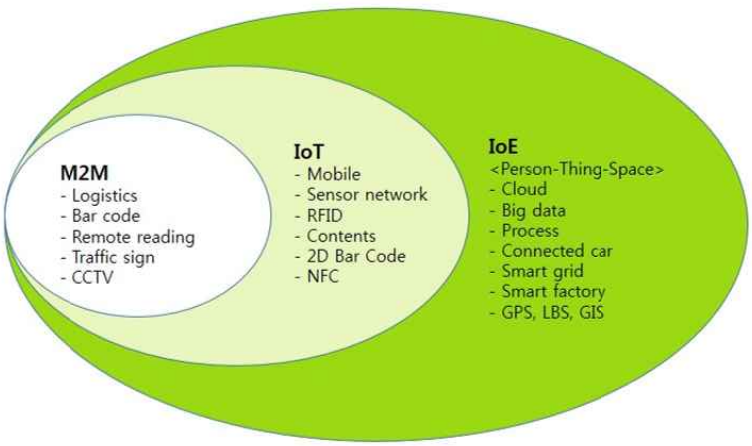
- Analysis of a relationship between spatial information and IoT leading 'Hyper-connected Society'
- Formulation of a concept of IoT based on spatial information (Geo-IoT)
- Analysis of characteristics and demand changes of spatial information expected in the 'Hyper-connected Society'
- Exploration of spatial information policy options for the 'Hyper-connected Society'

❖ Concept of 'Hyper-connected Society'

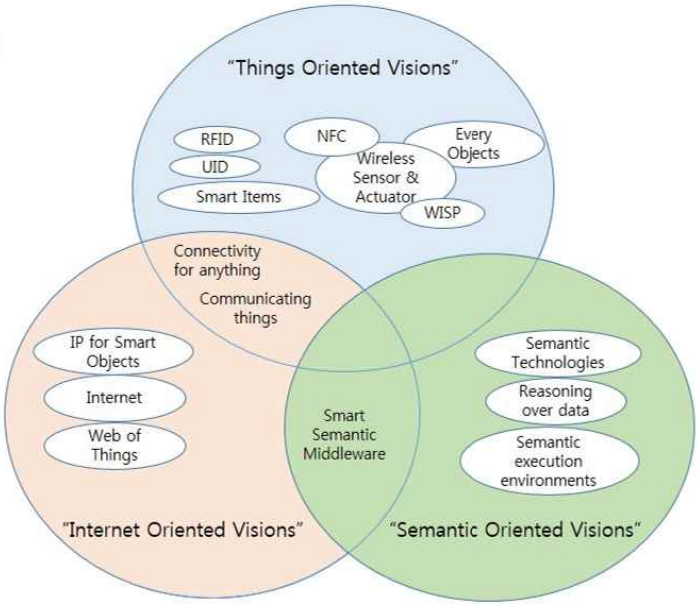


Source: ITU, adapted from Nomura Institute

❖ Concept of IoT

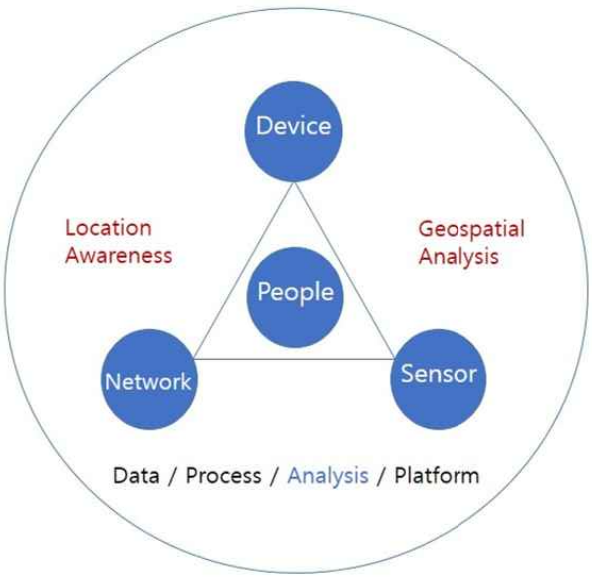


❖ 3 Visions of IoT



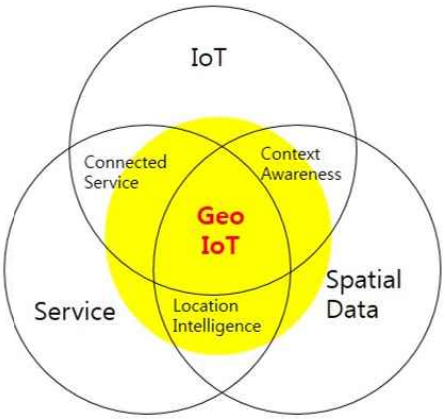
L. Atzori, A. Iera, and G. Morabito, "The internet of things: A survey", Computer Networks, vol. 54, no. 15, pp. 2787-2805, Oct. 2010.

❖ IoT components and SI

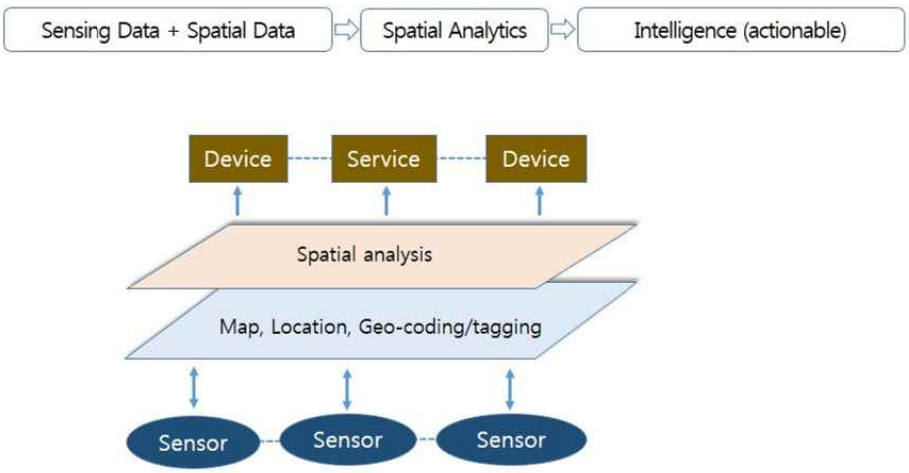


❖ Area of Geo-IoT

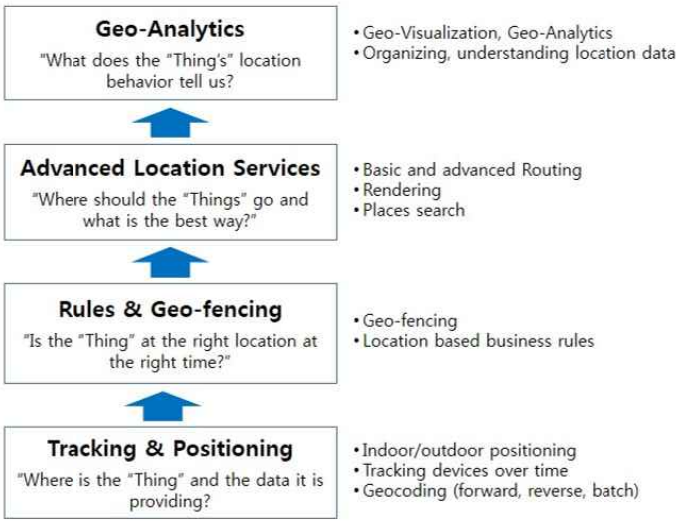
Sensors and devices located somewhere. Spatial information plays a key role when they collect or exchange data from the things.



❖ Concept of Geo-IoT

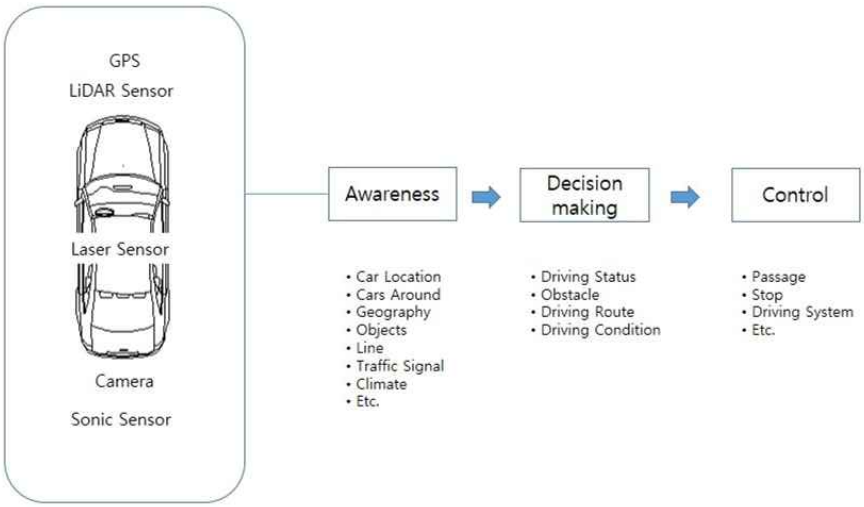


❖ Location technology layers for IoT: not just positioning

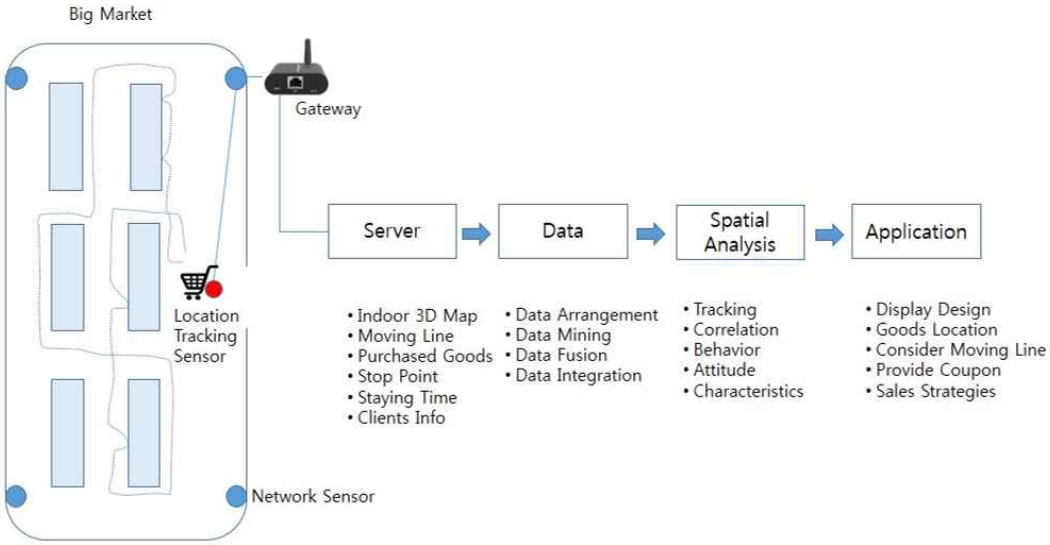


Source: Mikko Blomqvist(2016), Geo-IoT World Proceeding

❖ Example of Geo-IoT (Connected Car)

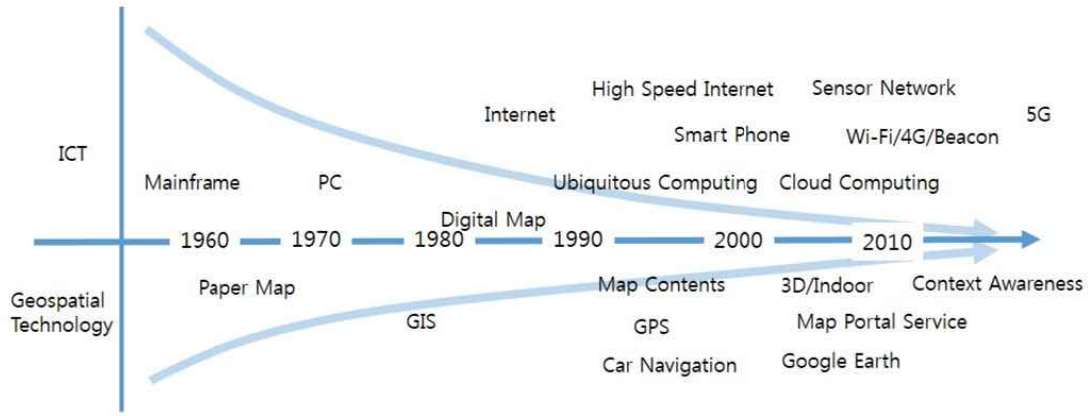


❖ Example of Geo-IoT (Big Market)

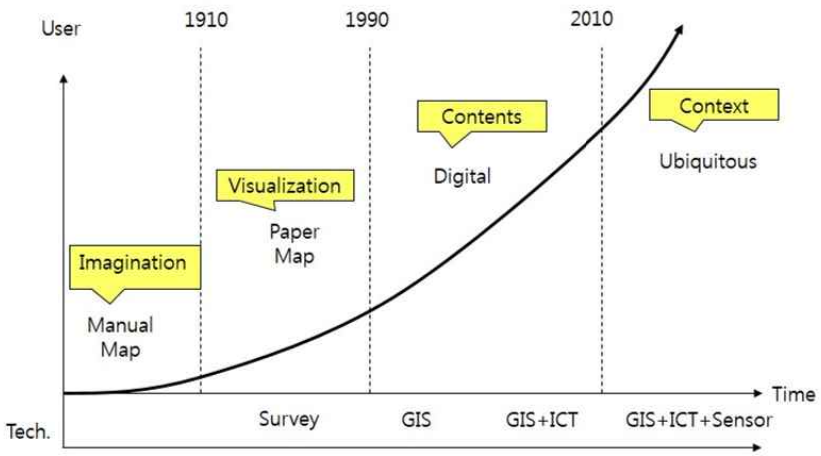


II. Trends and Prospects of SI

❖ Comparing the evolution of ICT and SIT

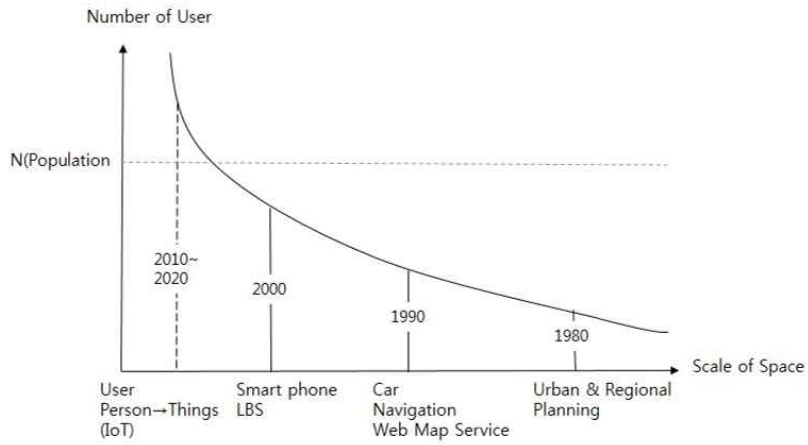


❖ Change Process of Spatial Information



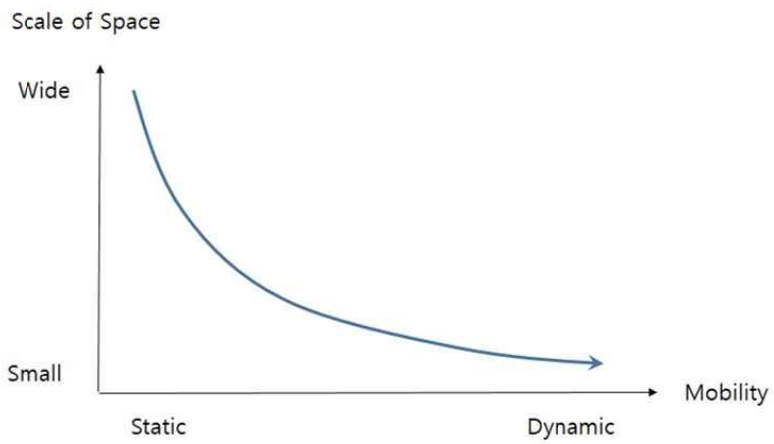
Source: Sakong, Hosang (2007)

❖ Change Process of SI Application

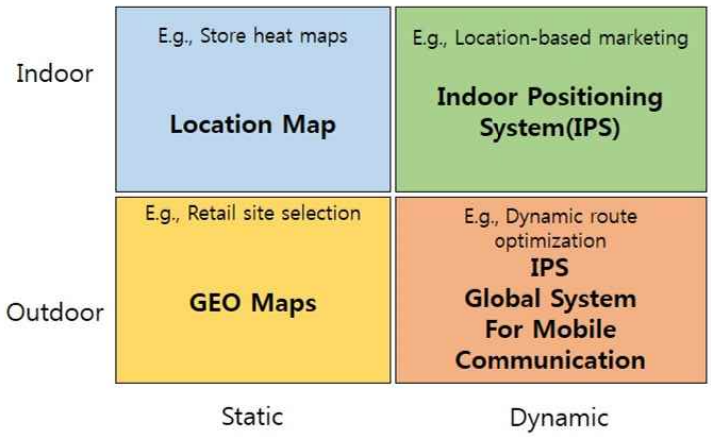


Source: Kim, Jong-Deok (2015)

❖ Change Prospects of SI Application



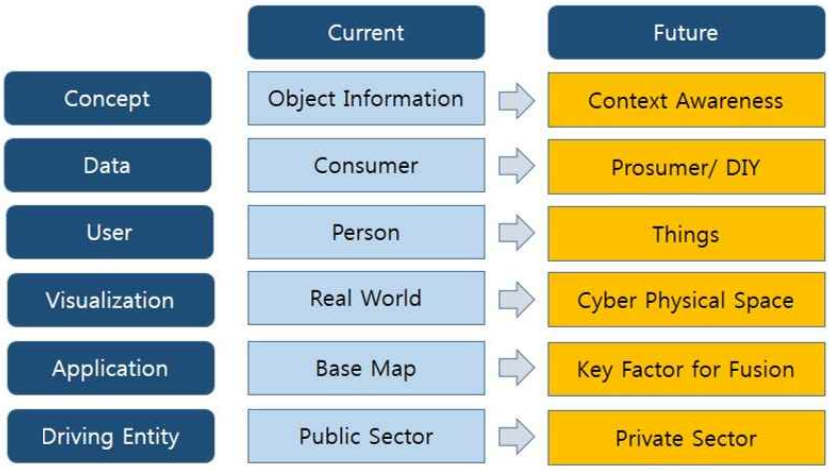
❖ Map/Location Strategy



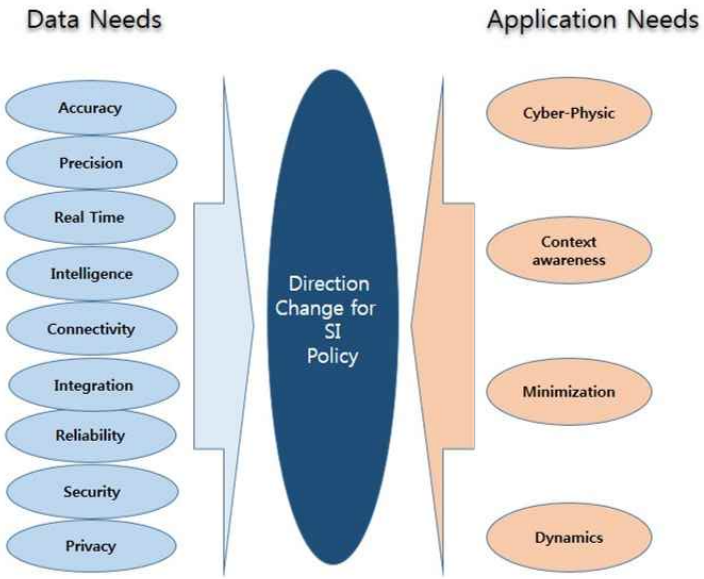
Source: Thomas W. Oestreich(2015), "Location, the Next Champion in Analytics", Gartner Group.

III. Policy Direction of Spatial Information

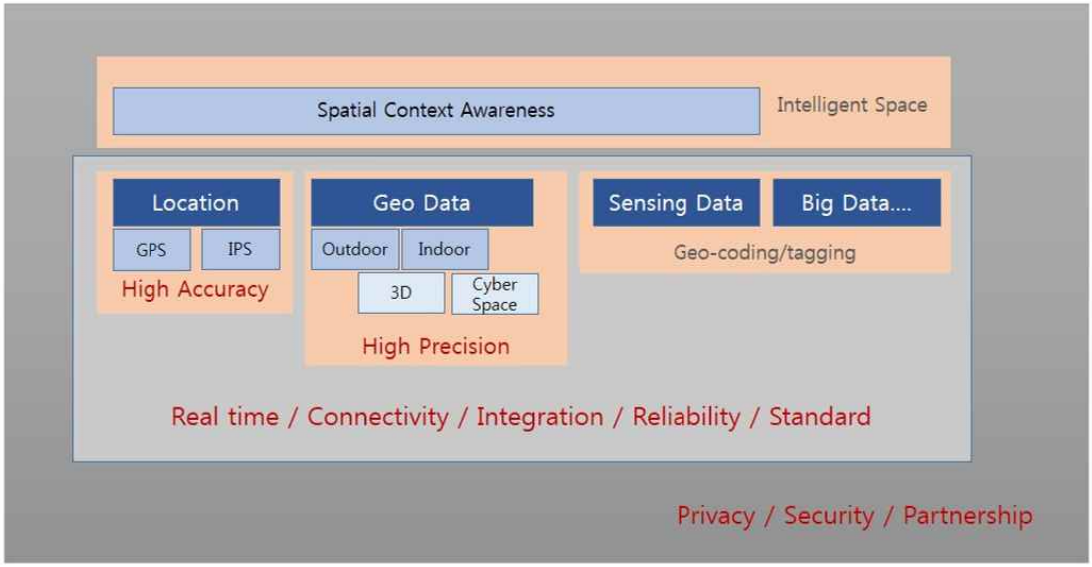
❖ Paradigm Shift of Spatial Information



❖ Factors for improving spatial information policy

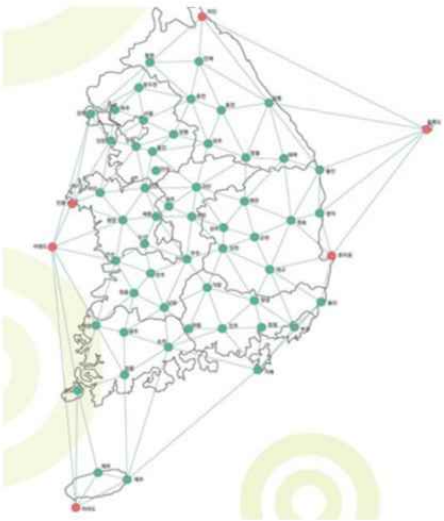


❖ SI Development Strategies for Hyper-connected Society



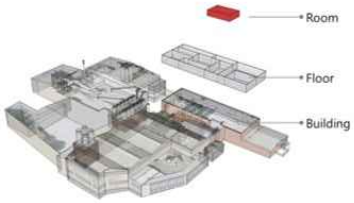
❖ High Accuracy Positioning System

- ✓ Accurate positioning data is an essential infrastructure in the Hyper-connected Society.
  - Location is very important when the sensor is collecting data.
  - Highly accurate position data for self driving vehicles, drone, robots etc. is needed.
  - Government should develop the "High Accuracy Positioning System".
  - The best way is providing positioning data with a precision of about 30cm to the public by government. More accurate data are provided by private companies.
  - National Geographic Information Institute (NGII) opens the GPS RINEX data to the people.
- ✓ Have our own satellite-based poisoning system like the QZSS.
  - Japan developed the Quasi-Zenith Satellite System(QZSS) in 2010, providing 3cm positioning data for social security and industry.



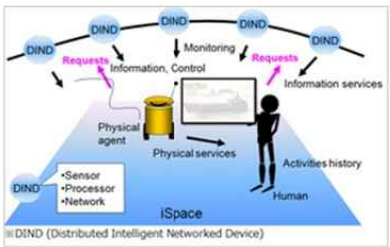
❖ High Precision in Geo Data

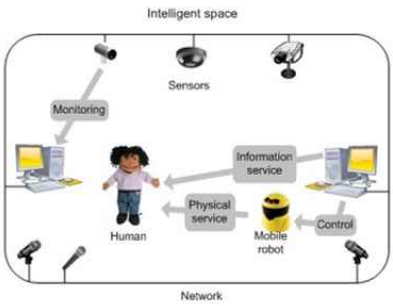
- ✓ High Precision Map for Hyper-connected Society
  - Framework Data
  - Road Map for self driving car
  - 3D Real Map for cyber world
  - Live Map for real time connected vehicles
  - Indoor Map for indoor services / associated with the BIM, AR, VR
- ✓ Government provides:
  - Data Model / Spec
  - Standard
  - Guide line / Principles
  - Pilot project
  - Provide a Test Bed / DIY open platform (Tango Project)
  - Adopt a new technology

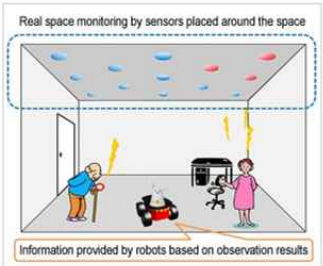


❖ Intelligent Space

- ✓ To make the intelligent space based on ubiquitous computing environment.
- ✓ To recognize the physical environment and conditions, including events and spatial context.
- ✓ To apply disaster prevention, safety, security, etc.
- ✓ Need of research on sensors, data fusion, network, algorithms, processor and services for intelligent space
- ✓ Geo-IoT Open Platform
- ✓ Interface for connecting to a virtual space and the real space





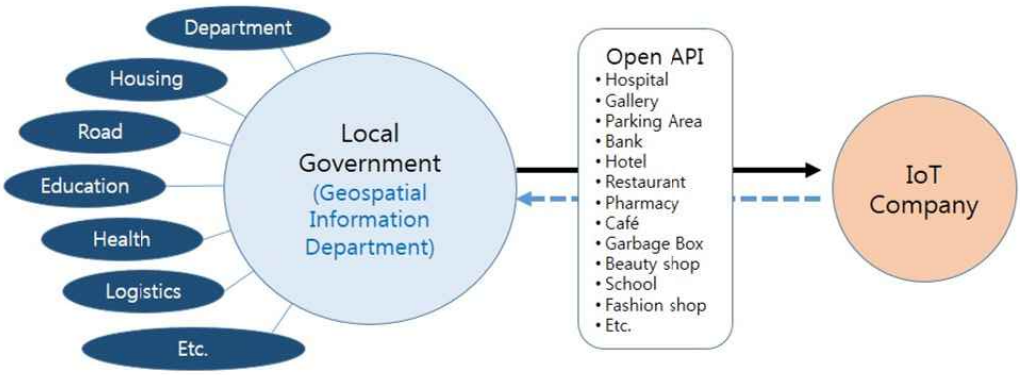


❖ Role of public sector & private sector

- ✓ Volunteered geographic information can act as a valuable mechanism to encourage public participation and citizen engagement in geospatial information.
- ✓ Private companies have played an increasing role as both data provider and service provider.
- ✓ Role of public sector
  - Provide an authoritative and reliable data.
  - Provide a simple framework data that updates in real time.
  - Present principles, criteria and standards.
  - Enhance a partnership between government departments.
  - Create a partnership model between public and private sector.

❖ Role of public sector (Local governments)

- ✓ Create a geospatial information API and open to the public.
- ✓ Identify the spatial information demand from IoT service developers.
- ✓ In collaboration with the business units of local government, creating a geospatial information API.



❖ Closing Remarks

- ✓ 'Hyper-connection' will cause a lot of changes like life style, culture and industry.
- ✓ Spatial information is essential for IoT service.
  - Location, Map, Spatial Context
- ✓ Spatial data and spatial information technologies must be changed to meet the IoT environment.
- ✓ The role of government has gradually reduced, on the contrary the private one has increased.
- ✓ The frame such as government roles, public and private partnership etc. must be changed according to the paradigm shift.
- ✓ The government should be partners to support the private sector.

Thank You!

Distribution of Open/Big Geospatial Data in Japan: The Construction of Open Source based Geospatial Platform

Toshikazu SETO
tosseto@csis.u-tokyo.ac.jp
Center for Spatial Information Science (CSIS), the University of Tokyo

Abstract

Since the end of the last decade, the use of open data (secondary use and machine-readable formats) has emerged as a political and cultural movement for the realization of citizen participation. Open government, citizen participation, transparency in government affairs, and cooperation of public and private entities were established as goals by the Obama administration in the U.S. in 2009. In the "G8 Open Data Charter," which was declared at the G8 Lough Erne Summit in June 2013, geospatial information data was recognized as an area of high value. In addition to open data policy, data flow is a necessity; for example, the CKAN platform with data catalogs have been developed as open source with the provision for the flow of information. Various policies and government strategies on open data have been enforced since 2012 in Japan, including the introduction of various guidelines and standard government terms and conditions. Japanese government is also promoting open and big data innovation to our lives by converging geospatial information and information communications technology.

In this presentation, we will illustrate with open/big data study projects in our laboratory, and construction of geospatial platform project supported by Ministry of Internal Affairs and Communications in Japan between 2014 and 2015. We focus distribution of people-flowing data and visualization being an important aspect of geographic information, the use of various tools, such as FOSS4G, is required. On the other hand, since the formats of open data currently vary, a cross-evaluation is necessary to determine the usability of the available data, especially in the case of geographical information comprising of latitudes and longitudes, as well as readable mechanical data. More geospatial data will be distributed through the open platform by the various organization will use these data, we believe that help to social issues and disaster response.

To support the distribution of open data, further study is necessary in regard to data characteristics positional accuracy and update frequency. The open data released in recent years include real-time data on expansion and space utilization rather than static geospatial information, which are essential to dynamic simulations and the development and study of urban infrastructure. In general, there is a continuing need for further comparative studies on the utility of open geospatial data in decision-making.

Keywords: Big Data, Free and Open Source Software for Geospatial (FOSS4G), Human behavior, Open Data

Distribution of Open/Big Geospatial Data in Japan: The Construction of Open Source based Geospatial Platform

Toshikazu Seto

CSIS

Project Lecturer
Center for Spatial Information Science (CSIS)
the University of Tokyo

Self Introduction https://researchmap.jp/tosseto/

Toshikazu Seto

- Education & Jobs
  - (2002) B.A. in Geography at Komazawa Univ.
  - (2004) MSc. in Urban Science (Sociology) at Tokyo Metropolitan Univ.
  - Research Associate & Lecturer at Ritsumeikan Univ.
  - (2012) Ph.D. in Literature (Geography) at Ritsumeikan Univ.
  - Postdoc. in Ritsumeikan Univ. Visiting Fellow of Center for Geospatial Analysis at Harvard Univ.
  - 2013.06～ : Project Assistant Professor (CSIS) (Shibasaki & Sekimoto Lab. http://sekilab.iis.u-tokyo.ac.jp/)
- Research Topics
  - Participatory GIS
  - Volunteered Geographic Information

OSGeo.JP Your Open Source Compass

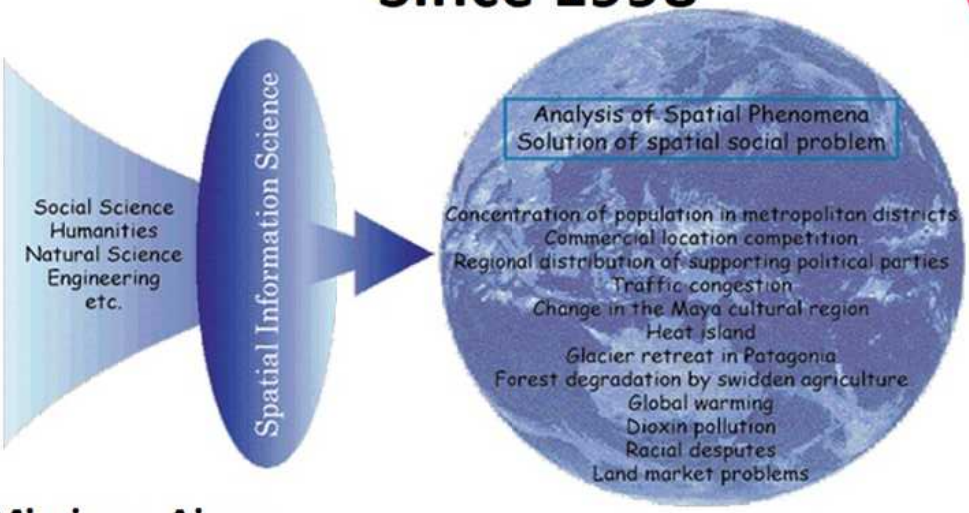
OSMF Japan

GISA

Center for Spatial Information Science

Since 1998

CSIS



Missions, Aims:

- **Creating, Developing, and Spreading Spatial Information**
- **Developing Spatial Databases for Research Purposes**
- **Promoting Joint Industry-Government-University Research**

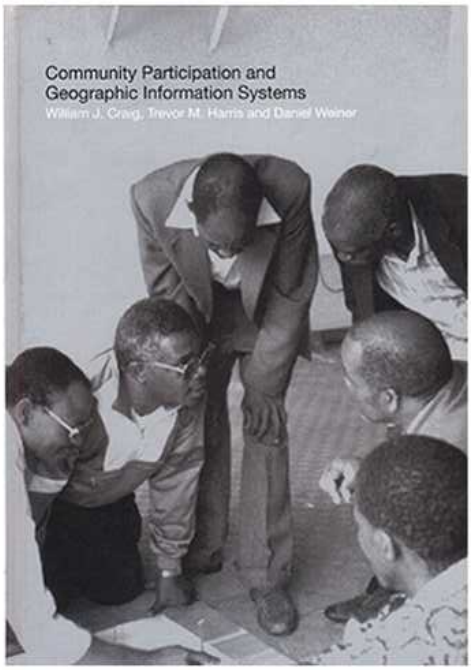
Sources: http://www.csis.u-tokyo.ac.jp/english/introduction.html

Research Background

Participatory GIS (PGIS) 1990s~

- Participatory GIS (PGIS) was one of the more substantive methodological and political themes to arise out of the "GIS and Society" research. (e.g. Environmental Decision making).
- PGIS is meant to bring the academic practices of GIS and mapping to the local level in order to promote knowledge production.

Sieber, 2006; Weiner et al., 2007



(Craig et al., 2002)

Neocartography

- Map makers who may not have come from traditional mapping backgrounds, and are frequently using open data and open source mapping tools .....
- Another difference is in the blurring of boundaries between map producers and map consumers.

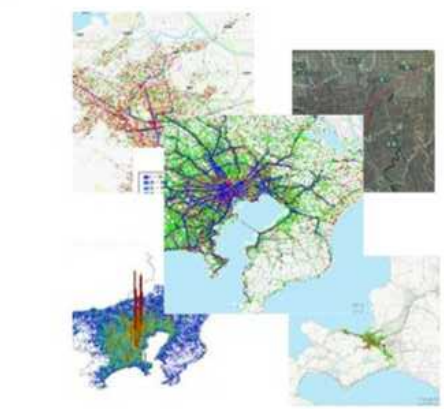
Our Recent Project Overview: Using Geo Big Data for "flow"

Shibasaki & Sekimoto Lab.
http://shiba.iis.u-tokyo.ac.jp/
http://sekilab.iis.u-tokyo.ac.jp/

People Flow Project (PFLOW)

Since 2008～

Data Provision Service | Data Cleaning Service | Data Visualization | Related Researches | Account Registration



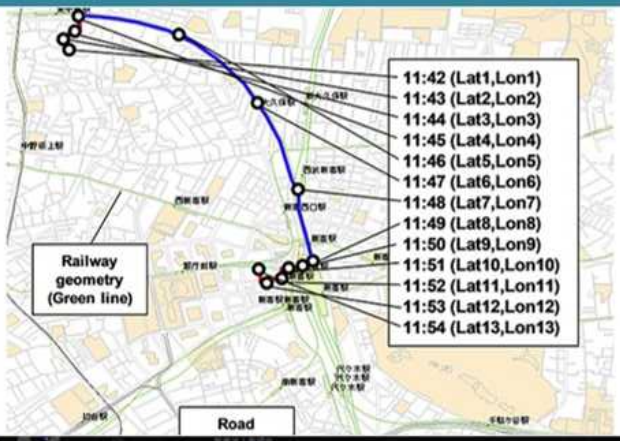
Recently, monitoring dynamic changes in people flow has become necessary, in order to mitigate secondary disasters following earthquakes, fires or other major events, as well as to mitigate congestion at nodes in terminal stations. From the point of view of public facility managers, it is necessary to grasp the people flow comprehensively, for instance, in order to design safe and comfortable spaces, and appropriate urban transport policies. In commercial fields of outdoor advertisement, price systems, which support an effective advertising activity, depend on the traffic volume of people for each location.

In technical terms, tracking mobile objects by GPS or PHS, tracking the number of people who are stationary by CCTV camera, tracking the number of passengers getting on and off according to the number of IC (integrated circuit) tickets through the automatic ticket gates, tracking the number of people who are stationary by the number of registered mobile phones at each base station, and tracking the hourly number of visitors to department stores enables us to measure people flow according to various dimensions.

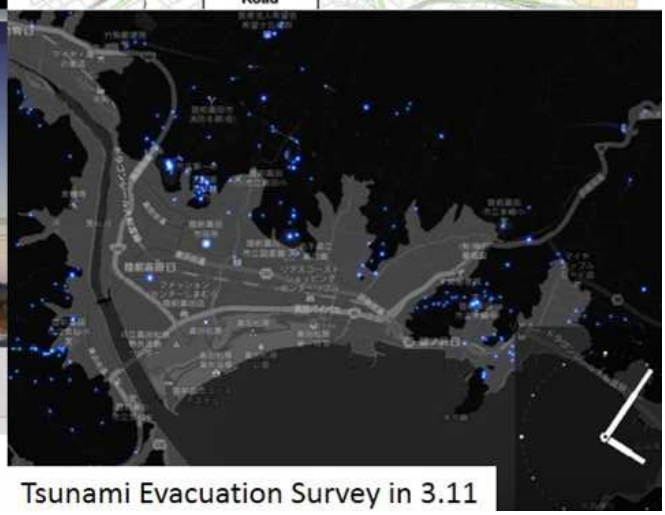
However, the scope of many of these goes no further than data acquisition technology. Such research cannot be seen as infrastructure data that can aggregate the acquired data and provide an overview of the mass flow. This is true in terms of the l accuracy, acquisition/process cost and value to the user as a service.

Source: http://pflow.csis.u-tokyo.ac.jp

Travel Survey Data in Tokyo 2008



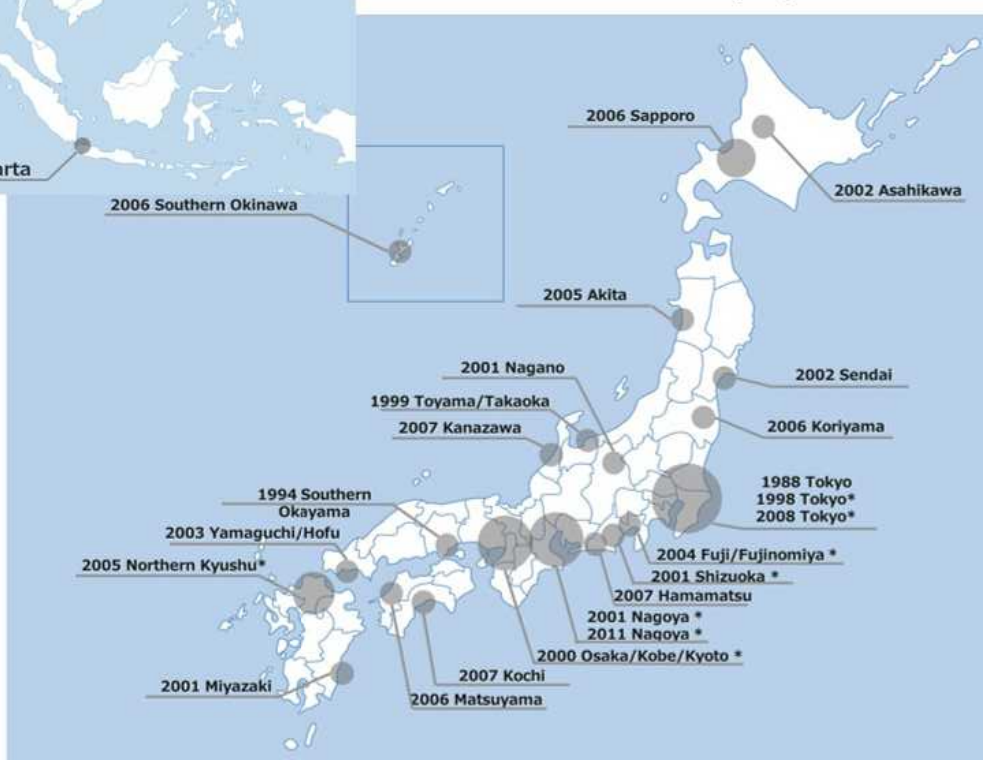
Mobmap: Google Chrome App. for Moving Data
Developed by Mr. Ueyama



Tsunami Evacuation Survey in 3.11

Available People Flow Data

These data can be accessed through joint research proposal with CSIS (JoRAS) for administrative or academic purposes.

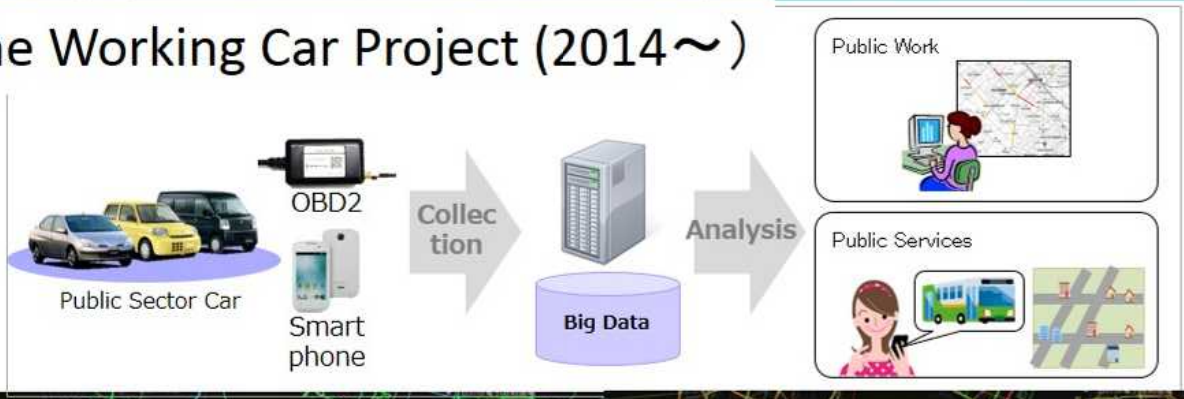


Social Big Data Platform for Creating Open Smart Cities (2014～)

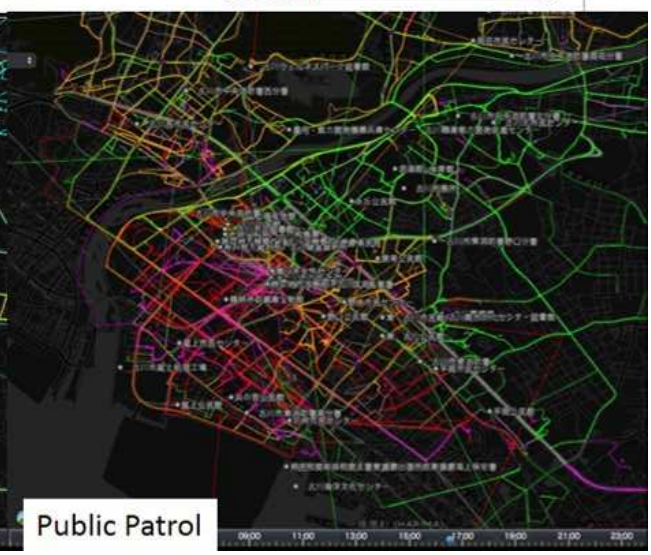
Real-time Urban Management by People Flowing Data in Fujisawa

Visualization of the call for service of the ambulance

The Working Car Project (2014～)



Public Pickup Bus/Car



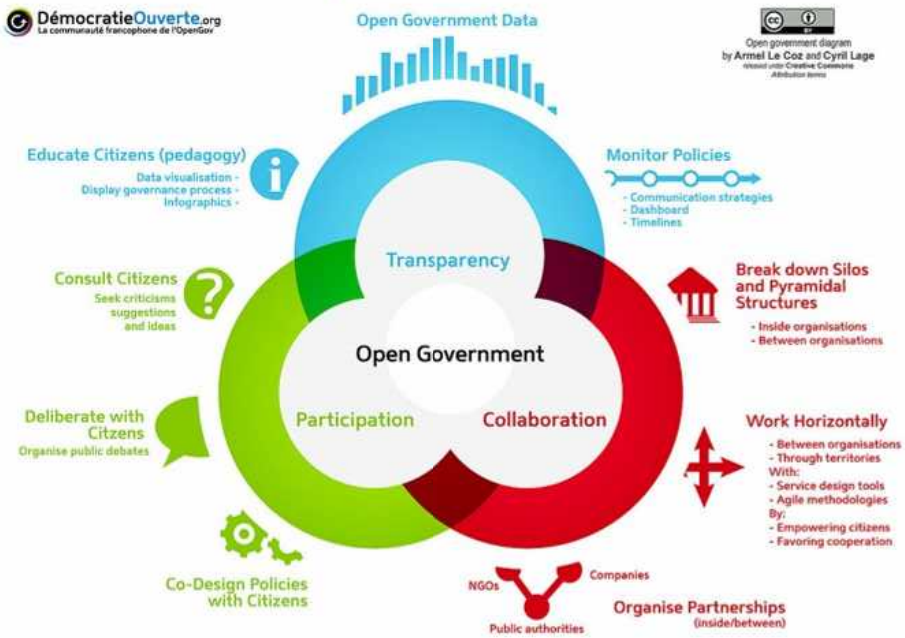
Public Patrol

The Geospatial Data for Open and Platformalization

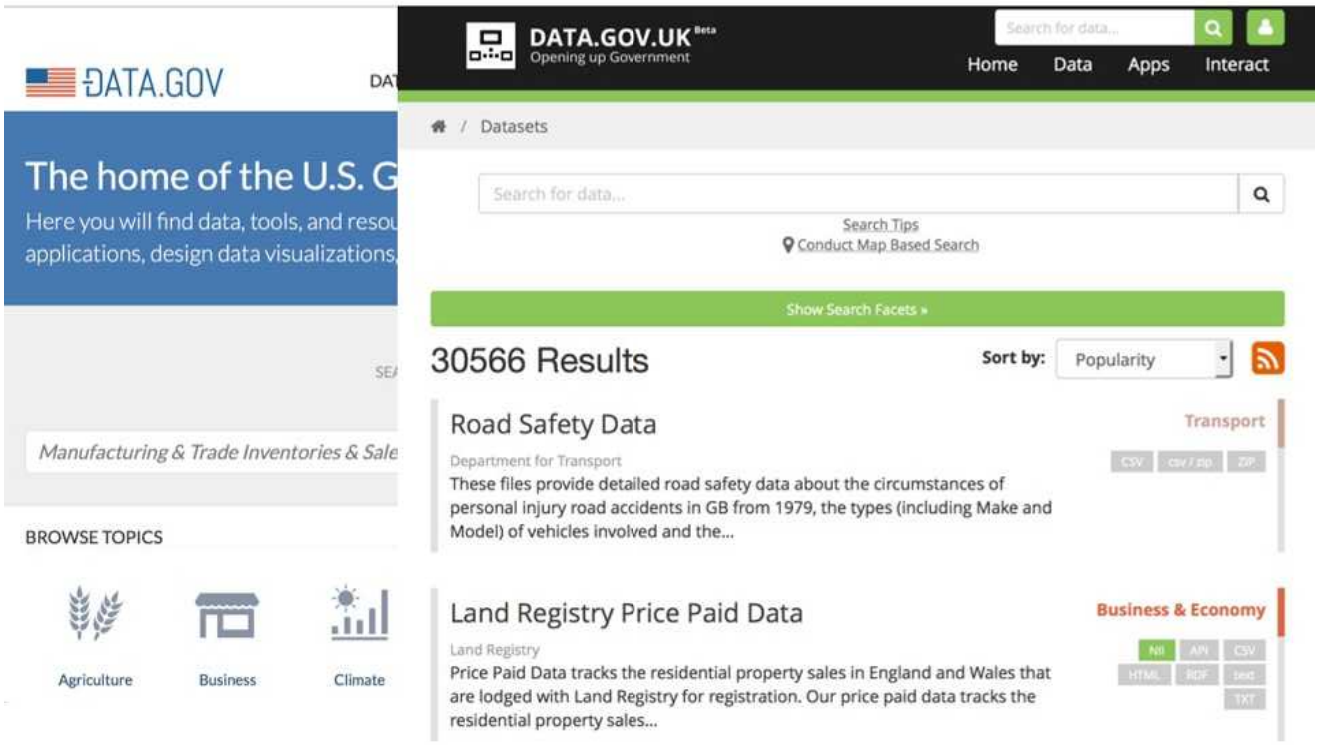
"Open means **anyone** can **freely access, use, modify, and share** for **any purpose** (subject, at most, to requirements that preserve provenance and openness)."

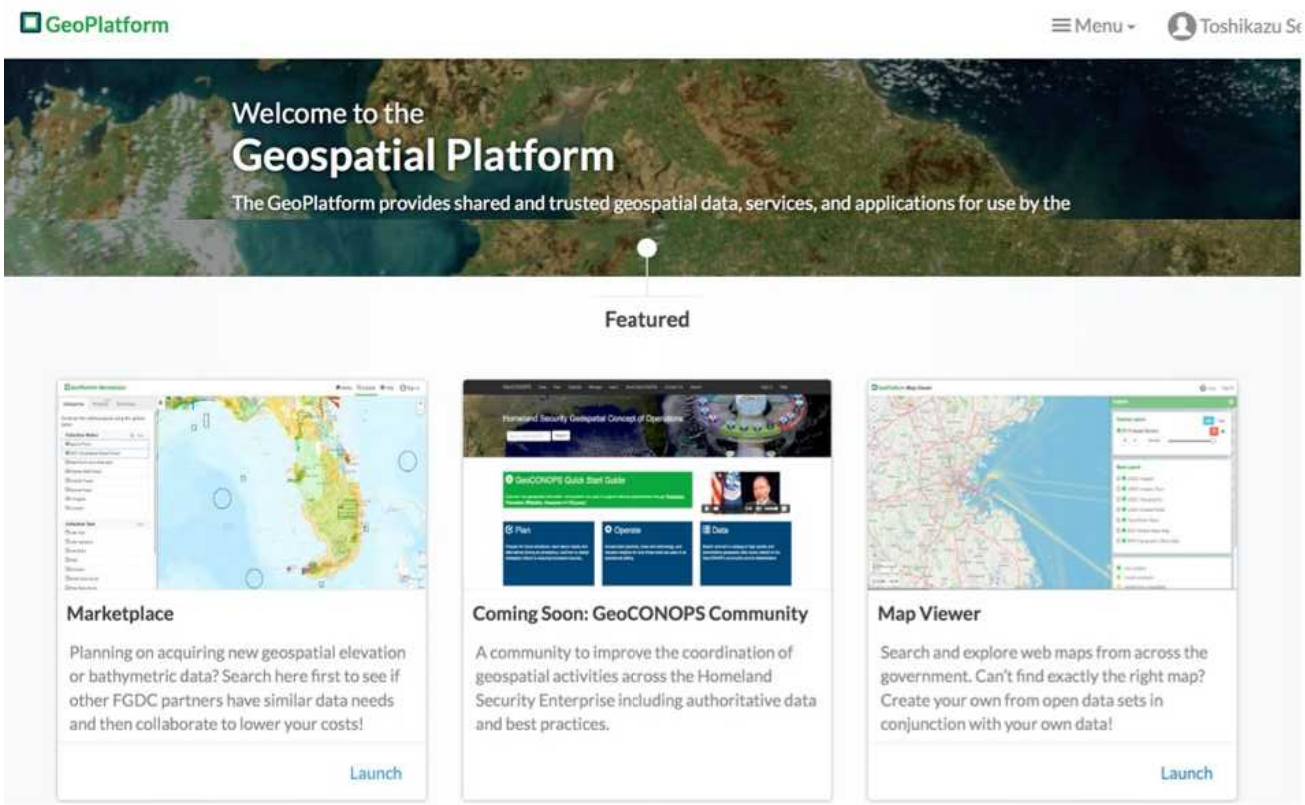
by opendefinition.org

■**Open government → Open Inovation !**



2009～: Government as Platform





Source: https://www.geoplatform.gov/

G8 Open Data Charter 2013.6.18→ High Value Data is Geospatial !

Policy paper

G8 Open Da Annex

Published 18 June 2013

Contents

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3. Principle 3: Usable by All
4. Principle 4: Releasing Data
5. Principle 5: Releasing Data
6. Technical annex

Prea

1) Th

Source:
https://www.gov.uk/governmer
http://www.mofa.go.jp/mofaj/g

Companies	Company/business register
Crime and Justice	Crime statistics, safety
Earth observation	Meteorological/weather, agriculture, forestry, fishing, and hunting
Education	List of schools; performance of schools, digital skills
Energy and Environment	Pollution levels, energy consumption
Finance and contracts	Transaction spend, contracts let, call for tender, future tenders, local budget, national budget (planned and spent)
Geospatial	Topography, postcodes, national maps, local maps
Global Development	Aid, food security, extractives, land
Government Accountability and Democracy	Government contact points, election results, legislation and statutes, salaries (pay scales), hospitality/gifts
Health	Prescription data, performance data
Science and Research	Genome data, research and educational activity, experiment results
Statistics	National Statistics, Census, infrastructure, wealth, skills
Social mobility and welfare	Housing, health insurance and unemployment benefits
Transport and Infrastructure	Public transport timetables, access points broadband penetration

Global Open Data Index 2015 http://2015.index.okfn.org/place/

GLOBAL OPEN DATA INDEX

This census data is available to use public domain.

Places Datasets Download Insights Methodology About Press

28	Chile	47%
30	Ireland	46%
30	Japan	46%
30	Latvia	46%
33	Kyrgyzstai	44%
3	Colombia	72%
4	Denmark	70%
5	Norway	68%
5	Canada	68%
7	Finland	67%
7	Australia	67%
9	Uruguay	66%
9	United States	66%
11	Netherlan	64%

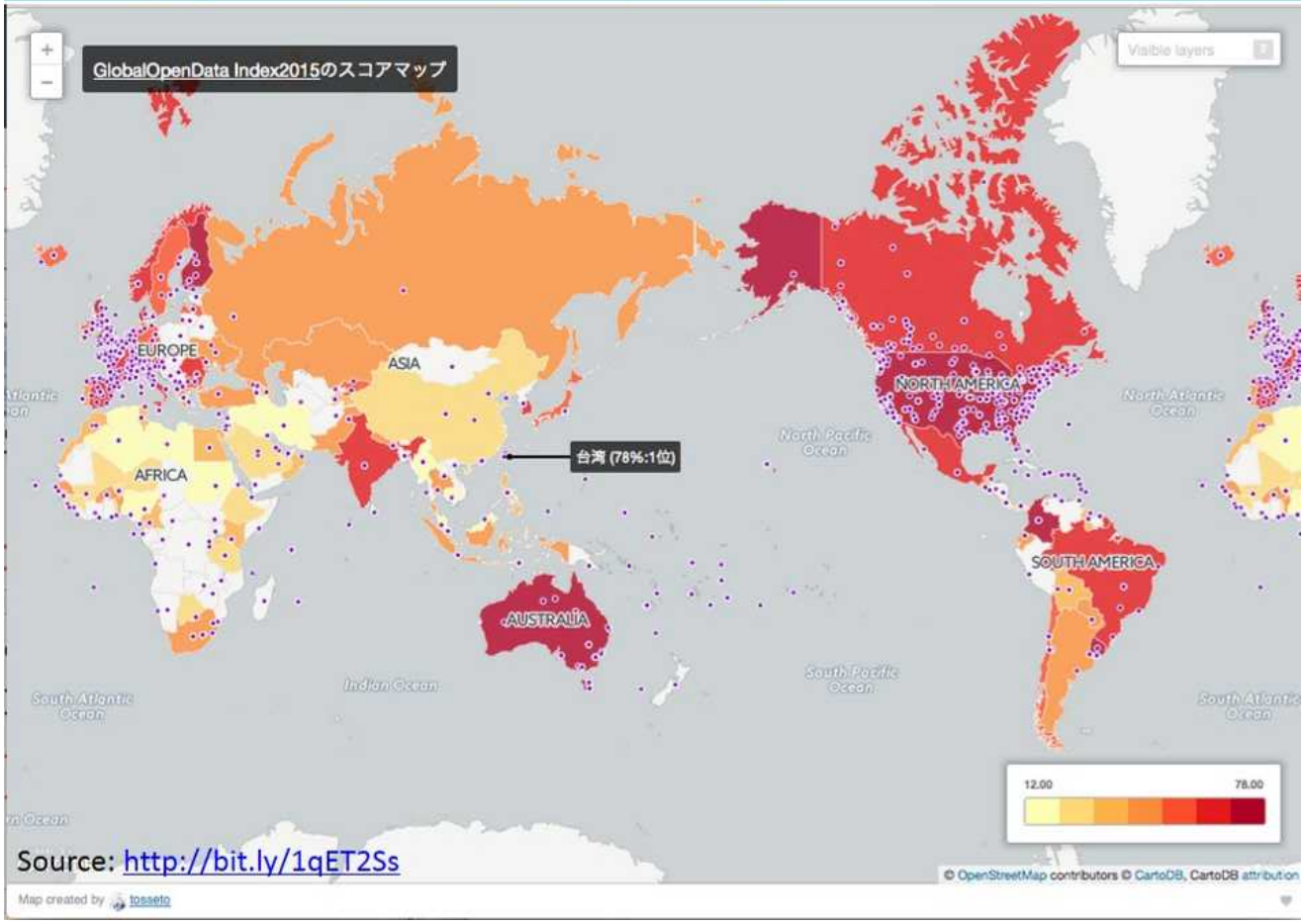
GLOBAL OPEN DATA INDEX

Places Datasets Download Insights Methodology About Press

The Evaluation of Japan

Rank	Dataset	Breakdown	Location (URL)	Format	Info	Prev. (2014)	Score
1	Location datasets		http://www.post.japanpost.jp/z...	CSV		#1 100%	100%
8	Government Spending		n/a	n/a		#15 10%	10%
16	Legislation		http://law.e-gov.go.jp/cgi-bin...	n/a		#12 75%	75%
20	Weather forecast		http://www.jma.go.jp/jp/week/	n/a		n/a	55%
25	Government Budget		http://www.mof.go.jp/budget/re...	Excel		#22 70%	70%
27	Pollutant Emissions		http://soramame.taiki.go.jp/	n/a		#13 70%	55%
31	Land Ownership		http://www1.touki.or.jp/	n/a		n/a	30%
33	National Statistics		http://www.e-stat.go.jp/SG1/es...	CSV, ...		#23 70%	70%
34	National Map		http://www.gsi.go.jp/kiban/ind...	GML		#20 70%	50%
36	Procurement tenders		http://www.kantei.go.jp/jp/kan...	n/a		n/a	45%
46	Water Quality		n/a	n/a		n/a	10%
47	Company Register		http://www.touki.or.jp/	n/a		#57 30%	25%
87	Election Results		http://www.soumu.go.jp/senkyo/...	Excel		#22 70%	0%

Sources: http://index.okfn.org/place/japan/



Source: http://bit.ly/1qET2Ss

G-space × ICT promotion council of Japanese Government

Common Infrastacture projects

(1) Construction of platform
- Constructing a platform that allows the utilization and application of flexible combinations of G-spatial-related data items possessed by the public and private sectors by around the end of fiscal 2015. Contributing to the realization of the "G-spatial Information Center".
- Opening the platform to organizations, such as private companies, for the utilization of the platform to develop and demonstrate the creation of a variety of new services.

(2) Reinforcement of arrangements including public-private cooperation toward the nationwide spread of G-spatial information applications
- Creating a best practice collection of utilization and application examples of G-spatial information by around the end of fiscal 2014, in order to promote the multi-purpose use of G-spatial information possessed by local governments.
- Local governments and public service companies will establish a collaborative model by around the end of fiscal 2015, in order to make efficiency improvements in the production and updating of maps, and systematically expanding the model.

A G-spatial-related market with a scale of approximately 62 trillion yen in 2020
(currently approximately 20 trillion yen).
Expanding the results of the projects in both Japan, and overseas.

Utilization and application projects

(1) Actualizing the provision of precise information by various means
- Developing by around the end of fiscal 2015, and systematically introducing a system that will make a big data analysis of G-spatial information in real time, apply various means of transmitting information including the message function of quasi-zenith satellites, and actualize a model system that will provide each individual with precise information.

(2) Introducing advanced disaster management systems, such as disaster-response robots
- Developing, by around the end of fiscal 2020, and systematically introducing a disaster prevention system that will apply advanced information to large-scale disasters and special disasters that people cannot approach as well as utilizing necessary equipment such as robots under unmanned, remote control.

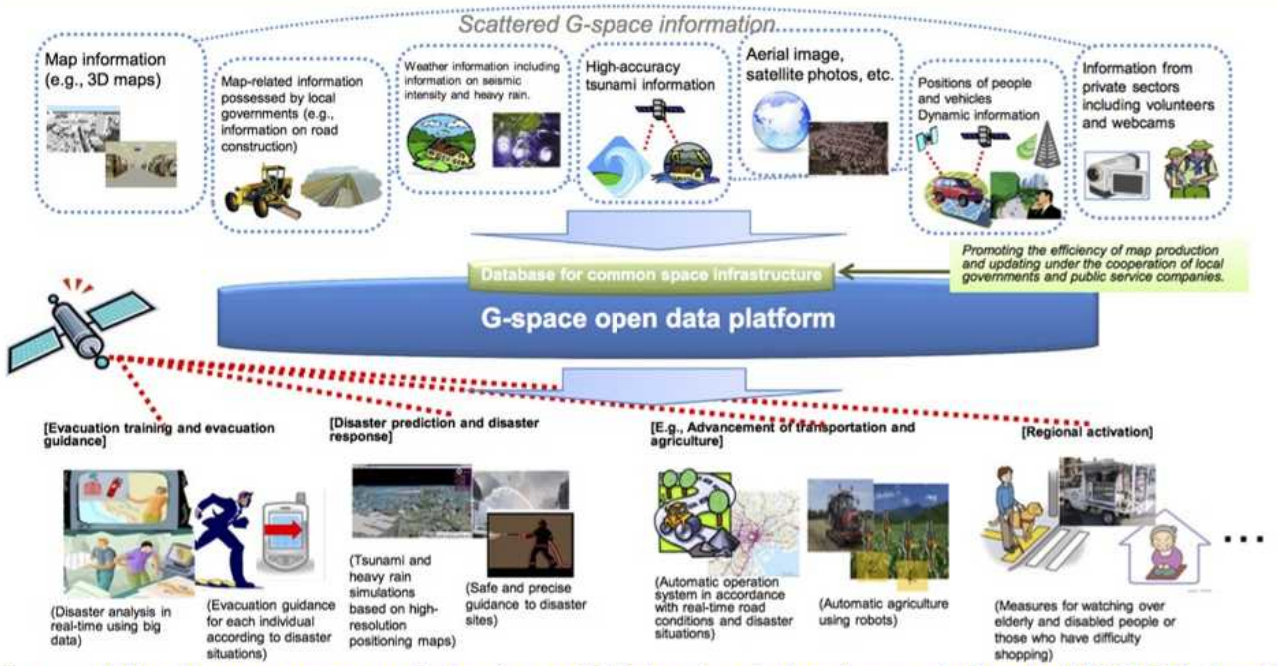
(1) Implementing a leading-edge utilization and application model
- Establishing a leading-edge model of the utilization and application of G-spatial information with ICT in cooperation with ministries concerned with areas such as the advancement of transportation and agriculture in and after fiscal 2014.

(2) Implementing demonstrative projects abroad
- Implementing G-spatial and ICT demonstrative projects overseas centered on the ASEAN regions in and after fiscal 2014, in order to reinforce international competitiveness and promote an expansion of the use of "G-spatial information × ICT".

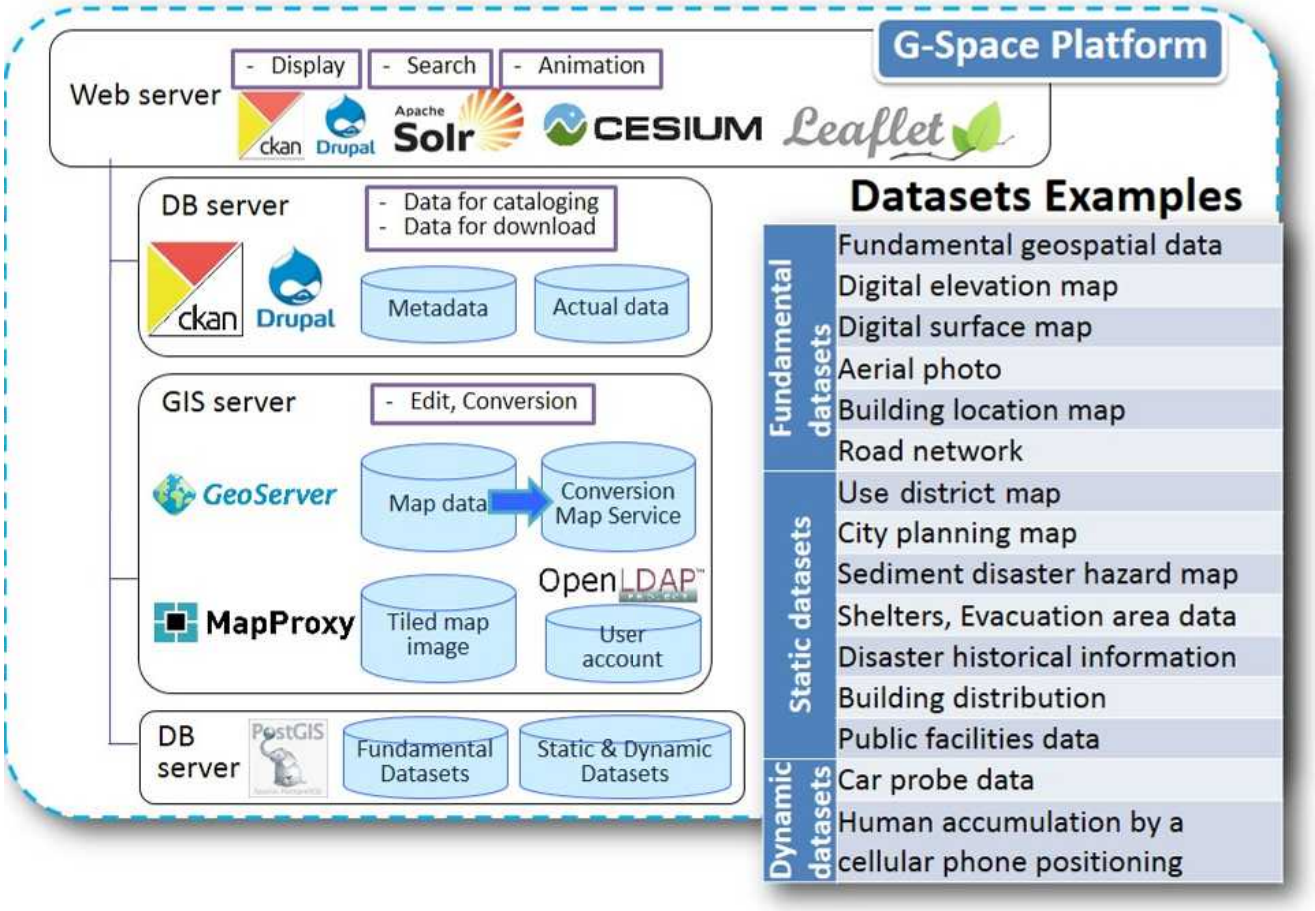
Source: http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/presentation/pdf/130628_1.pdf

This project (2014-2015) are funded by Ministry of Internal Affair and Communications (MIC).

- **Establishing a platform to enable smooth use of the data of G-space, which both public and private sectors hold by around the end of fiscal 2015.**
- **Opening that platform to private companies, and utilizing it to develop new services.**



Source: http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/presentation/pdf/130628_1.pdf


G-Space Platform
Web server
- Display
- Search
- Animation
ckan
Drupal
Apache Solr
CESIUM
Leaflet
DB server
- Data for cataloging
- Data for download
ckan
Drupal
Metadata
Actual data
GIS server
- Edit, Conversion
GeoServer
Map data
Conversion Map Service
OpenLDAP
MapProxy
Tiled map image
User account
DB server
PostGIS
Fundamental Datasets
Static & Dynamic Datasets
Datasets Examples
Fundamental datasets
Fundamental geospatial data
Digital elevation map
Digital surface map
Aerial photo
Building location map
Road network
Static datasets
Use district map
City planning map
Sediment disaster hazard map
Shelters, Evacuation area data
Disaster historical information
Building distribution
Public facilities data
Dynamic datasets
Car probe data
Human accumulation by a cellular phone positioning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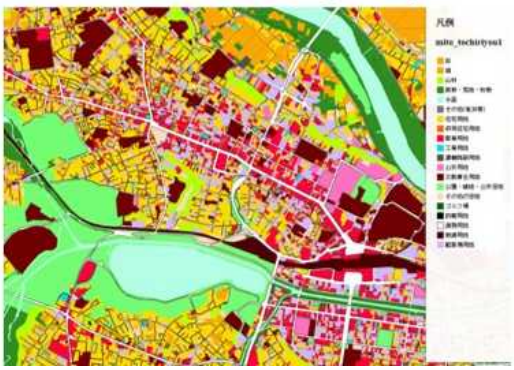
高知市における津波避難人流シミュレーション

Local Governments and Public Organization's Data

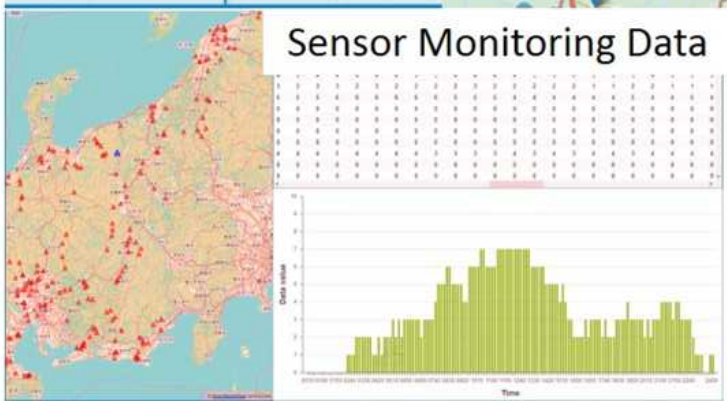
Detail Aerial Photos

Infrastructure Construction History Data

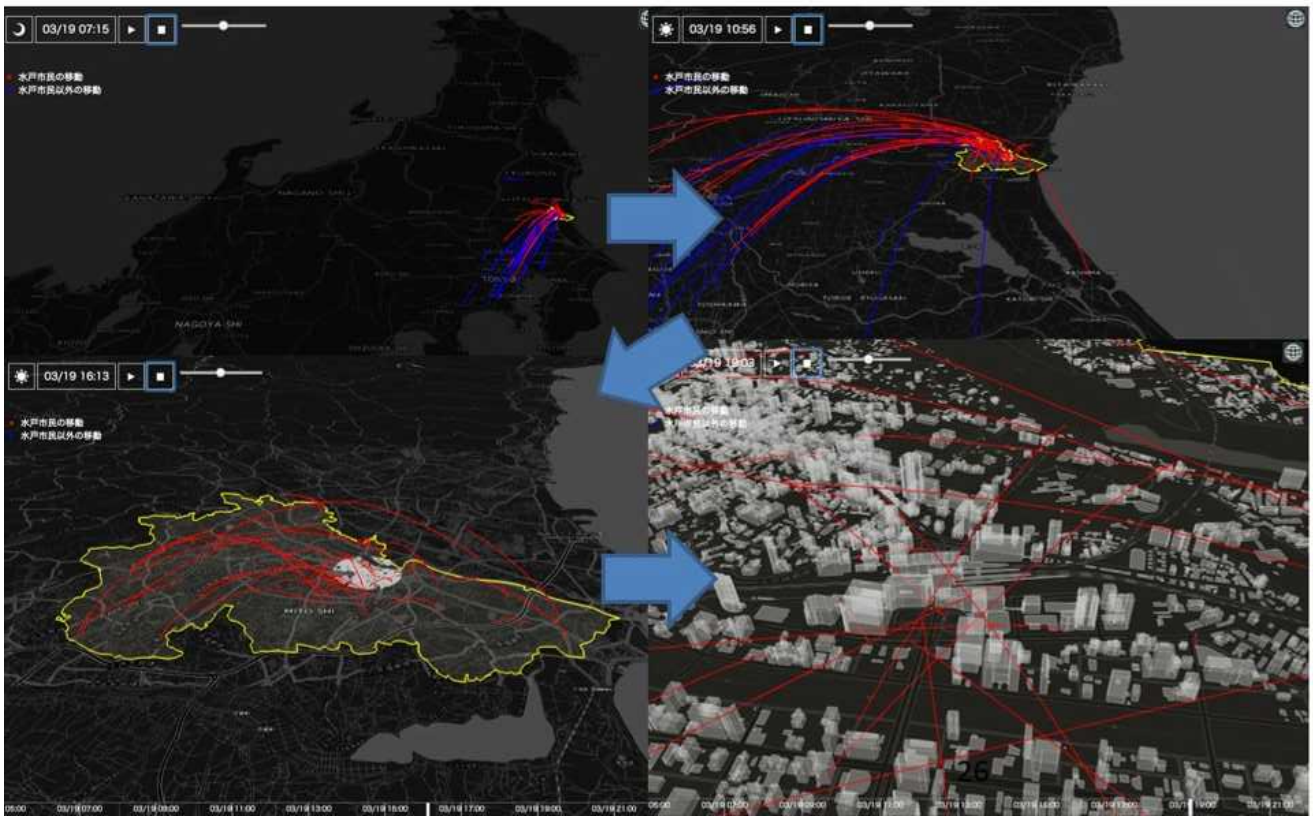
Urban Planning Maps



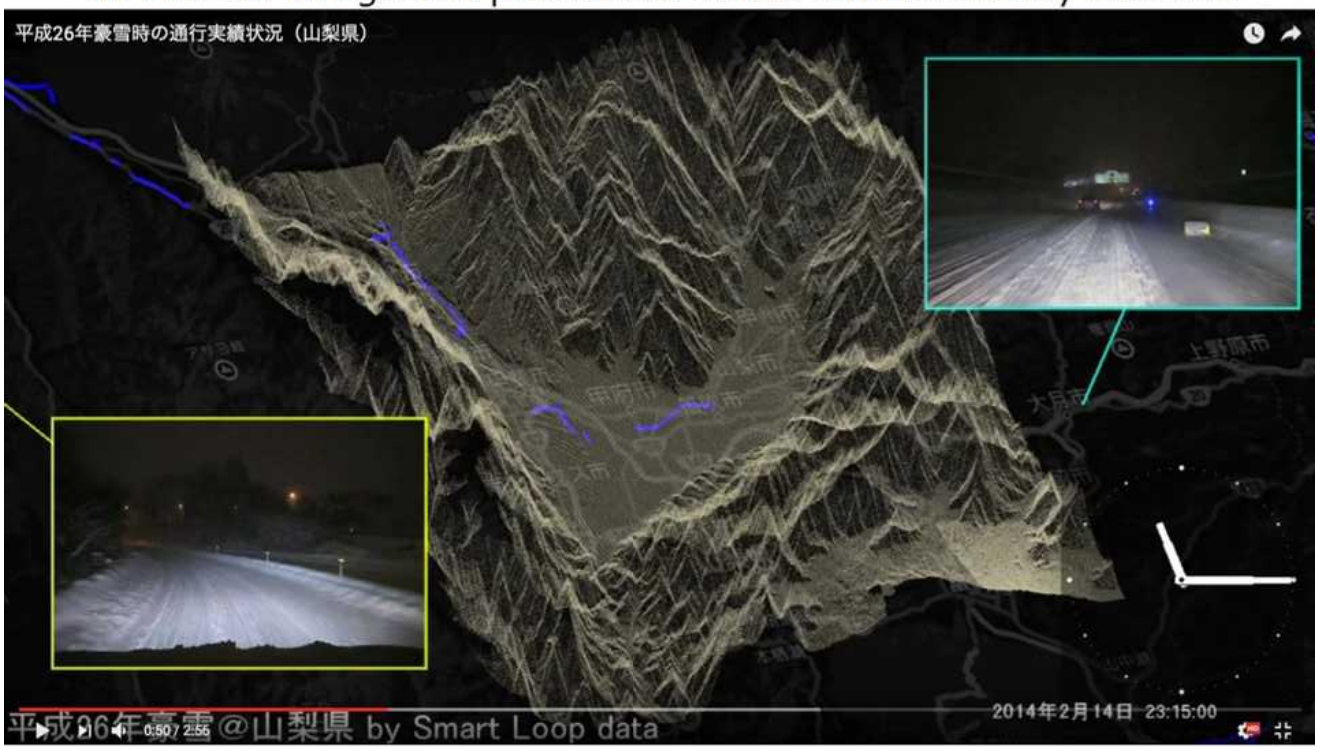
Sensor Monitoring Data



Future Plan: Treat with Commercial Data for people flowing
cf. Daily People Behavioral Aggregation Data by Mobile Phone



Future Plan: Treat with Commercial Data for Car Probe
cf. The Car image and probe data at the 2013.02 heavy snowfall



Source: https://www.youtube.com/watch?v=puf5MdlcNtw

Conclusions:

The Further Potential with Flowing Geospatial Data

- The importance of the flow data
  - Peoples, logistics and natural phenomena with real-time
- Understanding to urban dynamics
  - Focus on urban social issues (cf. Disaster Management)
  - More analyzing and visualizing flow data
- Integrate from static to dynamic geospatial data
  - The new value creation of geospatial data

Conclusions:

The Benefits of Open x Geospatial x Platform

- Data and Place Based Driven Decision Making
  - Data Visualization, GeoWeb
- Reduction of Government Costs
  - Not need to inquiry counter
  - Beyond/seamless to local area data
- Support to Open Government by Open Technology
  - Increased Citizen Engagement
  - Cultivation of GIS Volunteer

Thank you & Questions ?

tosseto@csis.u-tokyo.ac.jp
http://researchmap.jp/tosseto

Development of Activity-BAsed Traveler Analyzer (ABATA) system using bigdata

Kwang-Sub Lee
leeks33@krri.re.kr
Korea Railroad Research Institute

Abstract

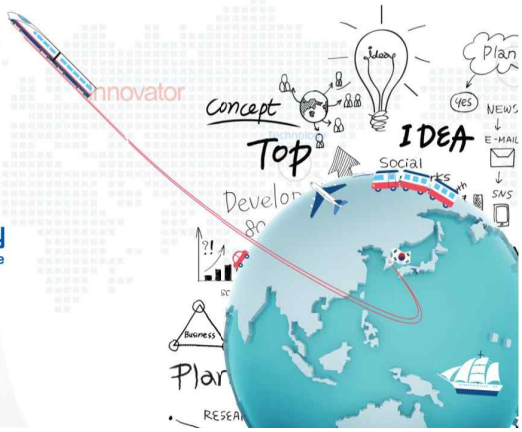
The travel demand forecast is a very important component in the evaluation of transportation related projects. Even though most of countries have their own feasibility system in order to evaluate transportation projects, they frequently face with concerns with, for example, the accuracy of estimation, such as overestimation of traffic demand and/or underestimation of costs. In the meantime, the recent developments of new data collection technologies and bigdata give new opportunities for transportation planners to improve travel demand analysis and to understand traveler's behavior. The limitations of a traditional 4-step travel demand forecasting model are well known to transportation experts; it is not very sensitive to traveler's behavior and transportation-land use related policies due to its limited analysis resolutions and basic assumptions. Therefore, many transportation planners try to apply an activity-based method. The basic idea of an activity-based model is that travel is derived from the demand for activity participation. Thus, an activity-based approach incorporates individual traveler's' scheduling of activities in time and space. Researchers at Korea Railroad Research Institute (KRRI) are developing a new system, called ABATA (Activity-based Traveler Analyzer). It is a system to estimate hourly activity population and trips, by considering an individual activity schedule of travelers. It is a transitional activity-based system, but is enough to analyze spatial-temporal effects of activity schedule changes, socio-demographic changes, and land use changes at a disaggregate level. ABATA system utilizes various input data, including household travel diary survey data, mobile phone data, block-group level statistics, and so on. Throughout the activity schedule modeling, activity population modeling, and relative attractiveness modeling, the system estimates number of hourly activity population by activity types at a block group level, and estimates hourly trips. The system is expected to be used in various transportation and land use related projects, for example, the impacts of land use changes (e.g., a large-scale shopping center construction) on transportation, the impacts of socio-demographic changes, and the effects of operation schedule or route changes.

Design your future. it is KRRI

Development of Activity-BAsed Traveler Analyzer (ABATA) system using bigdata

2016.9.2

Kwang-Sub Lee



한국철도기술연구원
Korea Railroad Research Institute

Contents

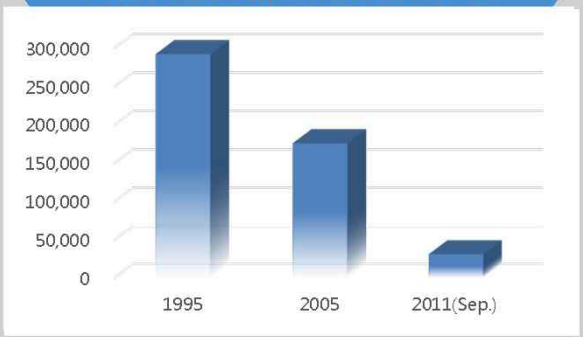
CONTENTS

- Introduction
- Development of ABATA
- Application of ABATA

Motivation

❖ Reliability issue of demand forecast

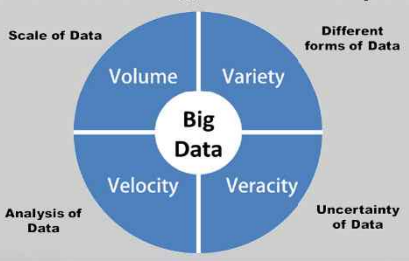
Busan-Gimhae LRT (Estimation & actual)

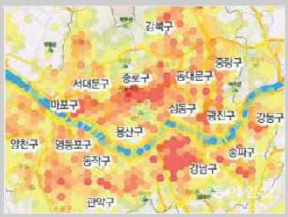


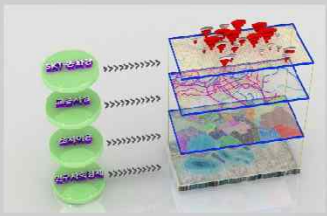
❖ Problem of over-estimation

Overestimation of demand

❖ The rise of bigdata and expectations







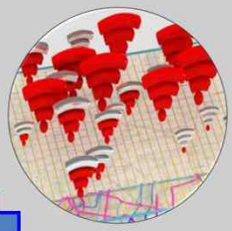
Motivation

❖ Traditional approaches

- Only 1 zone in local city (Limitation of intra-zonal analysis)

- Divide into sub-zones by analyzer

❖ Approaches in ABATA



- Block-group level statistics (about 1/25 size)
- National household travel survey data
- Hourly mobile phone data (Aggregated by 50mx50m)
- Total floor area of buildings
- Education statistics

Ⅰ. Overview of project

○ Backgrounds

■ Utilization of bigdata for public transport planning & operation

- Needs of an intra-city level, sophisticated travel demand analysis tool
  - Different from inter-regional travel demand analysis
  - Microscopic estimation method to incorporate various travel patterns
  - ⇒ Considering a block group level
- Limitations of traditional method
  - Based on national household travel survey data
  - Aggregated by administrative Dong level
  - Small sampling : less than 3% of total population
- Needs of a new analytical tool using bigdata to support transportation policy, to analyze the introduction of a new transport system, and to analyze impacts of land use on travel demand

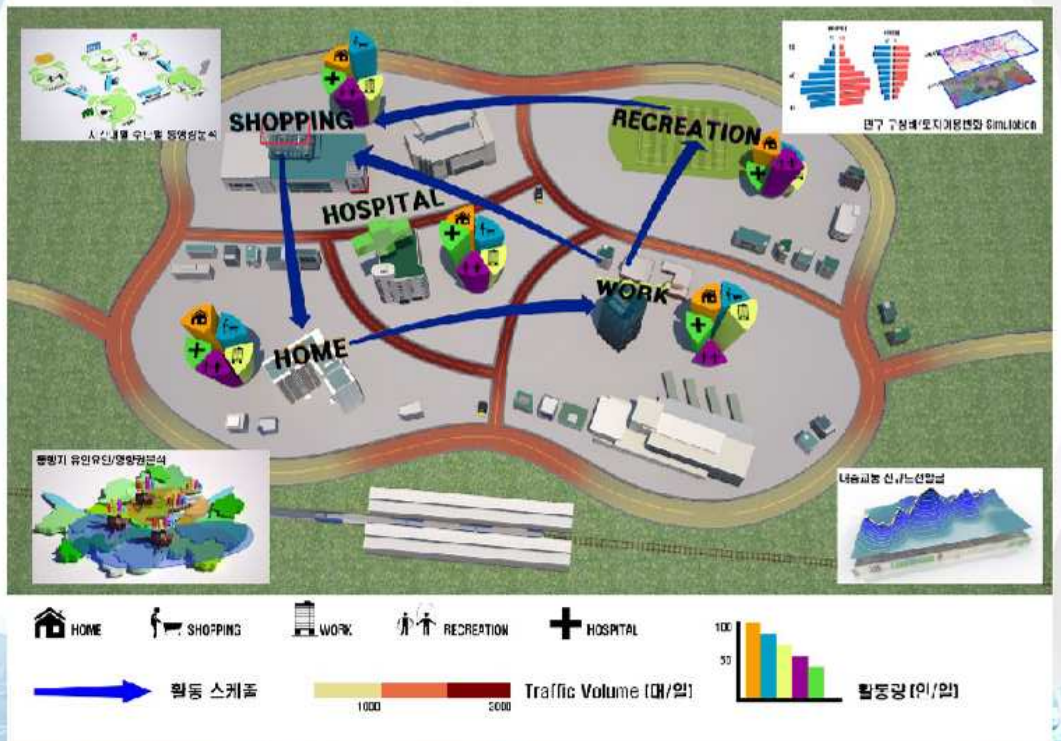
Comparison of Travel Demand Forecasting

Category	Traditional 4-step TDF method	ABM approach based on bigdata
Primary data	○ Household travel survey data (less than 3% sampling) ○ National statistics (based on administrative Dong)	○ Household travel survey data ○ Block group level national statistics ○ Hourly mobile phone data
Spatial resolution	○ Administrative Dong (Aggregated zone level)	○ Block group level (About 1/25 size of zone)
Trip resolution	○ Zonal trips excluding trip chains	○ Block group level trips, but based on 24-hr activity schedule including trip chains
Method	○ Traditional 4-step model (Trip generation → Trip distribution → Mode choice → Traffic assignment)	○ Estimation of travel demand by spatial-temporal activity-based model (Activity schedule modeling → Estimation of relative attractiveness → Estimation of spatial-temporal activity population → Estimation of travel demand)
Output resolution	○ Daily OD trips	○ Block-group level, hourly activity population and trip OD for 24 hours
Policy analysis	○ Limited policy investigations due to aggregated spatial-temporal resolution	○ Increased policy investigations due to finer resolutions - Integration with land use, social groups - Microscopic analysis

ABATA (Activity-BAsed Traveler Analyzer)

"Activity and bigdata based travel analysis system to estimate hourly activity population and travel demand, by considering individual activity schedule of urban travelers grouped by activity types (home, work, shopping, etc) and land uses (block-group level)"

Concept of ABATA



Why Developing ABATA?

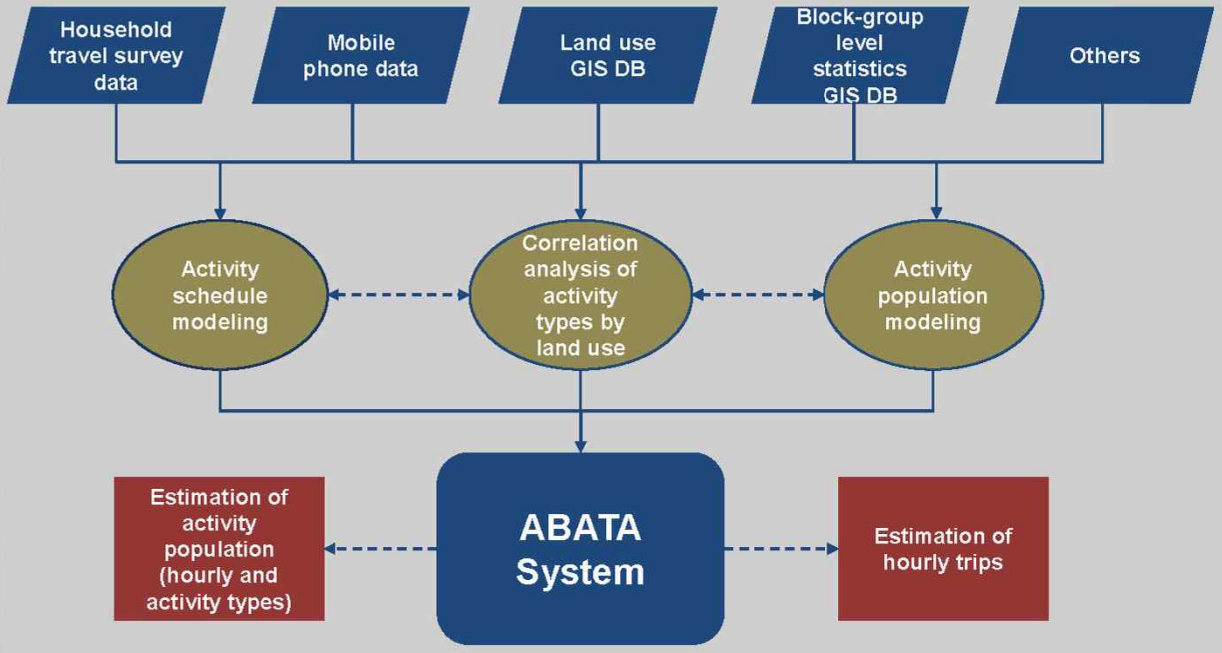
Q: What are the impact of operation schedule or route changes by subway or bus at a specific region based on hourly transit demand?

Q: When the population ratio of old people, for example, increases by 20% at a city, what would be travel patterns and transportation system?

Q: What are the impacts of land use changes or urban redevelopment on travel patterns?

II. Development of ABATA

Structure of ABATA System



Input Data

❖ Input data types used in ABATA

Types	Data	Note
Basic statistics	Population (Block-group level)	National Statistical Office
	Employment (Block-group level)	National Statistical Office
	…	…
Travel survey	Household travel survey data	
Mobile phone data	Hourly mobile phone data (Pcell, 50mx50m)	SKT

❖ Comparison of data

Features	Basic statistics	Household travel survey	Mobile phone data
Obtainability	○	○	X
Collection period	○	△	○
Spatial details	△	○	○
Temporal details	X	○	○
Information accuracy	○	△	△
Data scale	Population	Sampling	Estimated population

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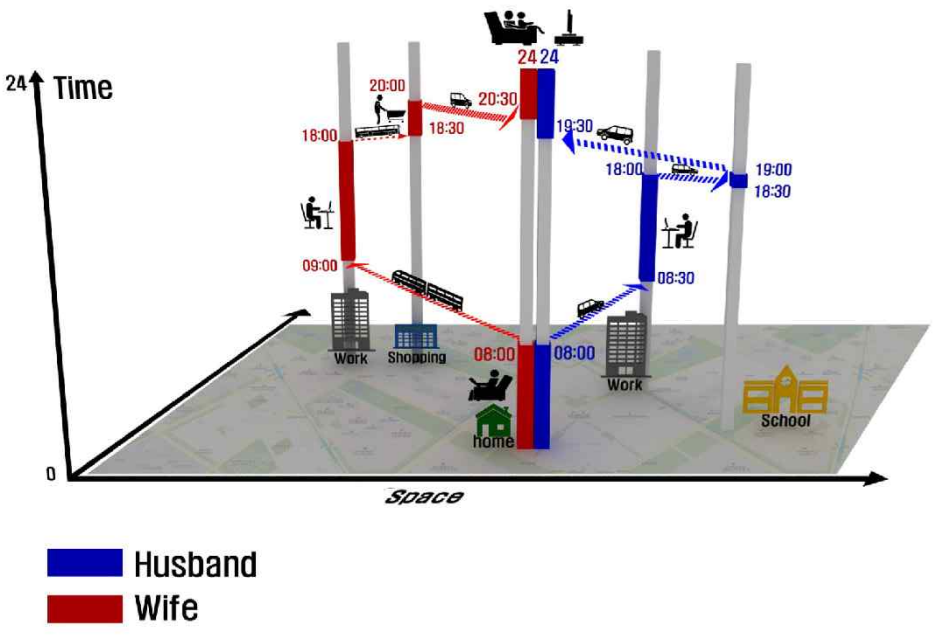
Activity Schedule



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Activity Schedule Modeling

Environment Change

- Land use
- Size of business
- Operation hours

Policy Change

- Home working
- Staggered office hours
- Part-time working

Schedule Change

- Ex) Extended working hours at department store HOME → SHOPPING
- Ex) Closing a school SCHOOL → HOME

Schedule Change

- Ex) Activity location change
- EX) Activity starting time or duration change

Developing Activity Schedule (Based on Household travel survey)

◈ Age

Group	Ratio
Under 10	10.0 %
10~19	15.1 %
20~29	17.3 %
30~39	15.4 %
40~49	24.6 %
50~59	11.4 %
Over 60	6.2 %

◈ Gender

Gender	Ratio
Man	50.1 %
Woman	49.9 %

◈ Occupation

Type	Ratio
Student	31.2 %
Homemaker/unemployed	21.8 %
Professional worker	4.6 %
Service worker	10.0 %
Sales worker	12.0 %
Office management	10.1 %
Agriculture, forestry	2.7 %
Mechanical	4.3 %
Others	3.3 %

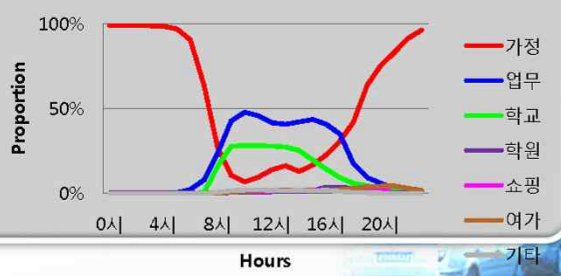
◈ Employment

Type	Ratio
Home worker	2.5 %
Full-time worker	34.5 %
Part-time worker	3.4 %
Self-employed	10.7 %
Others	5.9 %
Unemployed	43.0 %

Individual activity schedule

Hours																							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
H	H	H	H	H	H	H	H	H	H	H	H	H	H	M	O	O	M	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	W	W	W	W	W	W	W	W	W	W	H	H	H	H	H
H	H	H	H	H	H	H	H	H	M	W	W	W	W	W	W	W	W	W	M	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Activity Profile



Activity Schedule Change (Ex. Increasing the elderly to 30%)

◈ Age

Group	Ratio
Under 10	6.2 %
10~19	7.4 %
20~29	8.8 %
30~39	10.6 %
40~49	15.6 %
50~59	21.4 %
Over 60	30.0 %

◈ Gender

Gender	Ratio
Man	45.9 %
Woman	54.1 %

◈ Occupation

Type	Ratio
Student	13.5 %
Homemaker/unemployed	23.8 %
Professional worker	2.3 %
Service worker	8.8 %
Sales worker	11.1 %
Office management	5.7 %
Agriculture, forestry	25.7 %
Mechanical	5.9 %
Others	3.3 %

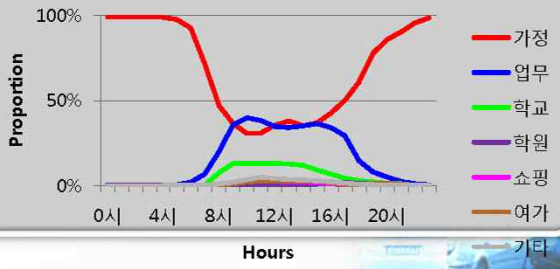
◈ Employment

Type	Ratio
Home worker	0.9 %
Full-time worker	11.0 %
Part-time worker	3.4 %
Self-employed	41.5 %
Others	5.9 %
Unemployed	37.3 %

Individual activity schedule

Hours																						
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
H	H	H	H	H	H	H	H	H	H	H	H	H	H	M	O	O	M	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	H	H	H	R	R	R	R	R	R	H	H	H	H	H	H	H
H	H	H	H	H	H	H	H	M	W	W	W	W	W	W	W	W	W	M	S	M	H	H	H
H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

Activity profile



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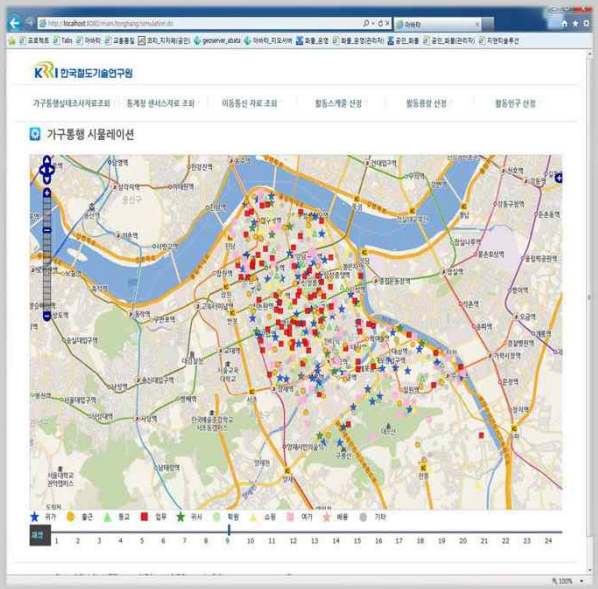
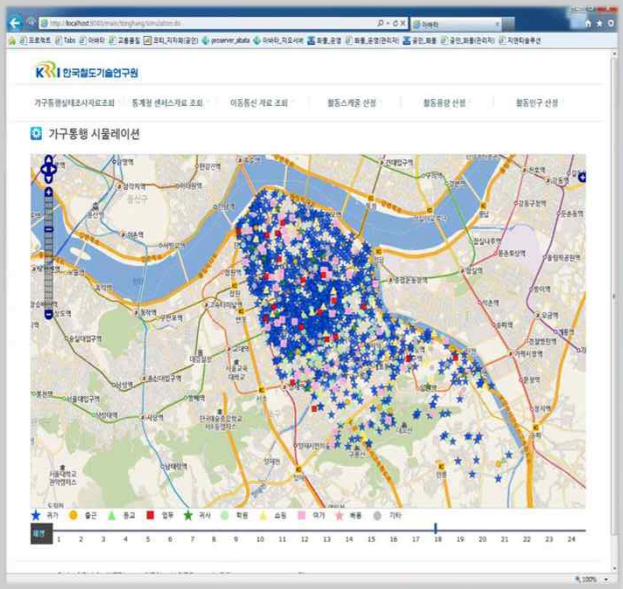
Simulation of Household Travel Survey Data





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Estimation of Relative Spatial Attractiveness

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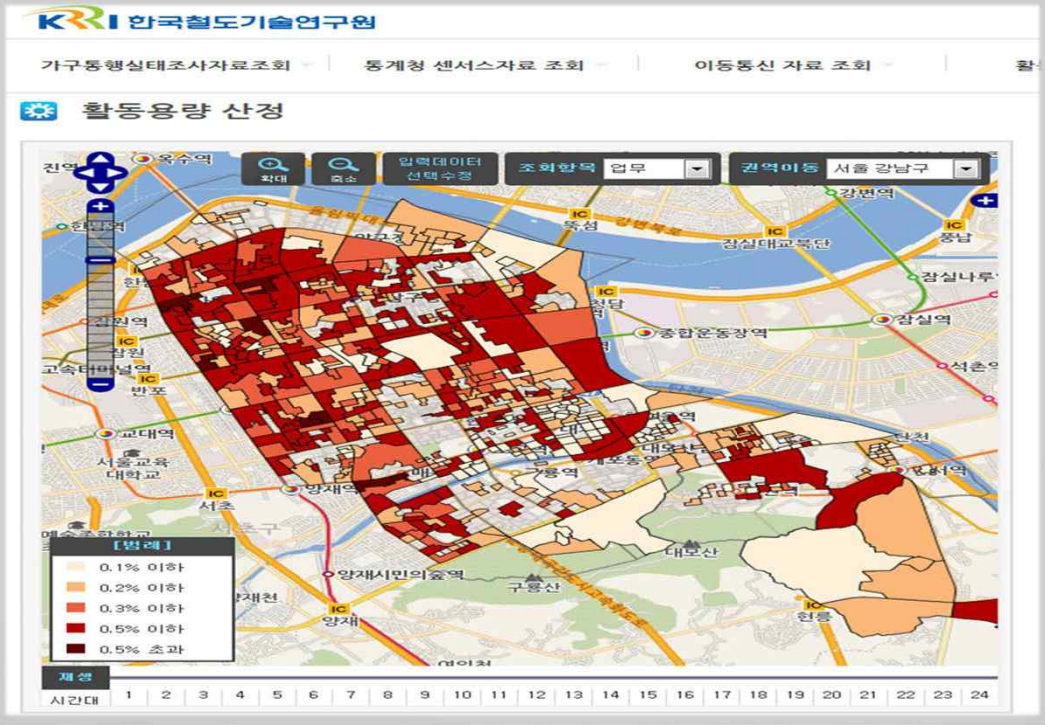
Spatial Attractiveness in ABATA



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Estimation of Spatial-temporal Activity Population

Estimation of Hourly Trip O/D

	1	2	3	4	5	6	7	8	9	10	11	12
1	121401.5	20109.21	8604.463	2960.58	3239.224	13652.42	5324.526	3687.13	11333.62	3435.228	2868.648	14824.9
2	18971.84	52156.21	21157.06	8715.707	1396.598	9675.5	2450.17	10028.41	3949.92	1522.423	1282.644	9088.006
3	9860.989	27483.93	104541.8	3068.331	150.092	1556.133	110.6	2720.441	1004.73	1098.773	151.789	879.303
4	1492.671	8887.966	3203.281	79247.67	10625.65	15922.16	2557.463	2341.347	1057.895	390.649	476.614	211.271
5	3198.181	1062.408	139.023	7512.708	94543.9	11120.92	9894.752	318.148	953.789	900.287	1147.909	150.036
6	13339.4	7670.752	845.907	22769.82	10363.06	142835	38331.65	21926.81	8855.487	1590.112	5227.537	794.51
7	6486.531	2043.908	235.472	3751.828	8084.391	38770.82	105709.4	2399.721	98.857	249.824	13978.72	67.2
8	38534.18	6283.501	2349.051	2412.597	581.037	20427.75	1913.403	204423.5	36194.28	6061.455	14686.79	2989.798
9	12282.77	4152.82	1086.765	1833.82	653.102	7718.278	64.48	37882.88	165161.7	32781.25	9646.115	139.324
10	4507.975	1348.753	295.421	677.949	681.753	1359.546	302.262	4495.664	27407.88	117389.9	18237.66	3.15
11	2917.749	1347.452	167.878	1367.078	1301.51	5270.044	10681.64	12171.06	8017.962	18220.5	184505.6	110.185
12	13992.89	8272.252	1504.938	329.995	98.599	540.939	86.443	3068.225	178.97	2.1	103.178	165350.9
13	26191.99	12065.05	4889.59	242.934	342.74	2668.67	510.224	5116.346	937.279	382.809	247.489	34676.37
14	13281.9	10048.66	11612.61	429.795	215.585	1708.512	807.357	1957.997	511.874	622.805	255.126	11373.2
15	1413.289	1060.913	610.208	12.352	74.262	17.118	6.813	52.796	2.1	0	11.187	988.449
16	2532.577	1856.336	193.097	52.848	13.744	217.779	58.318	55.735	37.9	3.377	3.391	965.212
17	1769.263	571.237	855.749	172.421	1.446	70.649	25.644	372.647	278.956	137.493	3.15	495.369
18	339.566	1603.497	2245.102	773.661	53.643	4.233	0	156.171	109.34	224.853	33.455	206.005
19	2416.627	3566.187	5342.721	401.73	101.114	428.219	271.086	946.64	263.52	180.149	106.88	2041.118
20	1675.831	5302.853	15110.69	26.016	70.936	45.533	63.095	484.758	522.414	448.949	165.626	631.335
21	1091.041	3150.297	6296.182	163.907	189.434	43.118	86.427	282.569	115.754	618.494	207.435	39.929
22	4547.765	6879.085	8190.66	1068.975	1275.14	1040.482	439.352	1485.308	1477.576	358.268	1149.381	902.385
23	7002.504	12843.29	9571.22	8536.065	7577.032	4244.119	3568.124	2932.944	2225.887	1207.511	2368.171	1539.525
24	427.133	1630.929	259.252	1145.714	13990.64	3006.744	2366.282	45.572	29.978	108.364	376.66	26.961
25	2807.241	667.767	74.876	40.182	9451.012	2943.984	414.221	681.541	681.531	222.12	279.972	44.767
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
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31	0	5.29558	0	0	0	0	0	0	0	0	0	0
32	0	35.13849	0	0	0	0	0	0	0	0	0	0
33	0	98.23359	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	91.96756	0	0	0	0	0	0	0
35	0	23.82872	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	248.956	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
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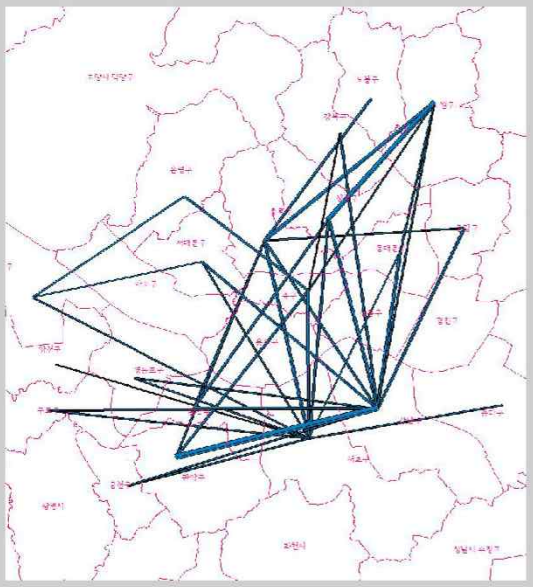
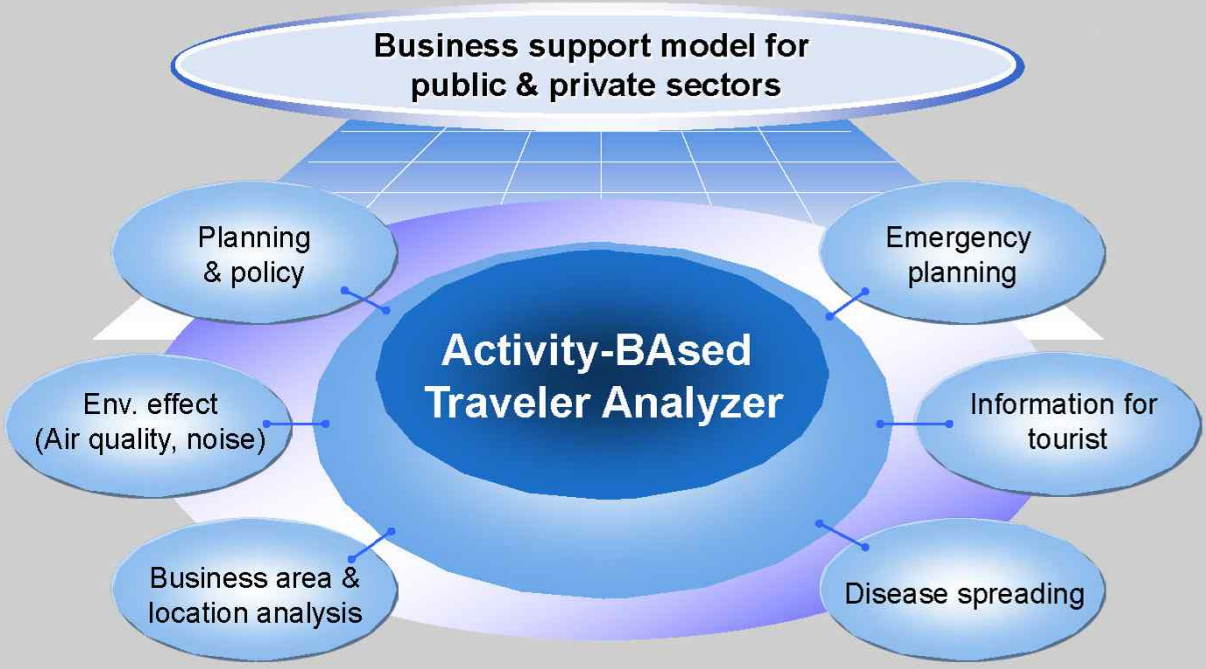


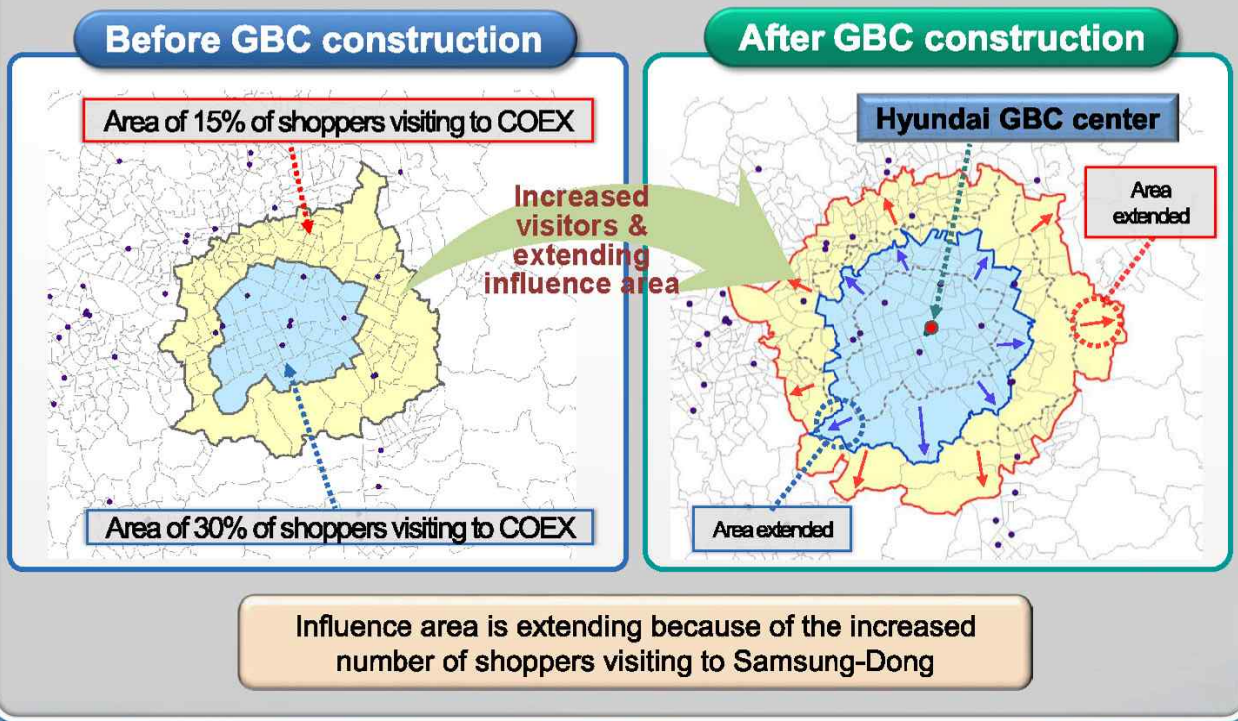
Ⅲ. Values and Applications of ABATA

Application Example

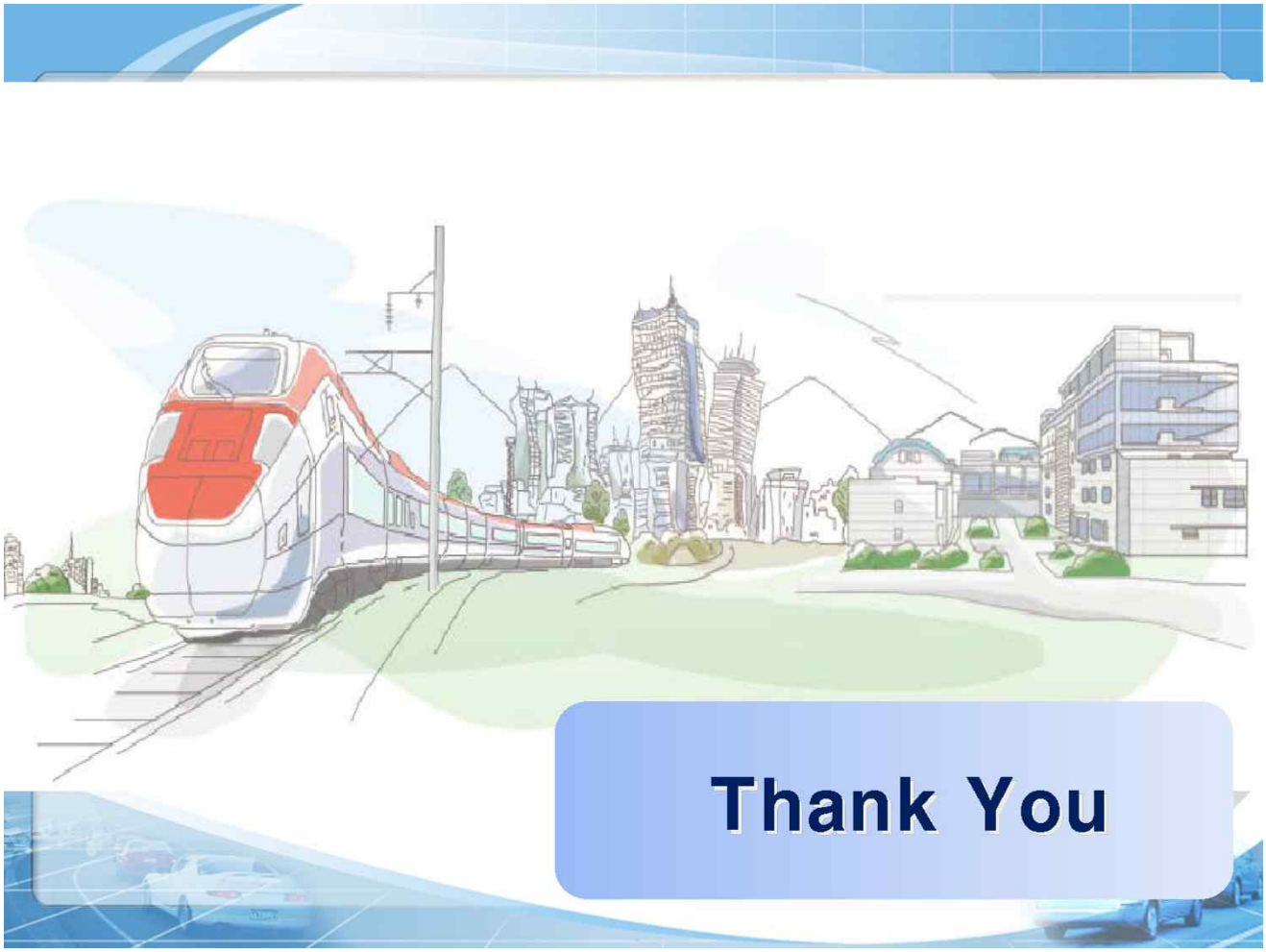


– 7 –

Example : Impacts of GBC Center



Influence area is extending because of the increased number of shoppers visiting to Samsung-Dong


Thank You

A Deep Dive into Location Intelligence and Big Data

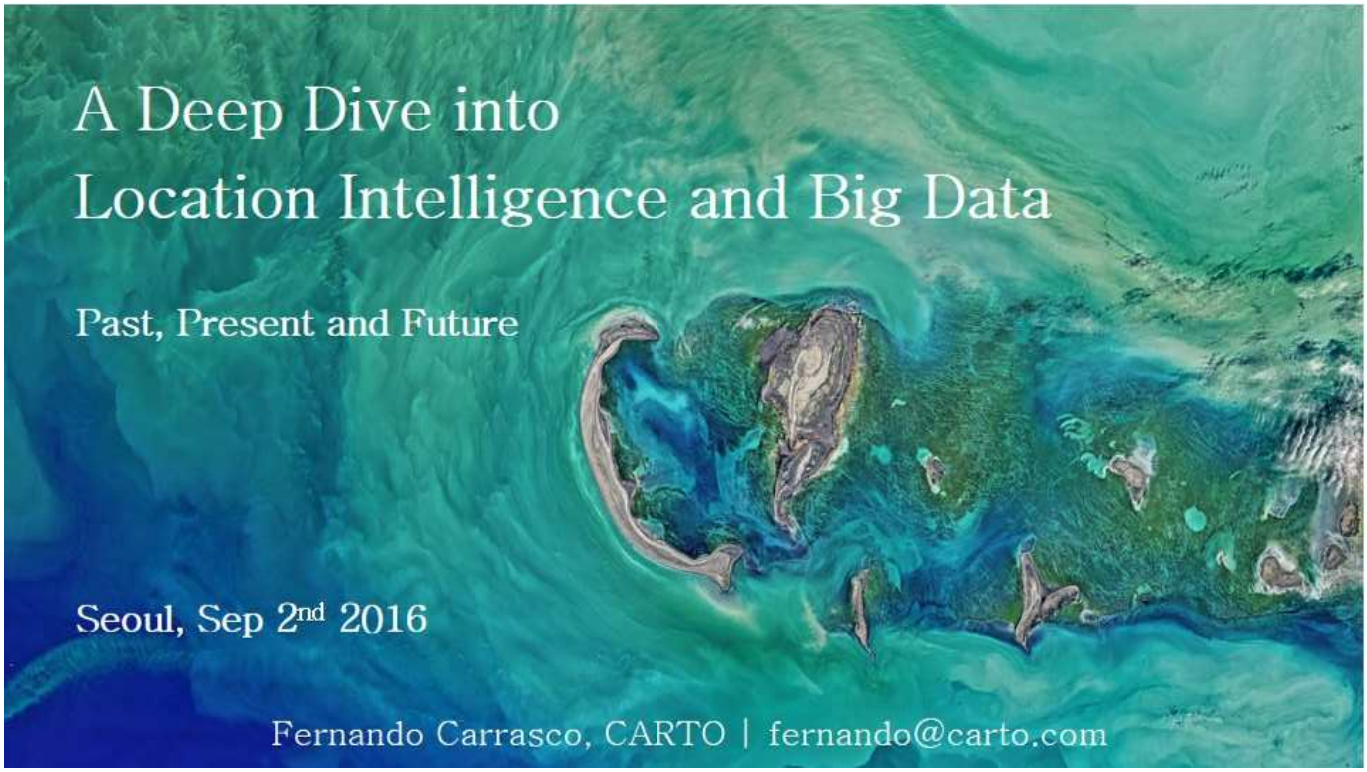
Fernando Carrasco

fernando@carto.com

CARTO

Abstract

A Deep Dive into Location Intelligence and Big Data is a presentation of the concept of Location Intelligence in the past, in the present and in the near future. The presenter will showcase different Location Intelligence cases and the audience will appreciate how the volume of location data has been increasing over time.



PAST

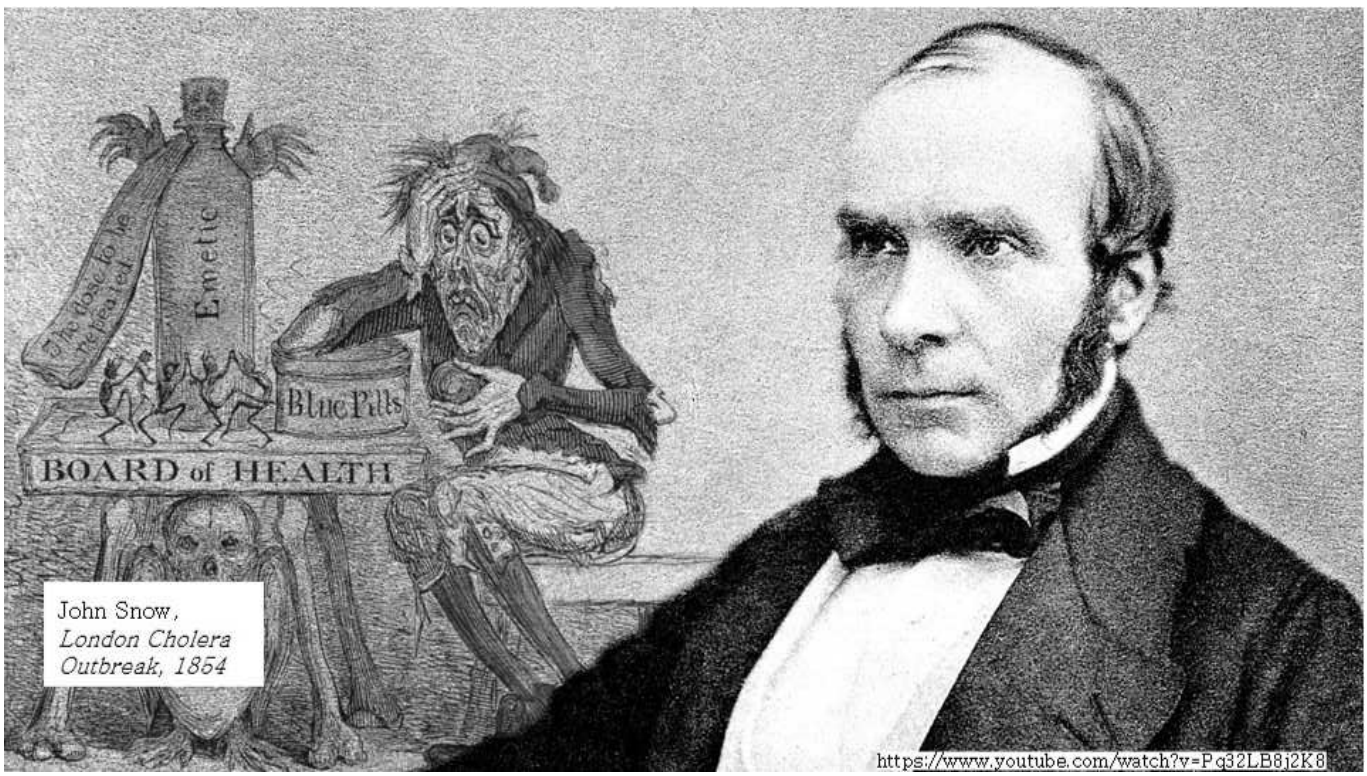
PRESENT

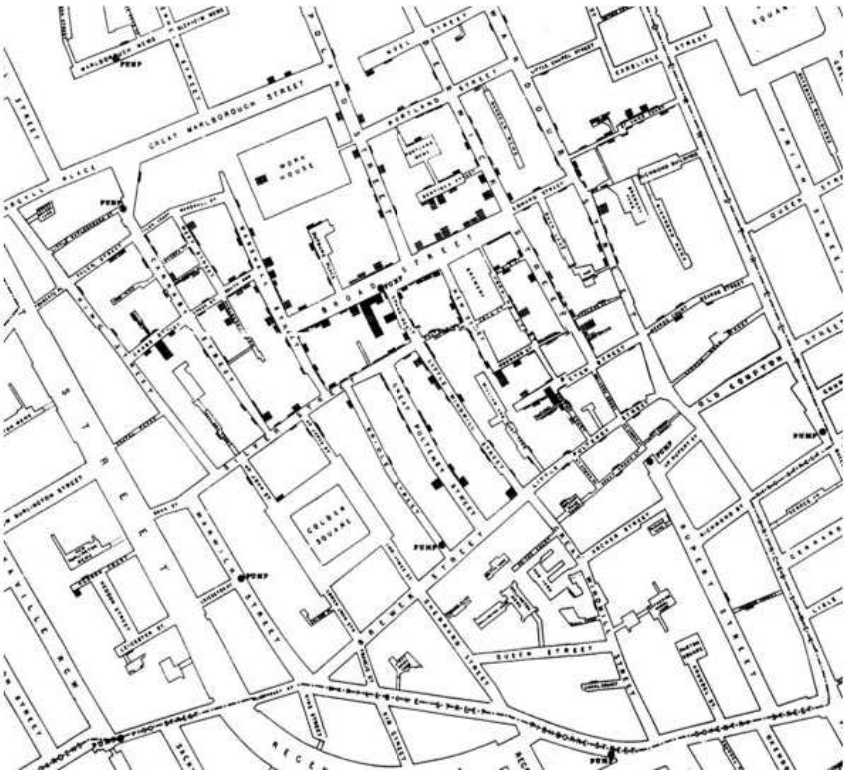
FUTURE

PAST

PRESENT

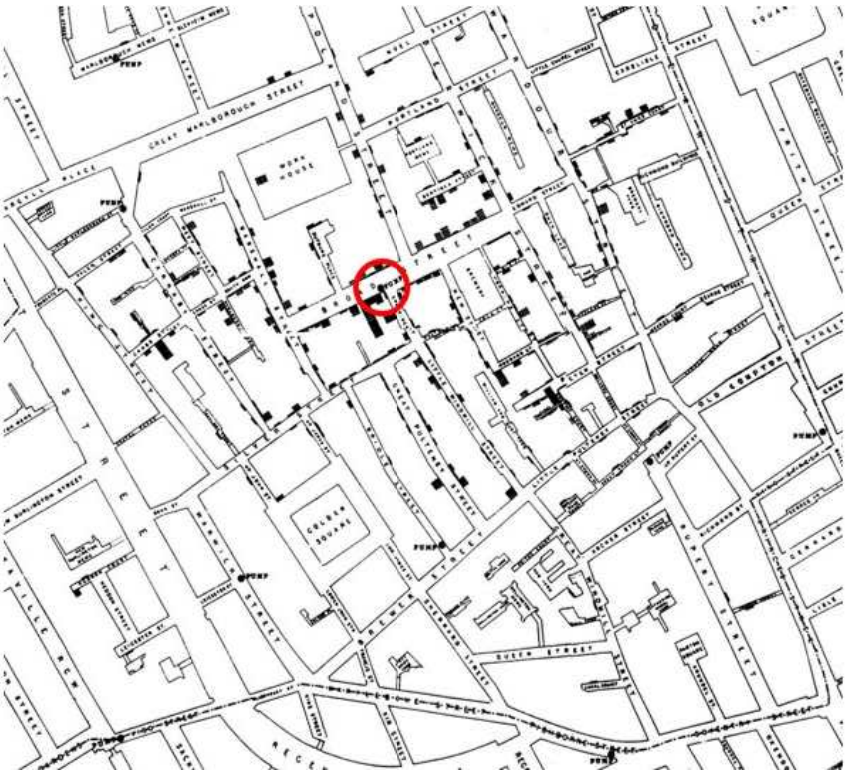
FUTURE



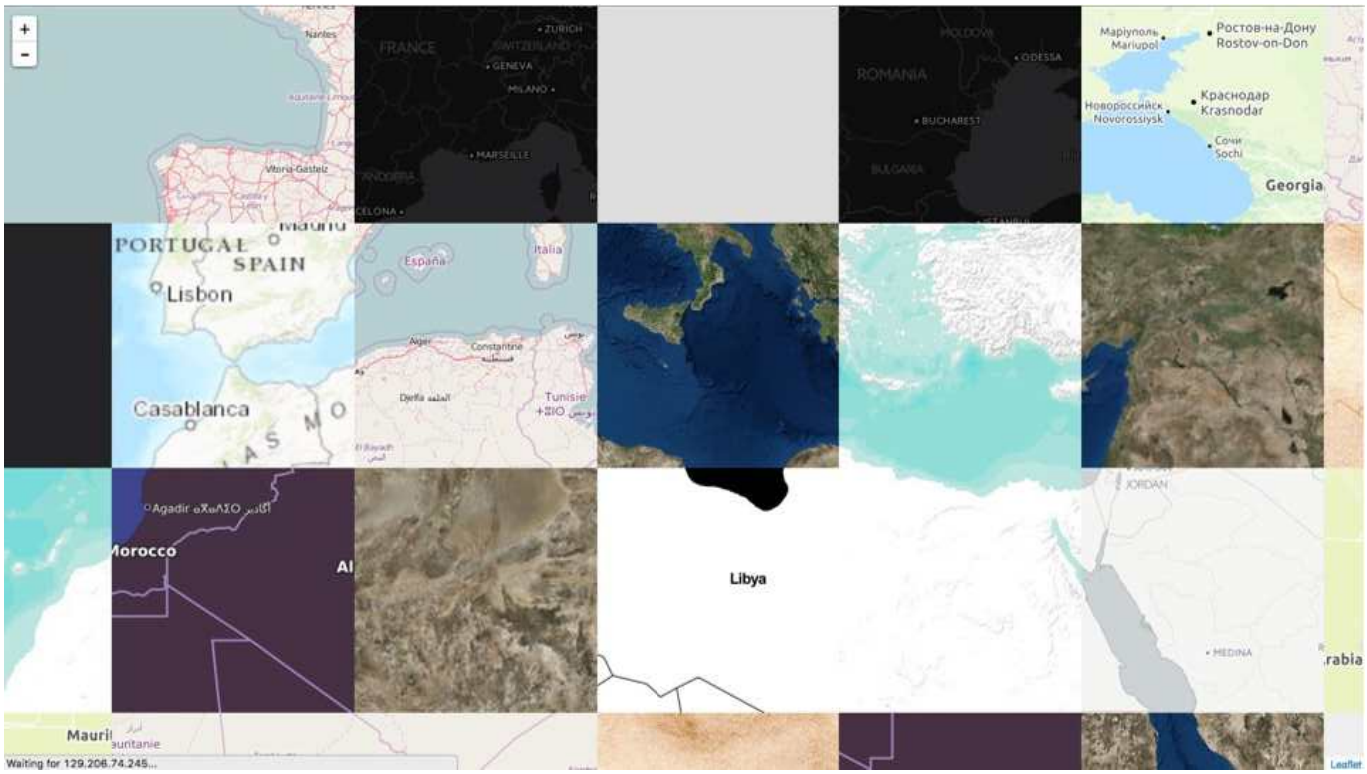


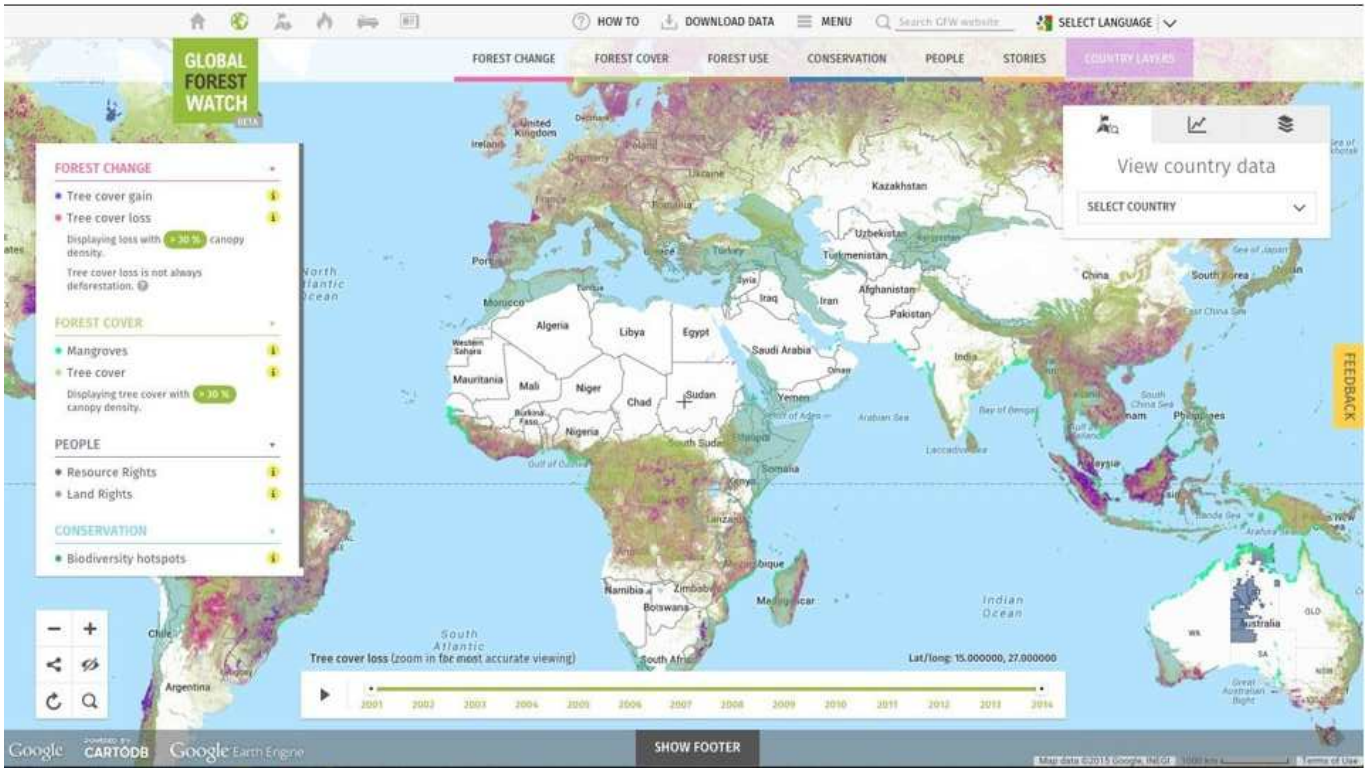
John Snow,
London Cholera Outbreak Map, 1854

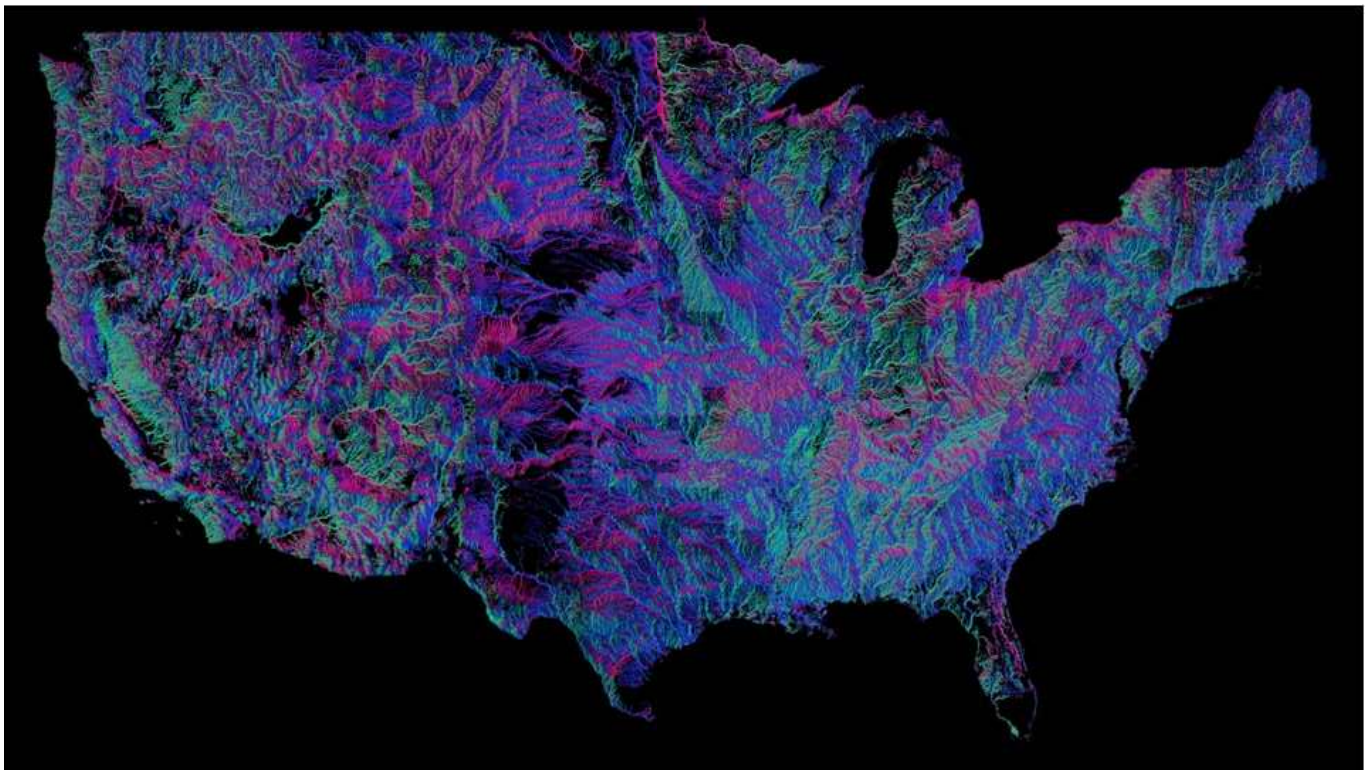
John Snow Memorial & Public House,
Broadwick Street, Soho



John Snow,
London Cholera Outbreak Map, 1854




GLOBAL FOREST WATCH
HOW TO
DOWNLOAD DATA
MENU
SELECT LANGUAGE
FOREST CHANGE
FOREST COVER
FOREST USE
CONSERVATION
PEOPLE
STORIES
COUNTRY LAYERS
FOREST CHANGE
Tree cover gain
Tree cover loss
Displaying loss with > 30 % canopy density.
Tree cover loss is not always deforestation.
FOREST COVER
Mangroves
Tree cover
Displaying tree cover with > 30 % canopy density.
PEOPLE
Resource Rights
Land Rights
CONSERVATION
Biodiversity hotspots
View country data
SELECT COUNTRY
FEEDBACK
Tree cover loss (zoom in for most accurate viewing)
Lat/long: 15.000000, 27.000000
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Google CARTODB Google Earth Engine
SHOW FOOTER




15
14
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line-opacity: 0.4;
line-width: 8;
}
[zoom <= 14]{
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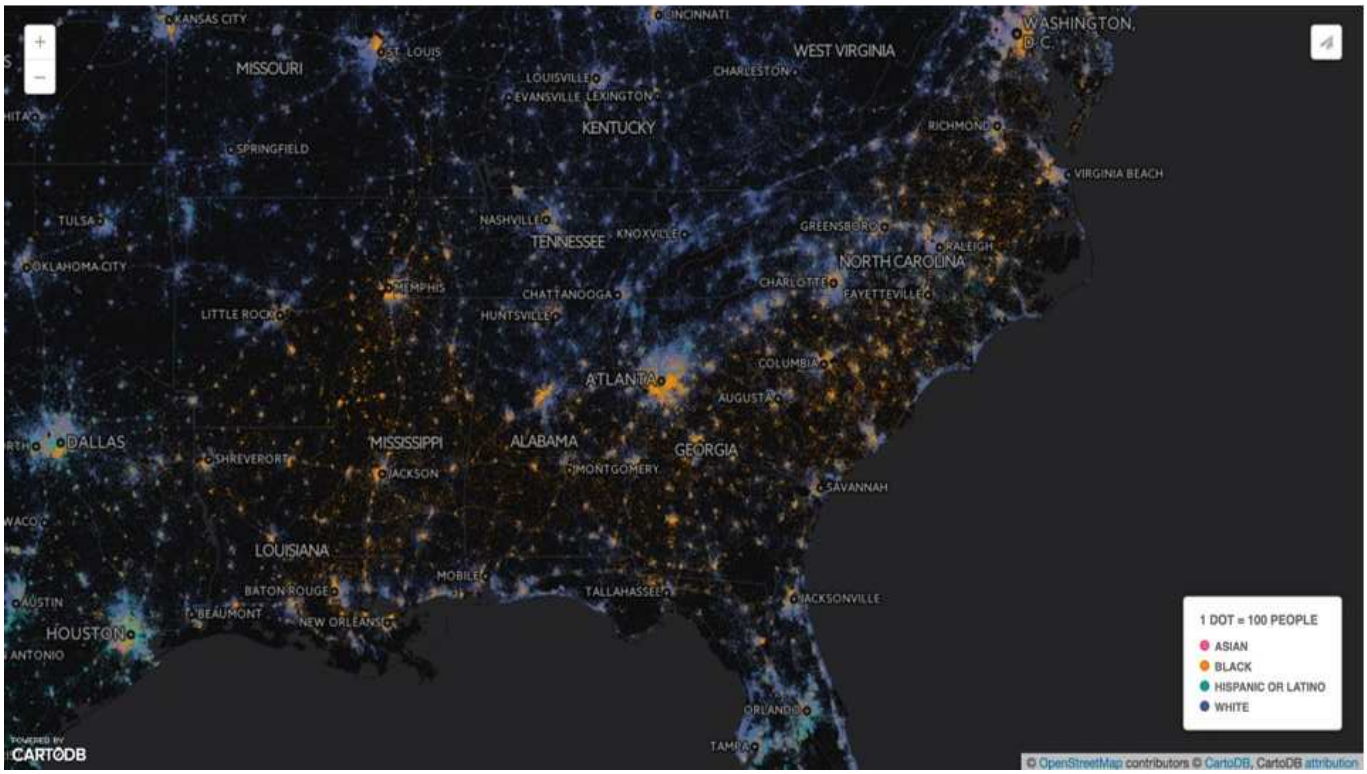
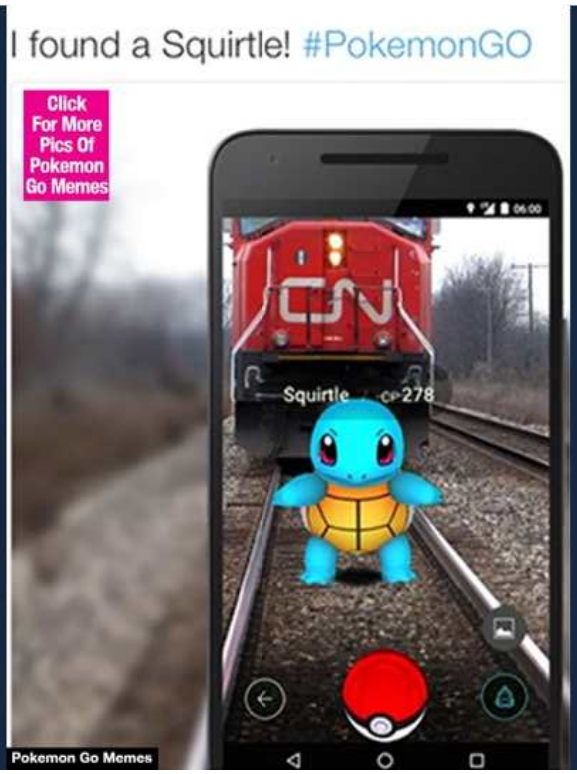
line-opacity: 0.3;
line-width: 10;
}}


KANSAS CITY
ST. LOUIS
MISSOURI
CINCINNATI
WASHINGTON, D.C.
WEST VIRGINIA
CHARLESTON
LOUISVILLE
EVANSVILLE
LEXINGTON
KENTUCKY
SPRINGFIELD
RICHMOND
VIRGINIA BEACH
TULSA
NASHVILLE
TENNESSEE
KNOXVILLE
GREENSBORO
RALEIGH
OKLAHOMA CITY
MEMPHIS
CHATTANOOGA
NORTH CAROLINA
CHARLOTTE
FAYETTEVILLE
LITTLE ROCK
HUNTSVILLE
COLUMBIA
ATLANTA
AUGUSTA
DALLAS
SHREVEPORT
MISSISSIPPI
ALABAMA
GEORGIA
JACKSON
MONTGOMERY
SAVANNAH
LOUISIANA
MOBILE
TALLAHASSEE
JACKSONVILLE
AUSTIN
BATON ROUGE
BEAUMONT
NEW ORLEANS
HOUSTON
ANTONIO
ORLANDO
TAMPA
1 DOT = 100 PEOPLE
ASIAN
BLACK
HISPANIC OR LATINO
WHITE
POWERED BY CARTODB
© OpenStreetMap contributors © CartoDB, CartoDB attribution

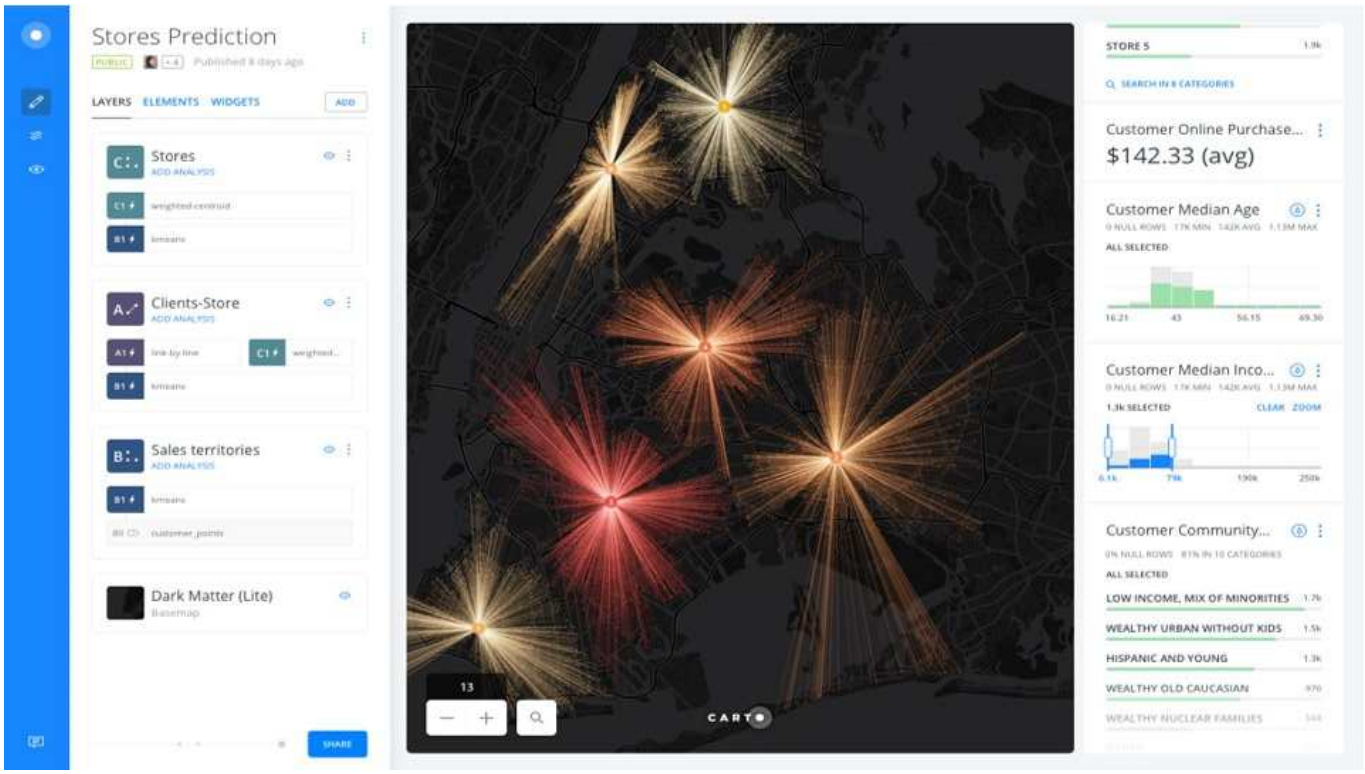
PAST

PRESENT

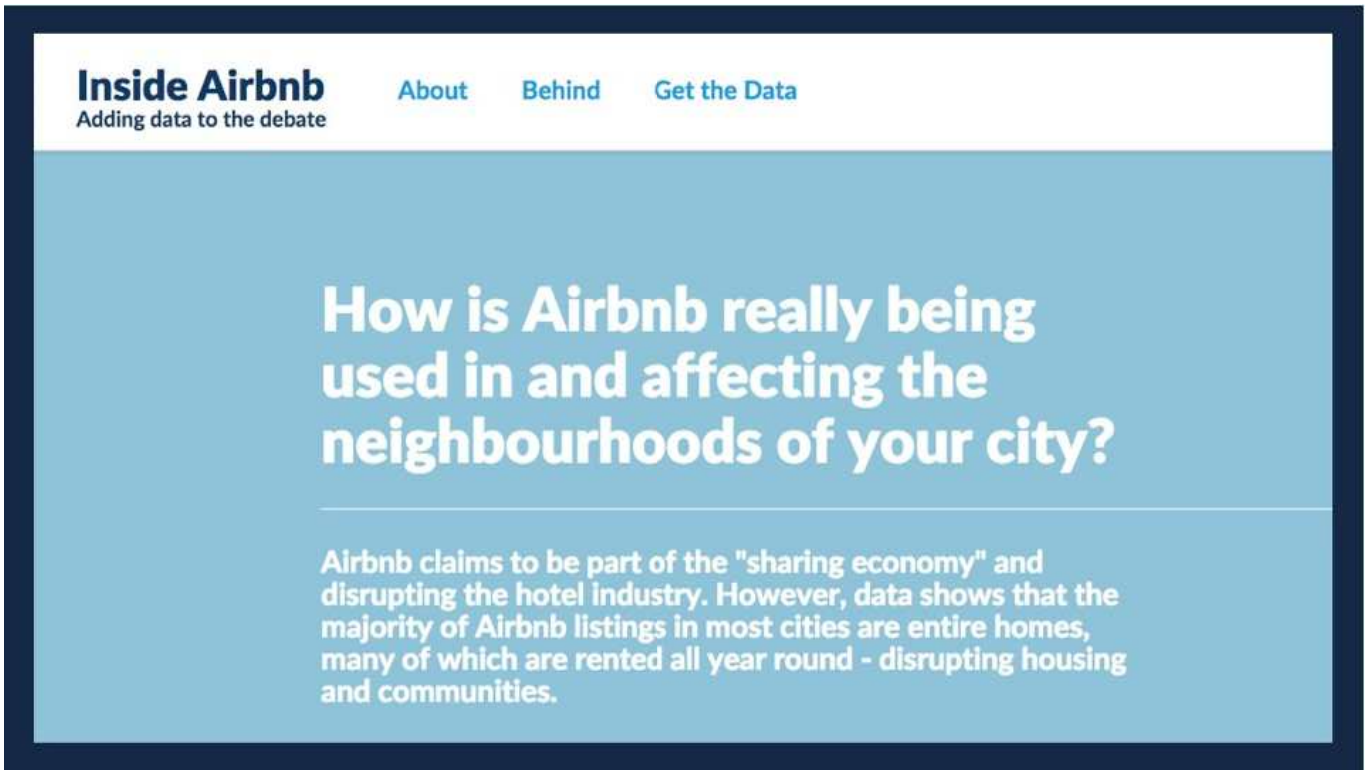
FUTURE

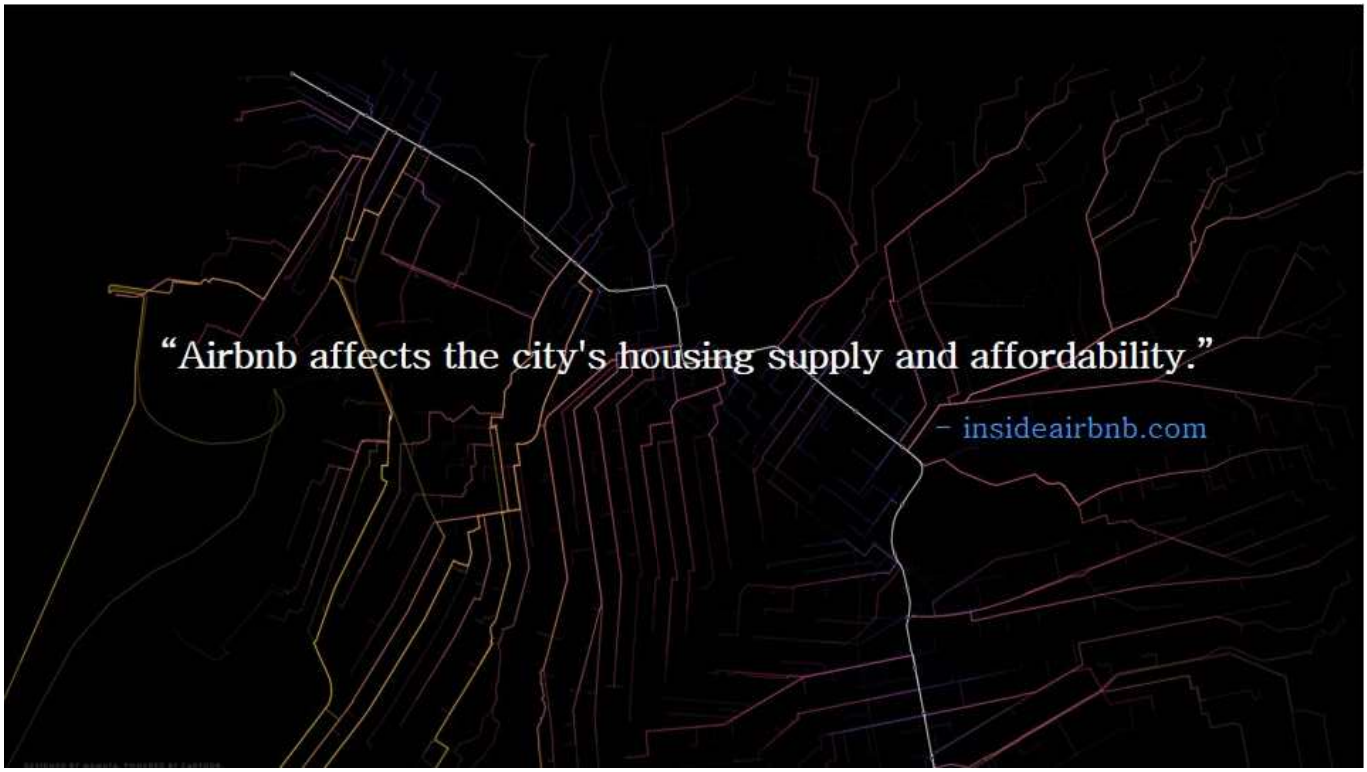


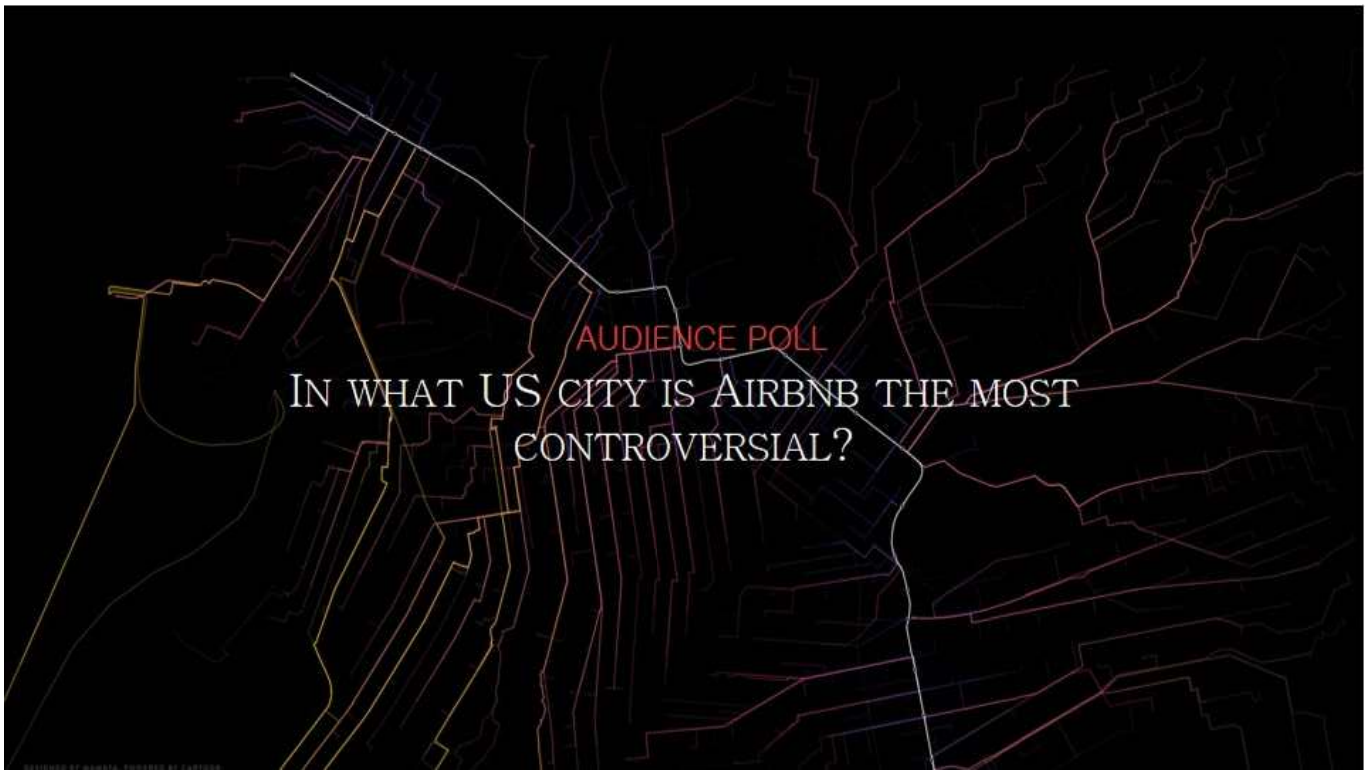

WHAT WERE WE MISSING IN THE PAST?


Stores Prediction
LAYERS
ELEMENTS
WIDGETS
ADD
Stores
Clients-Store
Sales territories
Dark Matter (Lite)
SHARE
CARTO
STORE 5
Customer Online Purchase...
$142.33 (avg)
Customer Median Age
ALL SELECTED
Customer Median Inco...
Customer Community...
LOW INCOME, MIX OF MINORITIES
WEALTHY URBAN WITHOUT KIDS
HISPANIC AND YOUNG
WEALTHY OLD CAUCASIAN

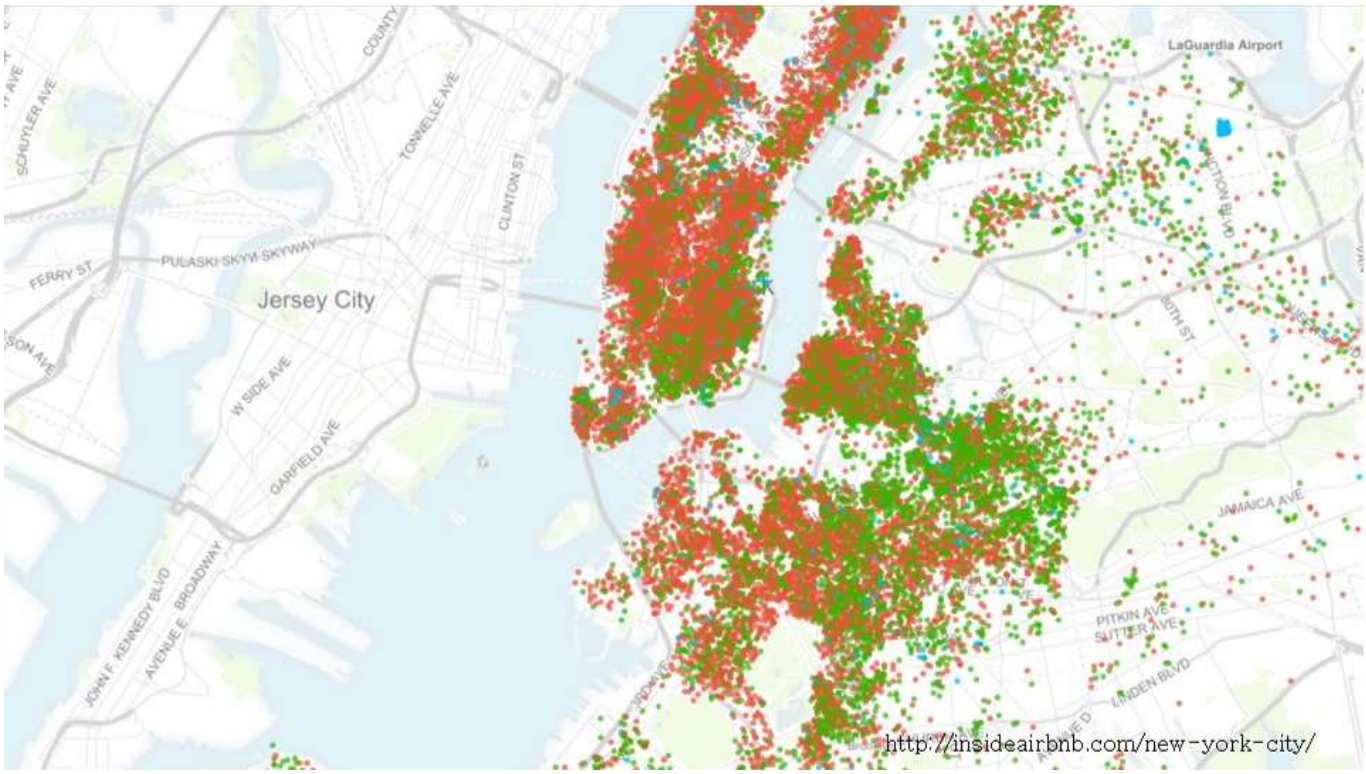

LET ME SHOW YOU WHAT I MEAN.

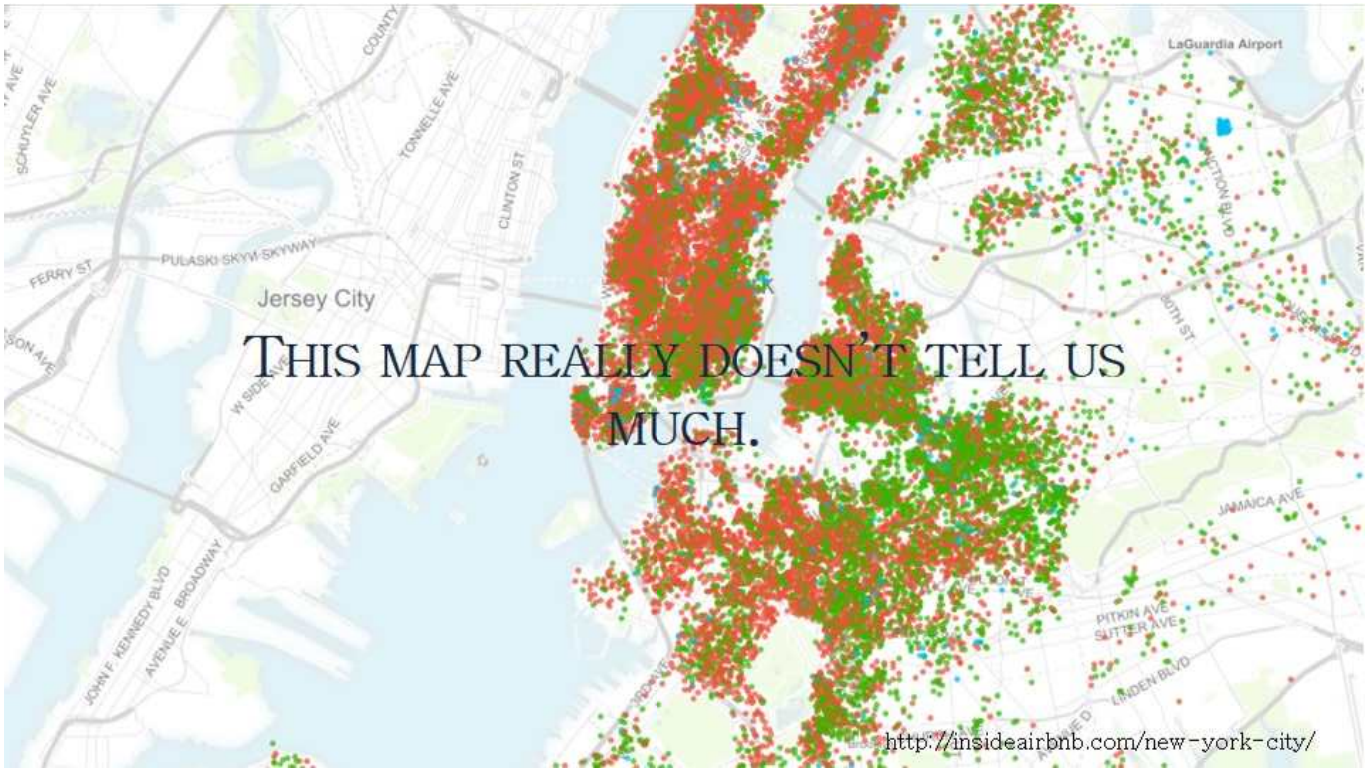

Inside Airbnb
Adding data to the debate
About
Behind
Get the Data
How is Airbnb really being used in and affecting the neighbourhoods of your city?
Airbnb claims to be part of the "sharing economy" and disrupting the hotel industry. However, data shows that the majority of Airbnb listings in most cities are entire homes, many of which are rented all year round - disrupting housing and communities.


“Airbnb affects the city's housing supply and affordability.”
– insideairbnb.com

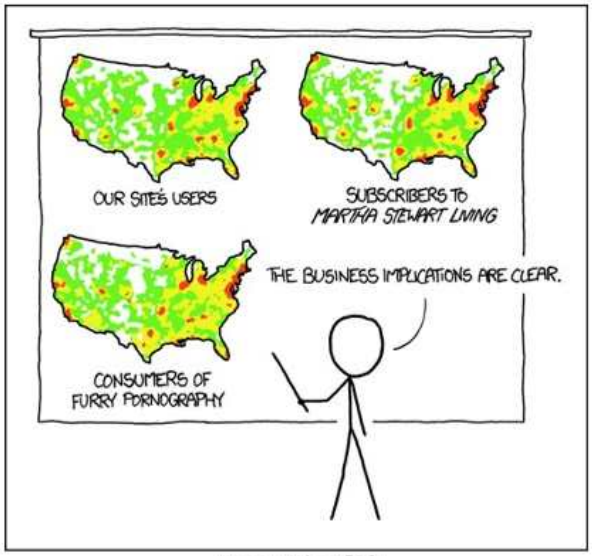

AUDIENCE POLL
IN WHAT US CITY IS AIRBNB THE MOST CONTROVERSIAL?


LET'S DIG INTO THE
DATA


LaGuardia Airport
Jersey City
COUNTY
TONNELLE AVE
CLINTON ST
FERRY ST
PULASKI SKYW-SKYWAY
W SIDE AVE
GARFIELD AVE
JOHN F KENNEDY BLVD
AVENUE E
BROADWAY
JAMAICA AVE
PITKIN AVE
SUTTER AVE
LINDEN BLVD
http://insideairbnb.com/new-york-city/

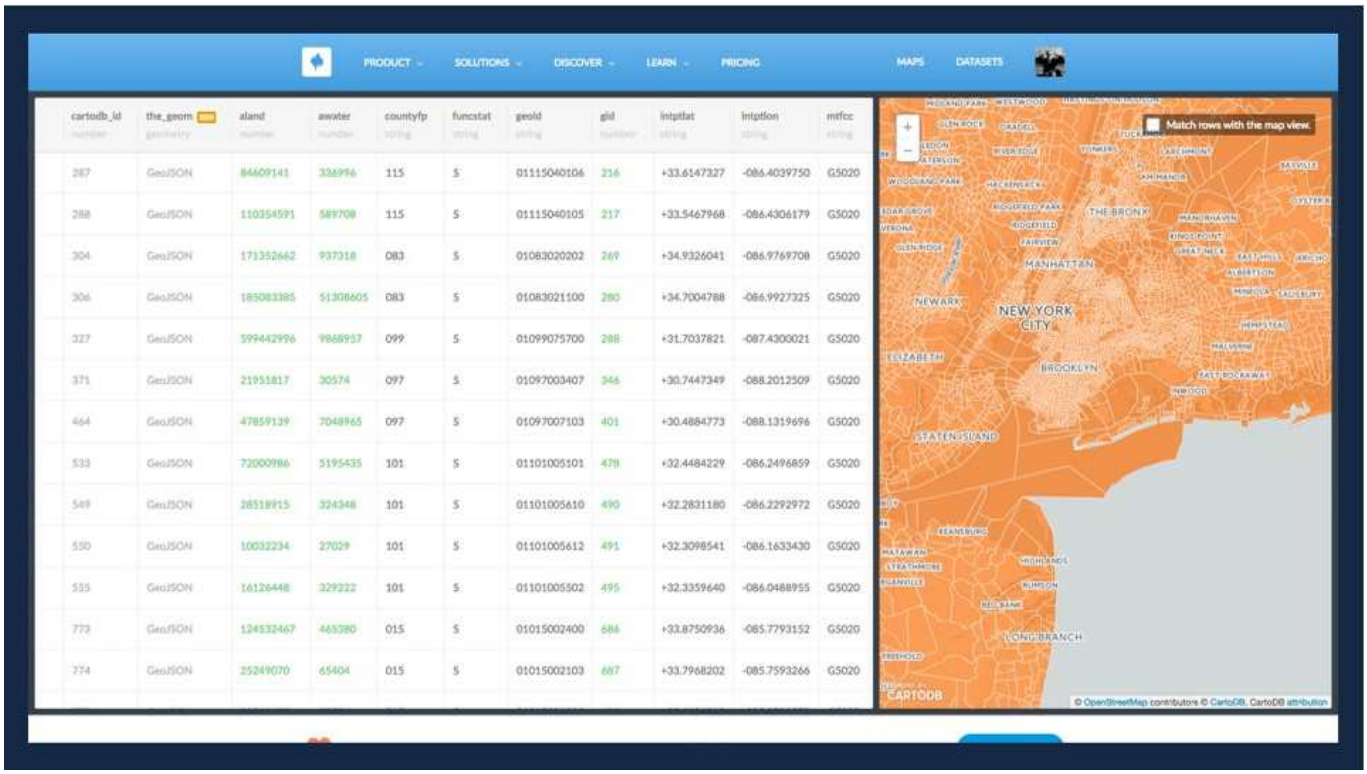

LaGuardia Airport
Jersey City
THIS MAP REALLY DOESN'T TELL US MUCH.
http://insideairbnb.com/new-york-city/


IT NEEDS DENOMINATORS.



PET PEEVE #208:
GEOGRAPHIC PROFILE MAPS WHICH ARE BASICALLY JUST POPULATION MAPS

https://xkcd.com/1138/



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306	GeoJSON	185083385	51308605	083	S	01083021100	280	+34.7004788	-086.9927325	G5020
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371	GeoJSON	21951817	30574	097	S	01097003407	346	+30.7447349	-088.2012509	G5020
464	GeoJSON	47859139	7048965	097	S	01097007103	401	+30.4884773	-088.1319696	G5020
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549	GeoJSON	28518915	324348	101	S	01101005610	490	+32.2831180	-086.2292972	G5020
550	GeoJSON	10032234	27029	101	S	01101005612	491	+32.3098541	-086.1633430	G5020
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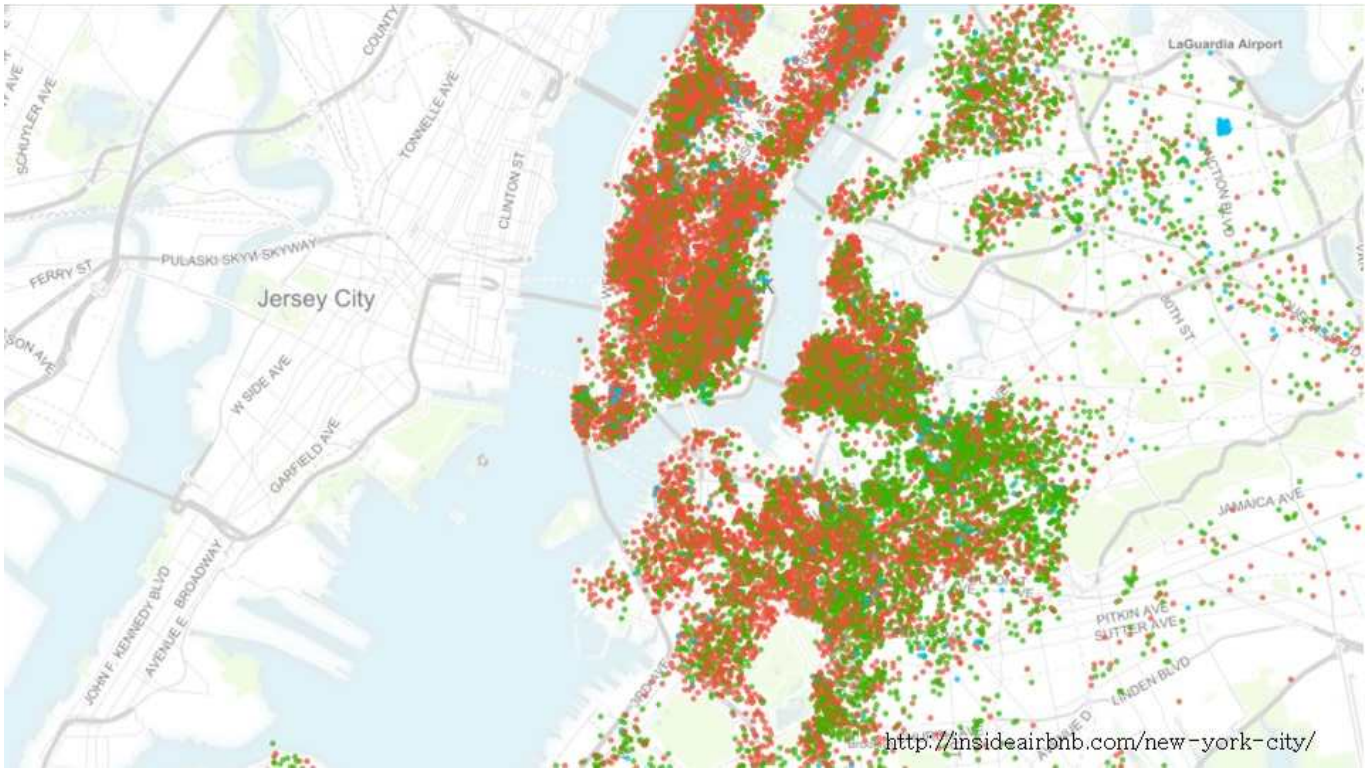
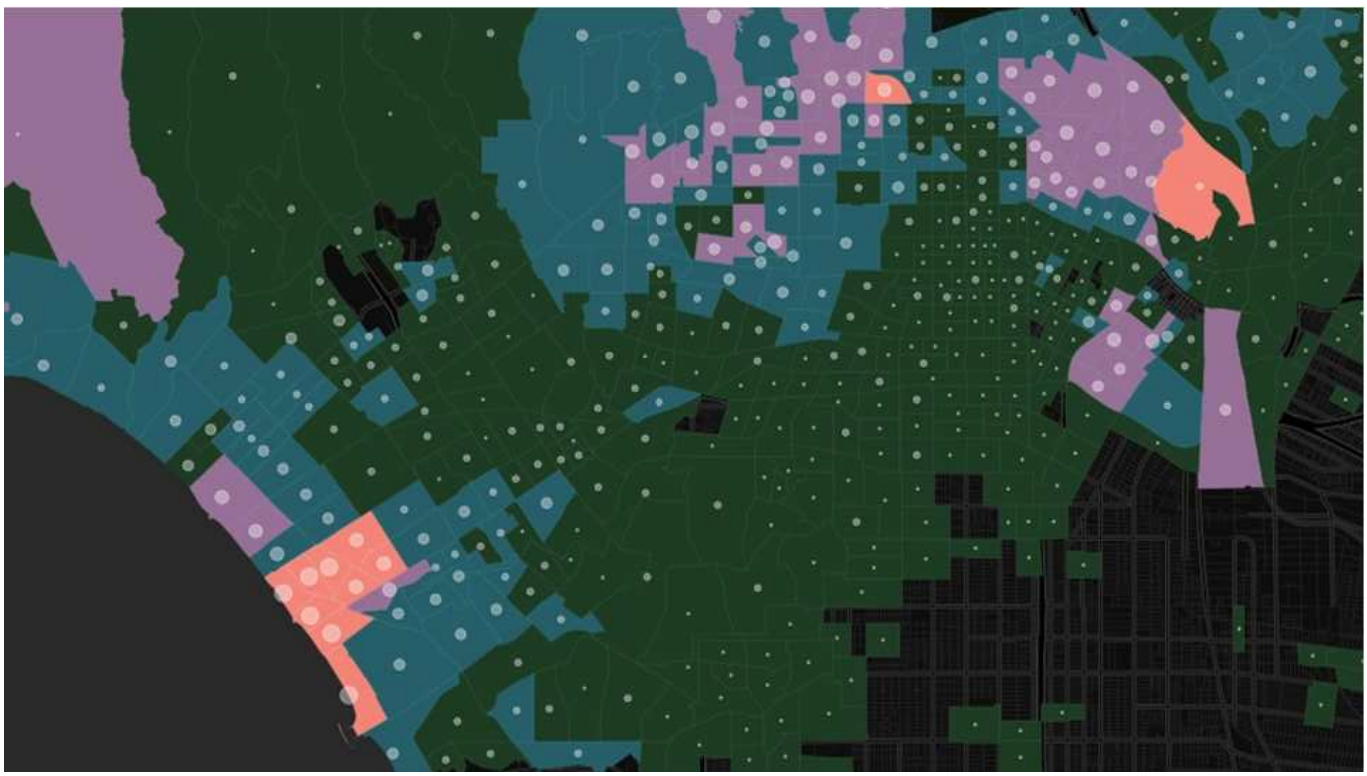
773	GeoJSON	124532467	465380	015	S	01015002400	686	+33.8750936	-085.7793152	G5020
774	GeoJSON	25249070	65404	015	S	01015002103	687	+33.7968202	-085.7593266	G5020

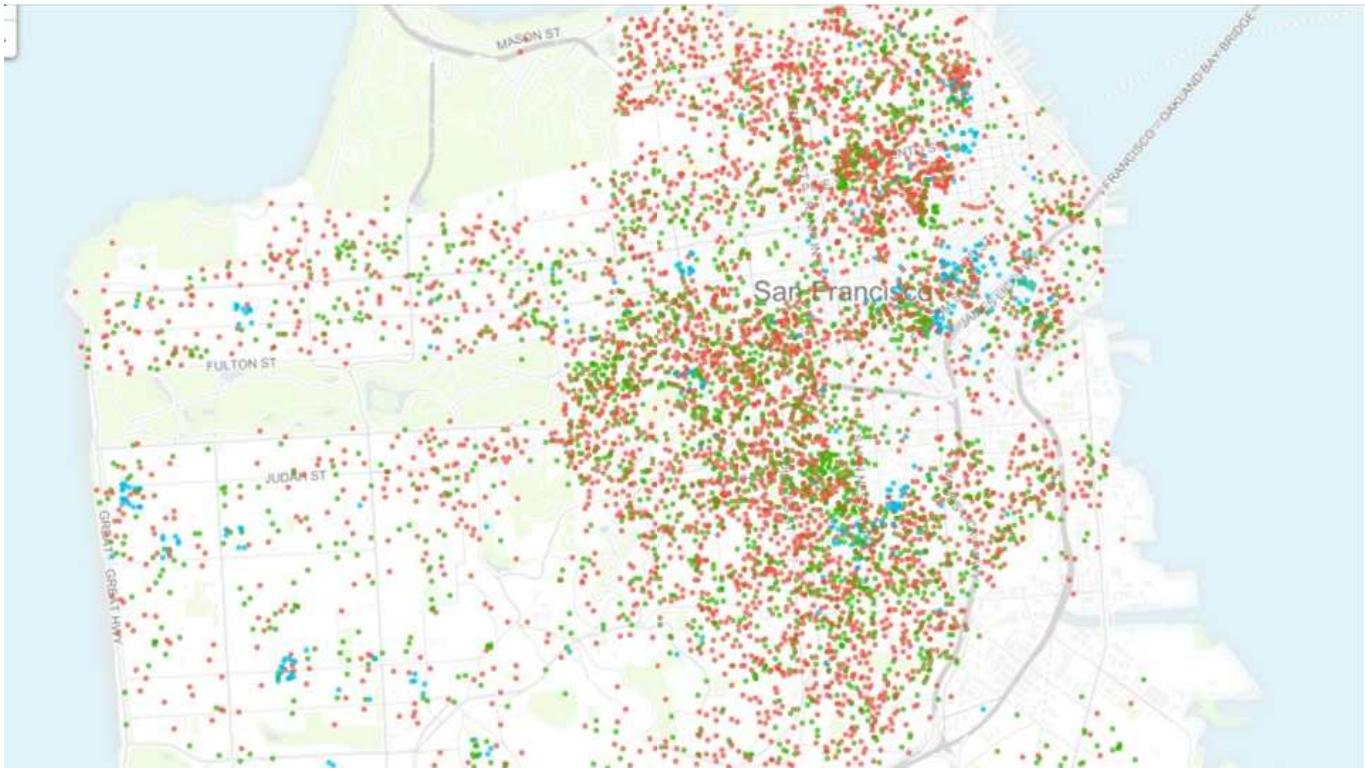

AGGREGATE AND BLEND THE
DATA.

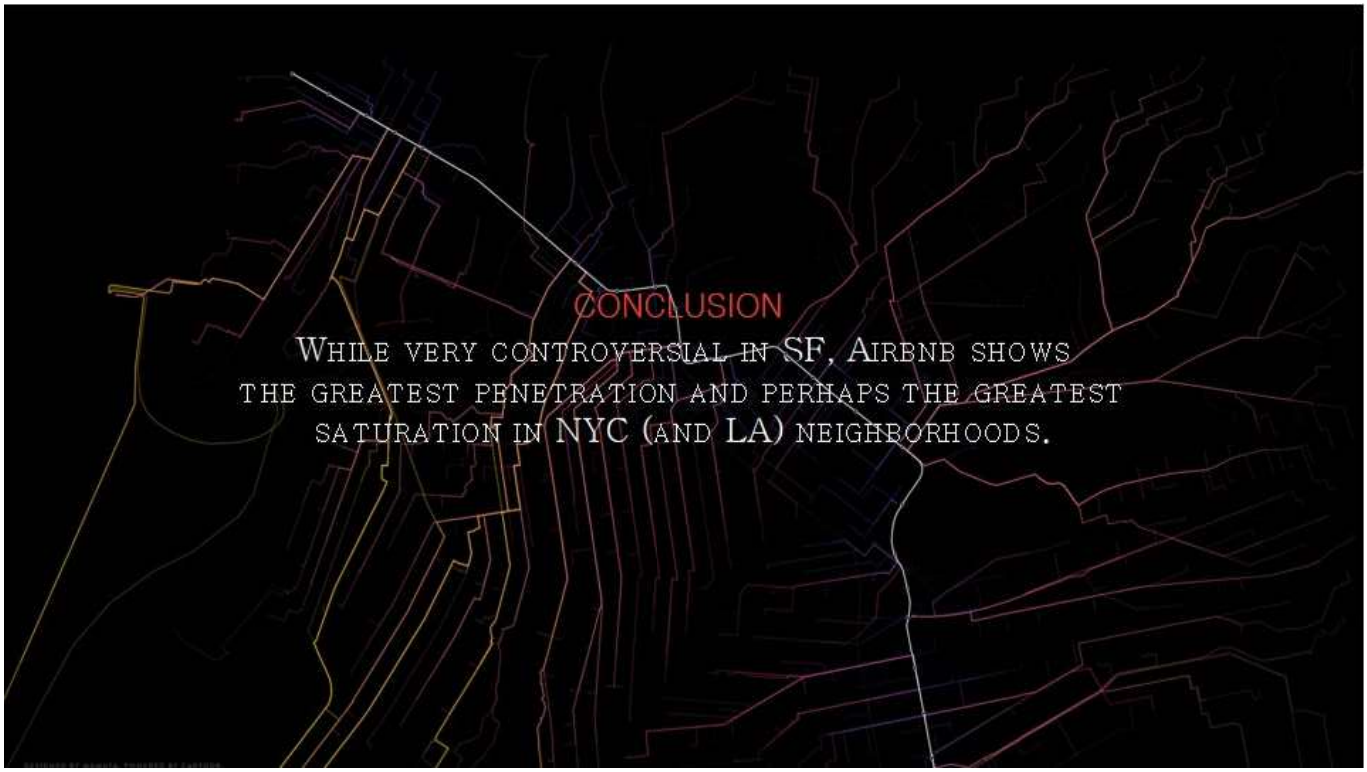

KitchenAid
KitchenAid


LaGuardia Airport
Jersey City
FERRY ST
PULASKI SKYW-SKYWAY
W SIDE AVE
GARFIELD AVE
JOHN F. KENNEDY BLVD
AVENUE E
BROADWAY
CLINTON ST
TONNELLE AVE
JAMAICA AVE
PITKIN AVE
SUTTER AVE
LINDEN BLVD
http://insideairbnb.com/new-york-city/


Beverly Hills
Los Angeles
Santa Monica
SUNSET BLVD
W SUNSET BLVD
WILSHIRE BLVD
W PICO BLVD
W JEFFERSON BLVD
W VERNON AVE
W 48TH ST
W 54TH ST
W SLAUSON AVE
E SLAUSON AVE
W FLORENCE AVE
E FLORENCE AVE
15TH ST
HOOPER AVE
ALAMEDA ST
SANTA FE AVE
S MAIN ST
SOUTH BROADWAY
S VERMONT AVE
S WESTERN AVE
Ladera Heights
View Park–Windsor Hills
Walnut Park




MASON ST
FULTON ST
JUDAH ST
GREAT HWY



PAST

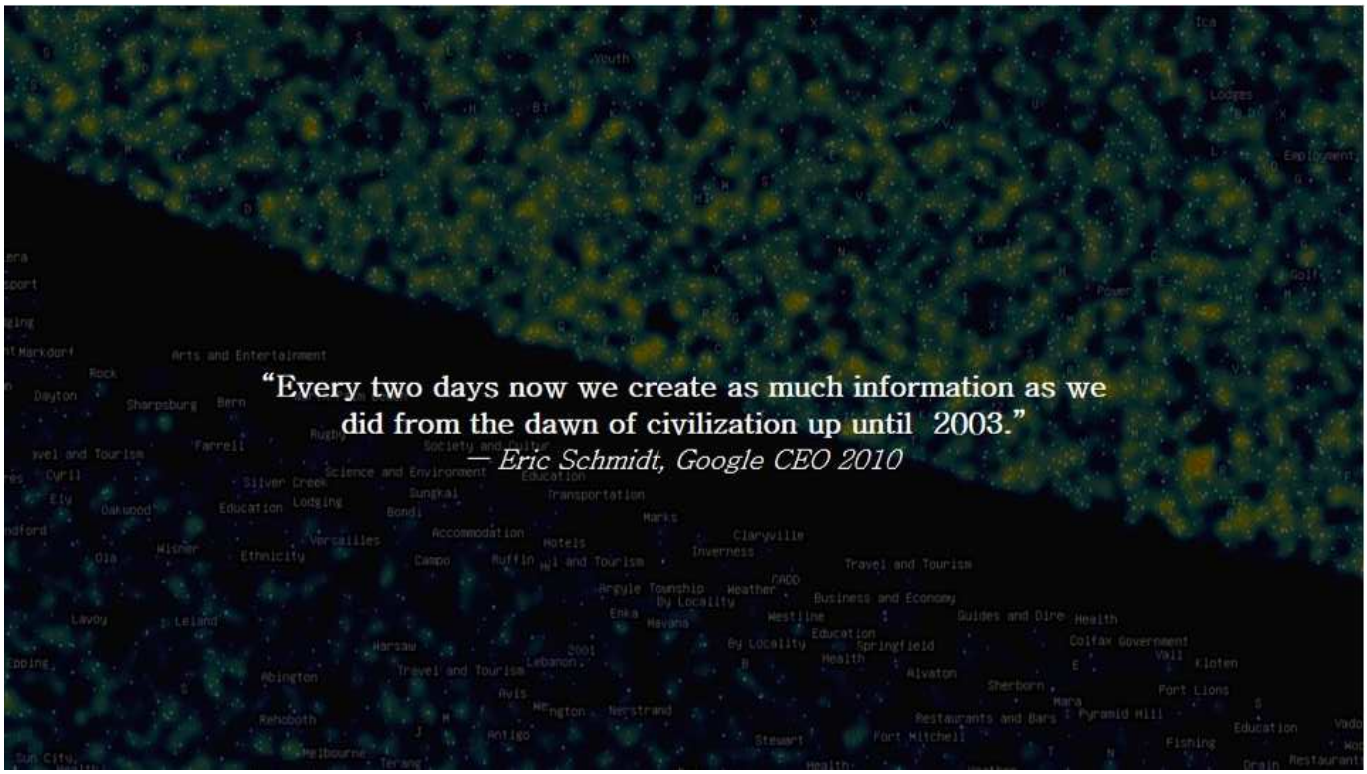
PRESENT

FUTURE

PAST

PRESENT

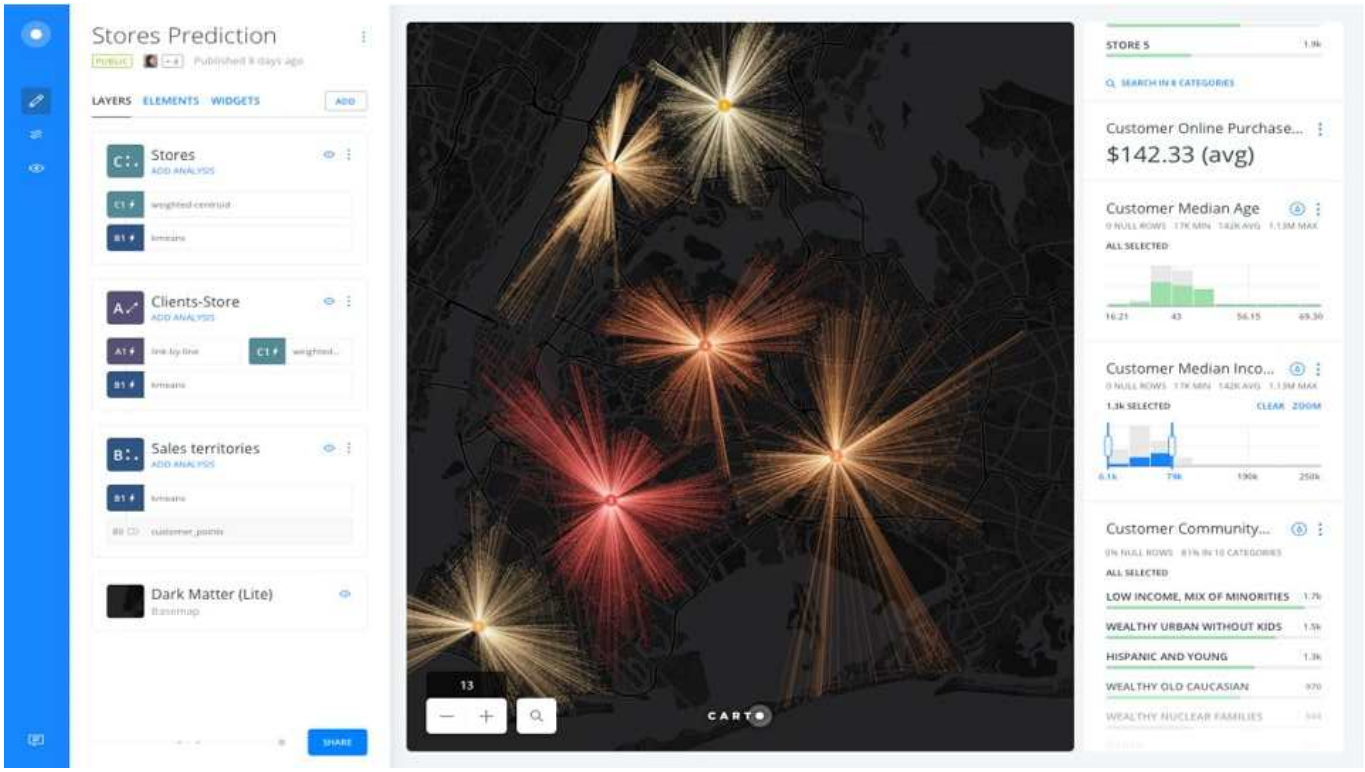
NEAR FUTURE




An increasing amount of data
needs more processing power


Analyze billions of historic and real-
time records like a regular table

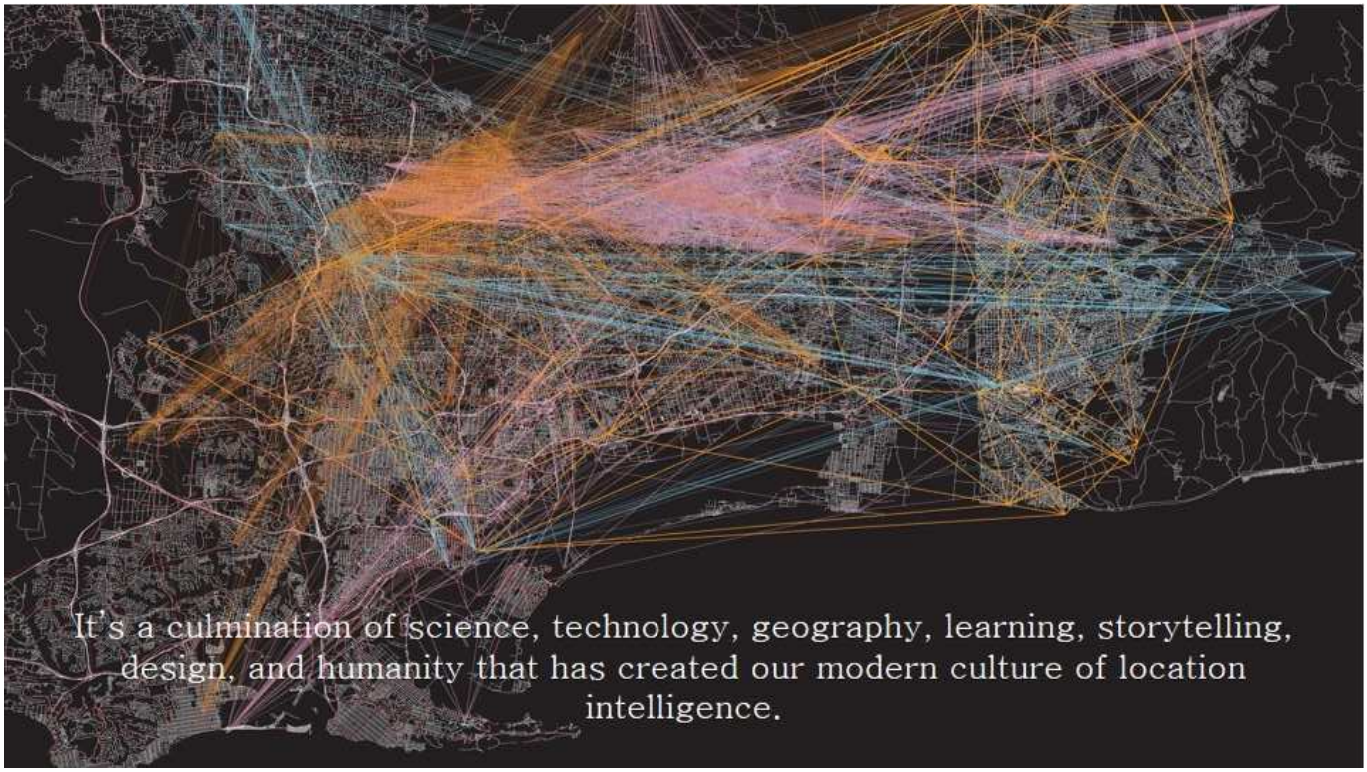

Spark



PAST

PRESENT

FUTURE



THANK YOU!

CARTO

FERNANDO@CARTO.COM

PREDICT THROUGH LOCATION