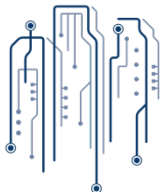


The data privacy, data protection and data security implications of smart cities and urban big data

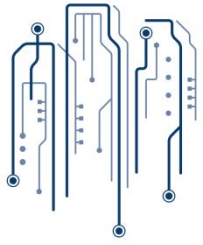
Prof. Rob Kitchin
Maynooth University

Geo Ethics, Twente
14th March 2016



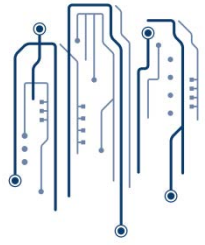
The Programmable City





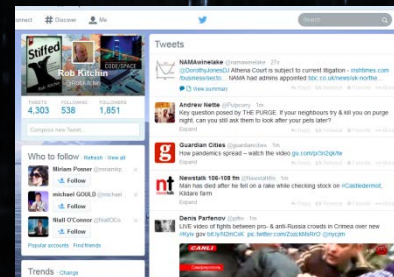
Data and the city

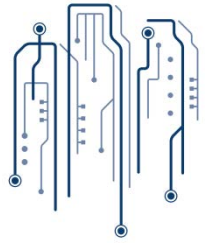
- Rich history of data being generated about cities
- Long had *data-informed urbanism*
- Being complemented and replaced by *data-driven, networked urbanism*



Urban big data

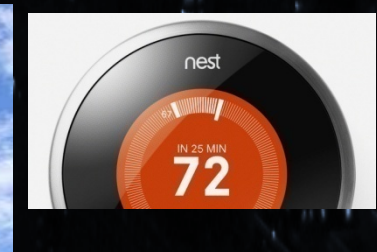
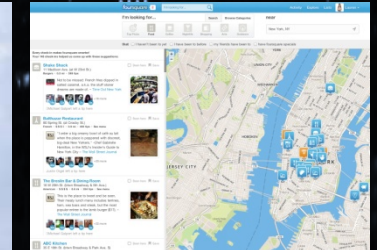
- Directed
 - Surveillance: CCTV, drones/satellite
 - Scaled public admin records
- Automated
 - Automated surveillance
 - Digital devices
 - Sensors, actuators, transponders, meters (IoT)
 - Interactions and transactions
- Volunteered
 - Social media
 - Sousveillance/wearables
 - Crowdsourcing/neogeography
 - Citizen science

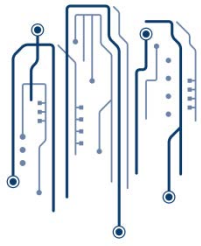




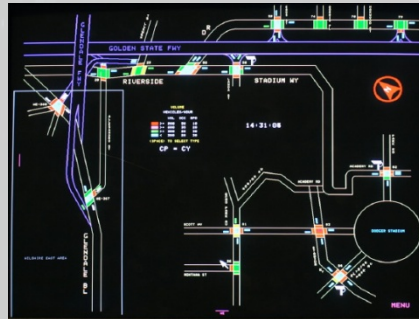
Urban big data

- Diverse range of public and private generation of fine-scale (uniquely indexical) data about citizens and places in real-time:
 - utilities
 - transport providers
 - environmental agencies
 - mobile phone operators
 - social media sites
 - travel and accommodation websites
 - home appliances and entertainment systems
 - financial institutions and retail chains
 - private surveillance and security firms
 - remote sensing, aerial surveying
 - emergency services
- Producing a data deluge that can be combined, analyzed, acted upon



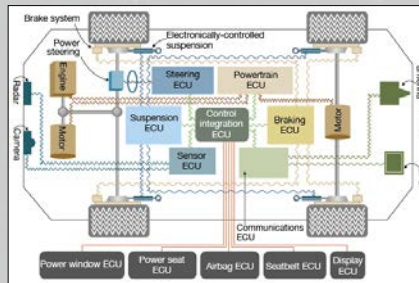


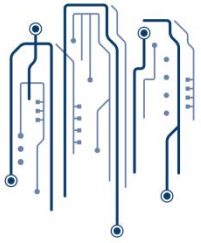
Single systems



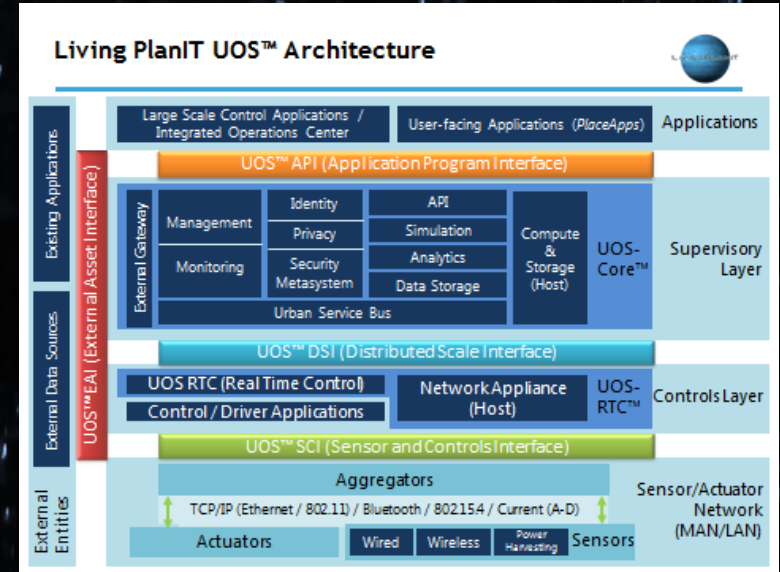
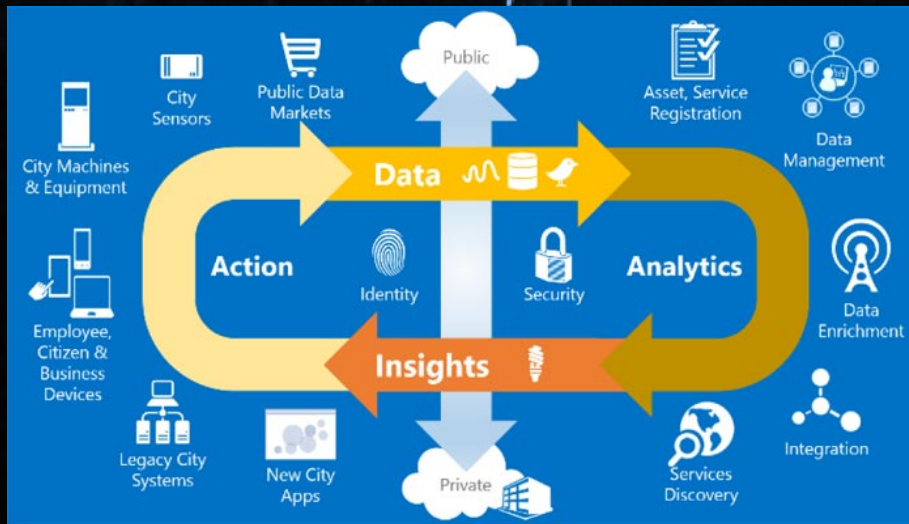
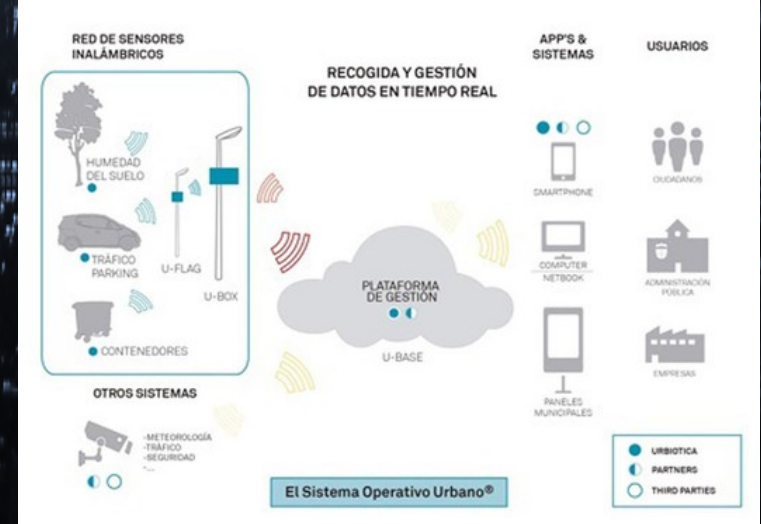
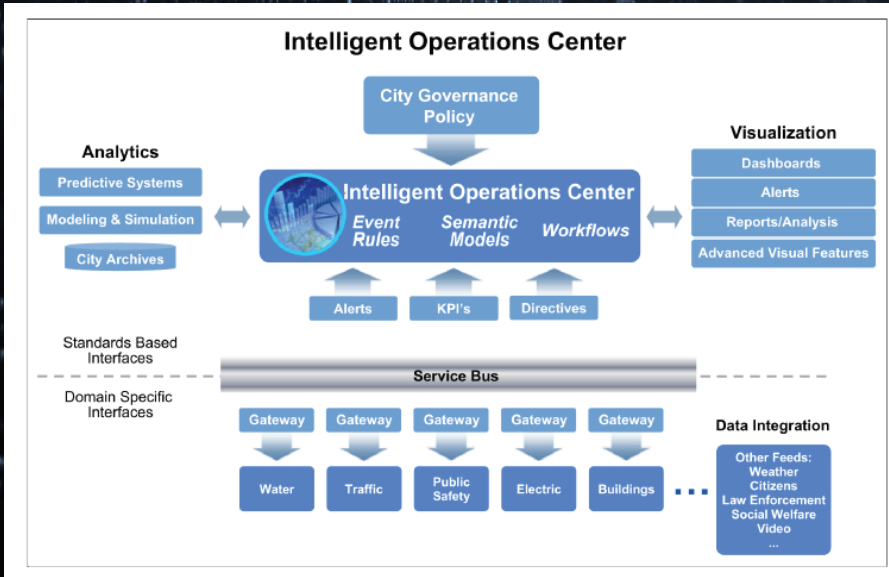
Los Angeles Communications Center

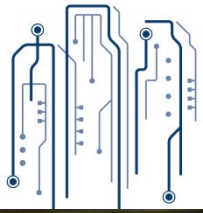
Time	Type	Location	Area
5:17PM	Police Traffic Signal	8001 ST AT S MEDINA AV	East Los Angeles
5:10PM	Police Traffic	EP 31719 JED WOODLEY AV	West Valley
5:40PM	Police Collision No Damage	W 10th ST AT S FOUNTAIN ST	Central Los Angeles
5:48PM	Police Traffic	EP 31719 JED BALBOA BLVD	West Valley
5:47PM	Police Collision No Damage	VAN NUTE BLVD AT VENTURA BLVD	Southwest Division
5:39PM	Police Traffic Signal	NE 400 JED BURBANK BLVD	West Valley
5:45PM	Police Collision No Damage	EP 31805 AV SUNSHINE BLVD	South Los Angeles
5:45PM	Police Collision	EP 31814 JED N PACIFIC AV	Alhambra
5:42PM	Police Collision No Damage	EP 31801 AT ATLANTIC AV	South Los Angeles
5:41PM	Police Collision Ambulance Responding	EP 31800 AT ATLANTIC BLVD	East Los Angeles
5:41PM	Police Collision	NE 300 LARKWOOD BLVD	Central Los Angeles
5:40PM	Police Hazard - Vehicle Objects	WB 3124 JED N HOLLYWOOD WY	Alhambra
5:37PM	Police Collision	NE 2100 WOODBURN CT	Northwest
5:37PM	Police Collision No Damage	EP 31719 JED E COLORADO BLVD	Alhambra
5:37PM	Police Collision Ambulance Responding	W 22200 ST AT N NORMAN RD	South Los Angeles
5:37PM	Police Collision	EP 31719 AT TORRENO CANYON BLVD	West Valley
5:36PM	Police Collision No Damage	NE 1110 AT 9th ST	Central Los Angeles
5:36PM	Police Collision	NE 1110 AT 9th ST	South Los Angeles
5:35PM	Police Collision	NE 1105 JED W 10th RD	West Los Angeles
5:25PM	Police Collision Ambulance Responding	EP 31515 AT N LONE HILL AV	Alhambra
5:22PM	Police Collision	12264 BUSH ST	Northwest
5:17PM	Police Collision No Damage	EP 31600 VALERIE BLVD	East Los Angeles
5:10PM	Police Collision	EP 31600 VALERIE BLVD	Northwest
5:02PM	Police Traffic	NE 400 TO EP 1101 COM	West Valley
4:55PM	Police Collision Ambulance Responding	E 1101 ST AT LA VERNE AV	East Los Angeles
4:52PM	Police Collision No Damage	NE 3114 JED RTD ROVER MINE RD	Alhambra
4:52PM	Police Collision Ambulance Responding	VANLEY BLVD AT WOODMAN HILL RD	Northwest
4:42PM	Police Collision No Damage	NE 3114 JED ALVA DULCE CANYON RD	Alhambra
4:37PM	Police Collision No Damage	NE 1010 JED NE 111th	Central Los Angeles
4:21PM	Police Collision No Damage	E 8200 ST AT CHANAY AV	South Los Angeles
4:19PM	Police Collision Ambulance Responding	WB AVENUE M ONR TO SB SK14	Alhambra





Integrated, city & sector wide





Data-driven urbanism

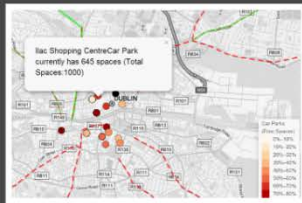




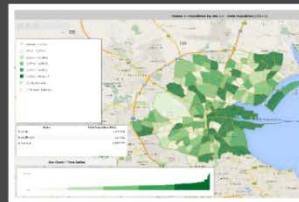
Dublin Overview



How's Dublin Doing?



Dublin RealTime



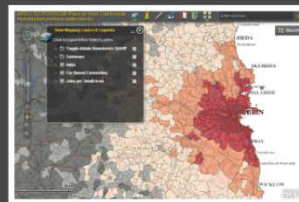
Dublin Mapped



Dublin Planning



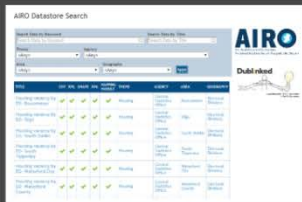
Dublin Near To Me



Dublin Housing

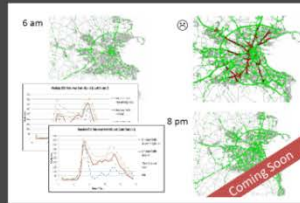


Dublin Reporting

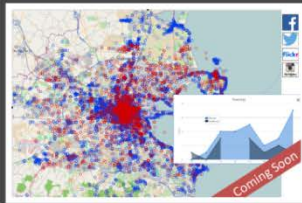


Dublin Data Stores

Dublin Apps



Dublin Modelled (Coming Soon)



Dublin Social (Coming Soon)

London

51.51 N, 0.13 W

14:26:09

Go to Map - Go to Grid - Change City

WEATHER STATIONS

STATION	Wind Speed	Wind Gusts	DIRECTION	TEMPERATURE	HUMIDITY	RAIN TODAY	PRESSURE	FORECAST
CASA Office Bloomsbury W1	8.2 mph	7 mph	E	17.7 °C	89%	1.6 mm	1016.5 mbars	Cloudy
Hampstead NWS	1.6 mph	0.5 mph	NW	17.2 °C	88%	0.5 mm	1017.2 mbars	Mainly Fine
Den Cooks Dow L2	0 mph	0 mph	NW	17.9 °C	81%	0.0 mm	1017.7 mbars	Dry Clear

WEATHER (METAR) 558 **London City Airport**
Mostly cloudy **W at 9 mph** **17 °C**

FORECAST (GOOGLE) 123
Mon **22 °C** Tue **22 °C** Wed **23 °C** Thu **17 °C**

TUBE LINE STATUS (TfL) 23

Line	Status
Bakerloo	Good Service
Central	Good Service
Circle	Good Service
District	Good Service
H & D	Good Service
Public	Good Service
Metropolitan	Good Service
Northern	Good Service
Placoidly	Good Service
Victoria	Good Service
W & A	Good Service
Overground	Good Service
DLR	Good Service

BIKE SHARING (TfL) 20

Category	Percentage	Count
Stations Full	3.7 %	6134
Stations Empty	8.6 %	589

Available Bikes (last 24h): 6000, 5500, 5000, 4500, 4000, 3500, 3000, 2500, 2000, 1500, 1000, 500, 0

AIR POLLUTION (DEFRA) 1208

Location	Ozone	NO ₂	PM ₁₀	PM _{2.5}	PM ₁₀ 24h
Bloomsbury	1	1	1	1	1
Marylebone Rd	1	2	1	2	2
N Kensington	2	1	1	2	1

MOOD (LSE HAPPINESS) 21

Slightly unhappier than the long term average for here

Quite a bit unhappier than the whole country right now

RADES (CASA) 5 **CASA Office Desk** **16 cpm (uncalibrated)**

RIVER LEVEL (PLA) 270 **Thames (Tower Pier)** **6.58 metres**

STOCKS (Yahoo) 6 **FTSE 100 Index** **5480.47** (+1.88 (0.03%))

TWITTER TRENDS FOR LONDON

Tom Maynard #20FactsAboutMe #CarersWeek Nalbandian Danny Fullbrook Jack Osbourne Kate Nash MBE Webb Simpson

TWITTER: LONDON NEWS AND EVENTS 1

Londonist: Don't know your Edinburgh previews from your improv? Take a look at our guide to live comedy in London <http://t.co/8zjUwS4O>

TWITTER: LONDON UNIVERSITIES 10

Imperial Spark: "As a scientist I feel really depressed, because we are losing the war against obesity" - Prof Jimmy Bell <http://t.co/C3ev1TR9H>

City Dashboard Amsterdam (beta)

Transport

- Avg. speed: 29.78 km/h
- Road pressure: 42.78 %
- Parking: 36.43 %

Actual trips

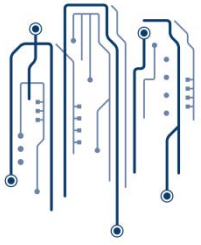
- On time
- Avg. delay time

Environment

- NO₂ (nitrogen dioxide): 459.78 µg/m³
- CO (carbon monoxide): 214.86 KdB
- Noise level: 58.66 dB
- Light: 218.52 lux

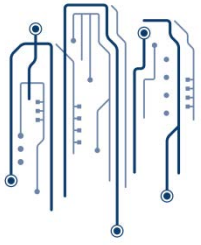
City Dashboard Amsterdam (beta)

City Dashboard Amsterdam (beta) includes various charts and graphs for Transport, Environment, and Social data.



Creating smart cities

- Tackle pressing issues
- New forms of operational governance
- More efficient, competitive and productive service delivery
- Increase resilience and sustainability
- More transparency and accountability
- Enhance participation in city life and quality of life
- Stimulate creativity, innovation, entrepreneurship and economic growth
- Improve models and simulations for future development



Ethics of data-driven urbanism

- Data-driven urbanism raises all kinds of ethical & related questions
 - Data ownership and control
 - Data integration and data markets
 - Data security and integrity
 - Data protection and privacy
 - Data quality and provenance
 - Data uses
 - Data practices and politics

Getting smarter about smart cities:
Improving data privacy and data security



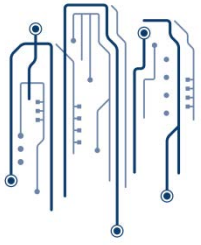
Department of the Taoiseach



The Programmable City

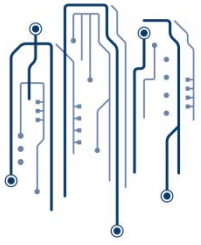
NIRSA





The politics of urban data

- Big data and dashboards are not simply technical tools
- Data are not pragmatic, neutral, objective, non-ideological;
- Data cannot speak for themselves
- Data are framed
- Big data and dashboards express a normative view
- And they have normative effect



The politics of urban data

Digital socio-technical assemblage

System/process
performs a task

Reception/Operation
(user/usage)

Interface

Code/algorithms
(software)

Data(base)

Code Platform
(operating system)

Material Platform
(infrastructure – hardware)

Context
frames the system/task

Systems of thought

Forms of knowledge

Practices

Finance

Political economies

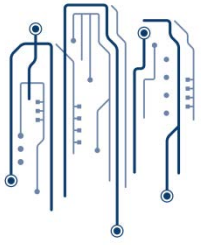
Governmentalities & legalities

Organisations and institutions

Subjectivities and communities

Marketplace

Places

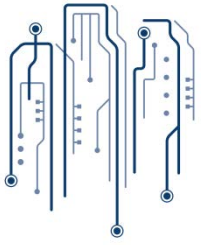


Privacy and big urban data

- Privacy debates concern acceptable practices with regards to accessing and disclosing personal and sensitive information about a person
 - *identity privacy* (to protect personal and confidential data)
 - *bodily privacy* (to protect the integrity of the physical person);
 - *territorial privacy* (to protect personal space, objects and property);
 - *locational and movement privacy* (to protect against the tracking of spatial behaviour)
 - *communications privacy* (to protect against the surveillance of conversations and correspondence);
 - *transactions privacy* (to protect against monitoring of queries/searches, purchases, and other exchanges)

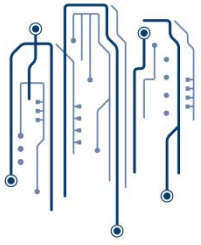
A Taxonomy of Privacy Harms (compiled from Solove 2006)

Domain	Privacy breach	Description
Information	<i>Surveillance</i>	Watching, listening to, or recording of an individual's activities
Collection	<i>Interrogation</i>	Various forms of questioning or probing for information
Information	<i>Aggregation</i>	The combination of various pieces of data about a person
Processing	<i>Identification</i>	Linking information to particular individuals
	<i>Insecurity</i>	Carelessness in protecting stored information from leaks and improper access
	<i>Secondary Use</i>	Use of information collected for one purpose for a different purpose without the data subject's consent
	<i>Exclusion</i>	Failure to allow the data subject to know about the data that others have about her and participate in its handling and use, including being barred from being able to access and correct errors
Information	<i>Breach of Confidentiality</i>	Breaking a promise to keep a person's information confidential
Dissemination	<i>Disclosure</i>	Revelation of information about a person that impacts the way others judge her character
	<i>Exposure</i>	Revealing another's nudity, grief, or bodily functions
	<i>Increased Accessibility</i>	Amplifying the accessibility of information
	<i>Blackmail</i>	Threat to disclose personal information
	<i>Appropriation</i>	The use of the data subject's identity to serve the aims and interests of another
	<i>Distortion</i>	Dissemination of false or misleading information about individuals
Invasion	<i>Intrusion</i>	Invasive acts that disturb one's tranquillity or solitude
	<i>Decisional Interference</i>	Incursion into the data subject's decisions regarding her private affairs



Privacy and big urban data

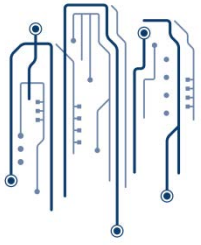
- Intensifies datafication



Location/movement data

- *Controllable digital CCTV cameras* + ANPR + facial recognition
- *Smart phones*: cell masts, GPS, wifi
- *Sensor networks*: capture and track phone identifiers such as MAC addresses
- *Wifi mesh*: capture & track phones with wifi turned on
- *Smart card tracking*: barcodes/RFID chips (buildings & public transport)
- *Vehicle tracking*: unique ID transponders for automated road tolls & car parking
- *Other staging points*: ATMs, credit card use, metadata tagging
- *Electronic tagging; shared calendars*

Data type	Data permissions that can be sought by android apps (from Hein 2014)
Accounts log	email log
App Activity	name, package name, process number of activity, processed id
App Data Usage	Cache size, code size, data size, name, package name
App Install	installed at, name, package name, unknown sources enabled, version code, version name
Battery	health, level, plugged, present, scale, status, technology, temperature, voltage
Device Info	board, brand, build version, cell number, device, device type, display, fingerprint, IP, MAC address, manufacturer, model, OS platform, product, SDK code, total disk space, unknown sources enabled
GPS	accuracy, altitude, latitude, longitude, provider, speed
MMS	from number, MMS at, MMS type, service number, to number
NetData	bytes received, bytes sent, connection type, interface type
PhoneCall	call duration, called at, from number, phone call type, to number
SMS	from number, service number, SMS at, SMS type, to number
TelephonyInfo	cell tower ID, cell tower latitude, cell tower longitude, IMEI, ISO country code, local area code, MEID, mobile country code, mobile network code, network name, network type, phone type, SIM serial number, SIM state, subscriber ID
WifiConnection	BSSID, IP, linkspeed, MAC addr, network ID, RSSI, SSID
WifiNeighbors	BSSID, capabilities, frequency, level, SSID
Root Check	root status code, root status reason code, root version, sig file version
Malware Info	algorithm confidence, app list, found malware, malware SDK version, package list, reason code, service list, sigfile version



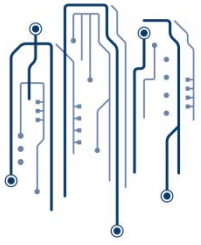
Privacy and big urban data

- Intensifies datafication
- Deepens inferencing
- Weak anonymization and enables re-identification
- Opacity and automation creates obfuscation and reduces control
- Data are being shared and repurposed and used in unpredictable and unexpected ways
- Notice and consent is an empty exercise or absent
-

Fair Information Practice Principles (OECD, 1980)

Principle	Description
Notice	Individuals are informed that data are being generated and the purpose to which the data will be put
Choice	Individuals have the choice to opt-in or opt-out as to whether and how their data will be used or disclosed
Consent	Data are only generated and disclosed with the consent of individuals
Security	Data are protected from loss, misuse, unauthorized access, disclosure, alteration and destruction
Integrity	Data are reliable, accurate, complete and current
Access	Individuals can access, check and verify data about themselves
Use	Data are only used for the purpose for which they are generated and individuals are informed of each change of purpose
Accountability	The data holder is accountable for ensuring the above principles and has mechanisms in place to assure compliance

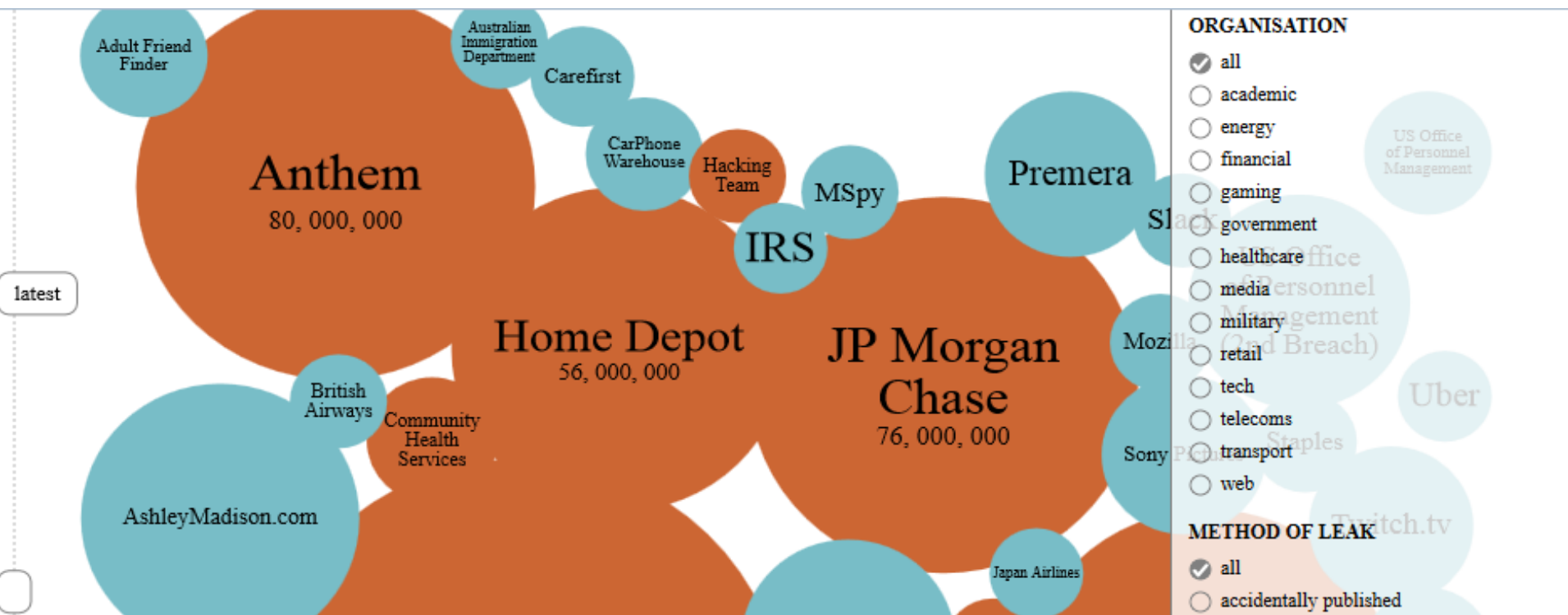
Redundant in the age of big urban data?



Privacy and big urban data

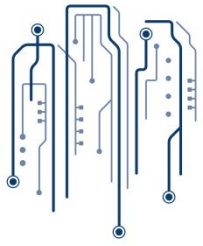
- Intensifies datafication
- Deepens inferencing
- Weak anonymization and enables re-identification
- Opacity and automation creates obfuscation and reduces control
- Data are being shared and repurposed and used in unpredictable and unexpected ways
- Notice and consent is an empty exercise or absent
- Hacking cities and data security

Hacking the City?



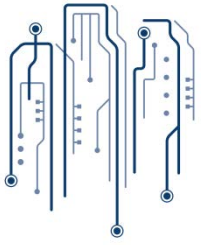
- Weak security and encryption
- Insecure legacy systems and poor maintenance
- Large and complex attack surfaces and interdependencies
- Cascade effects
- Human error and disgruntled (ex)employees





Suggested solutions

- **Market:**
 - Industry standards and self-regulation
 - Privacy/security as competitive advantage
- **Technological**
 - End-to-end strong encryption, access controls, security controls, audit trails, backups, up-to-date patching, etc.
 - Privacy enhancement tools
- **Policy and regulation**
 - FIPPs
 - Privacy by design;
 - security by design
- **Governance**
 - *Vision and strategy:* (1) smart city advisory board and smart city strategy;
 - *Oversight of delivery and compliance:* (2) smart city governance, risk and compliance board;
 - *Day-to-day delivery:* (3) core privacy/security team, smart city privacy/security assessments, and (4) computer emergency response team

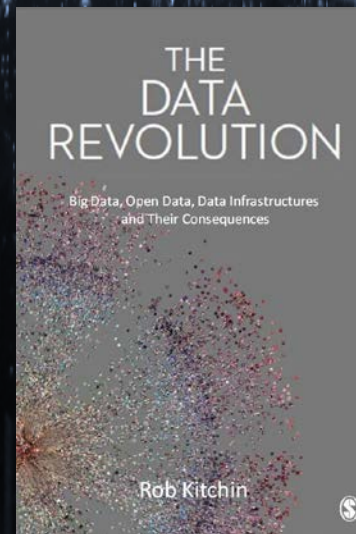
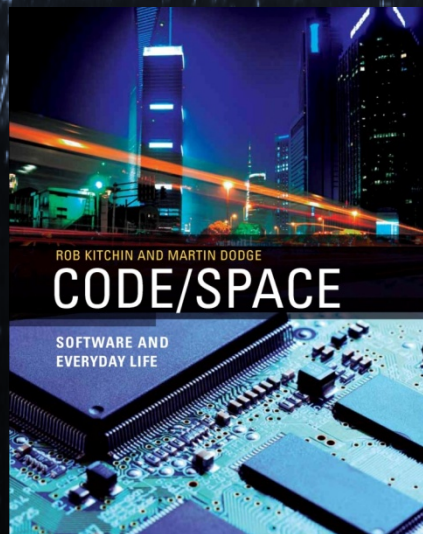


Conclusion

- Entering an era of embedded and mobile computation
- Vast quantities of real-time data, cities are responsive to these data, and enable new kinds of monitoring, regulation and control
- Cities are becoming data-driven and are enacting new forms of algorithmic governance
- Whilst data-driven, networked urbanism undoubtedly provides a set of solutions for urban problems it also raises a number of ethical and normative questions
- The challenge is to realise the benefits whilst minimizing pernicious effects

Rob.Kitchin@nuim.ie
@robkitchin

<http://www.nuim.ie/progcity>
@progcity



The Programmable City

