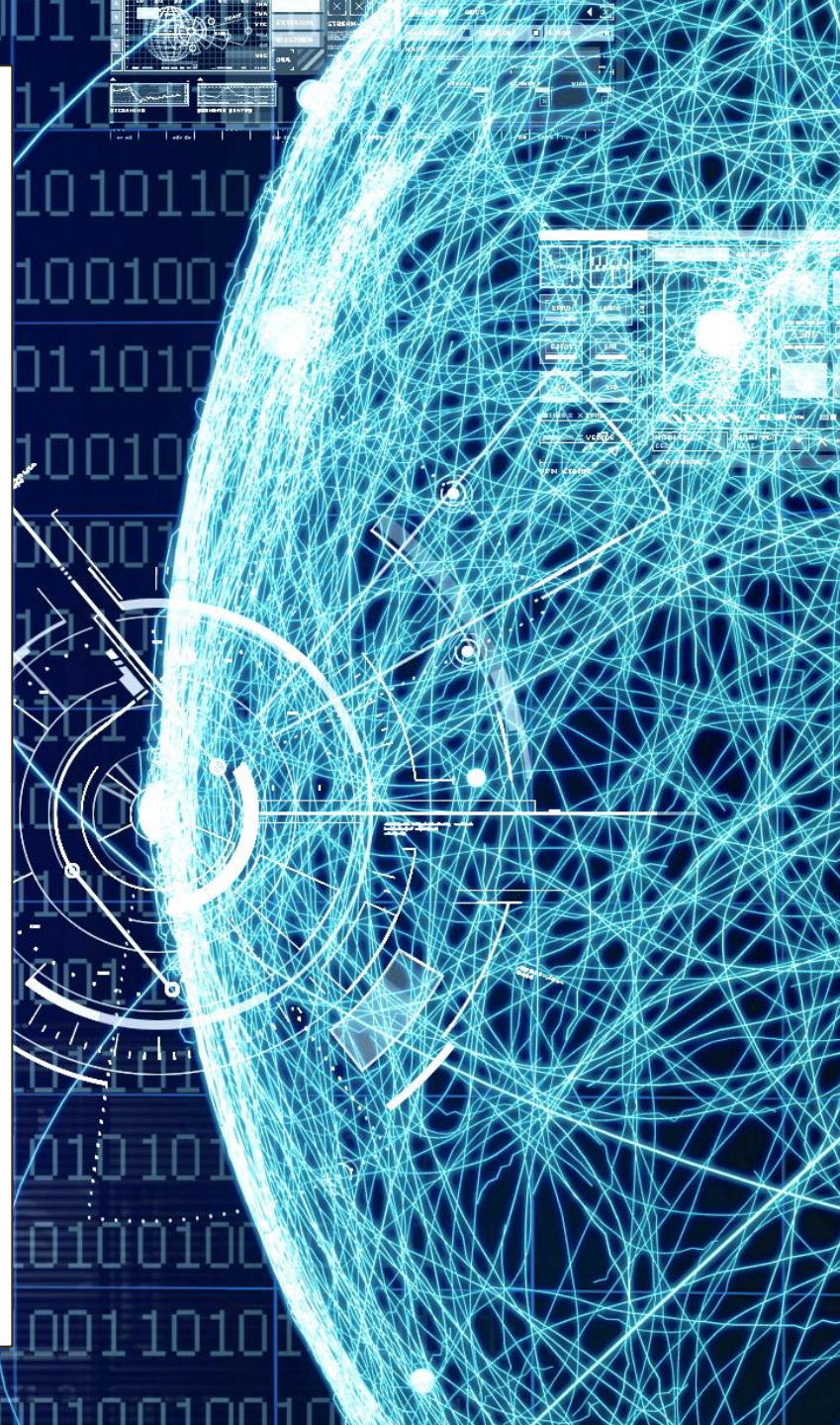# Smart Cities
Technologies, Big Data & Privacy

Mischa Dohler

Professor, King's College London, UK

Fellow & Distinguished Lecturer, IEEE

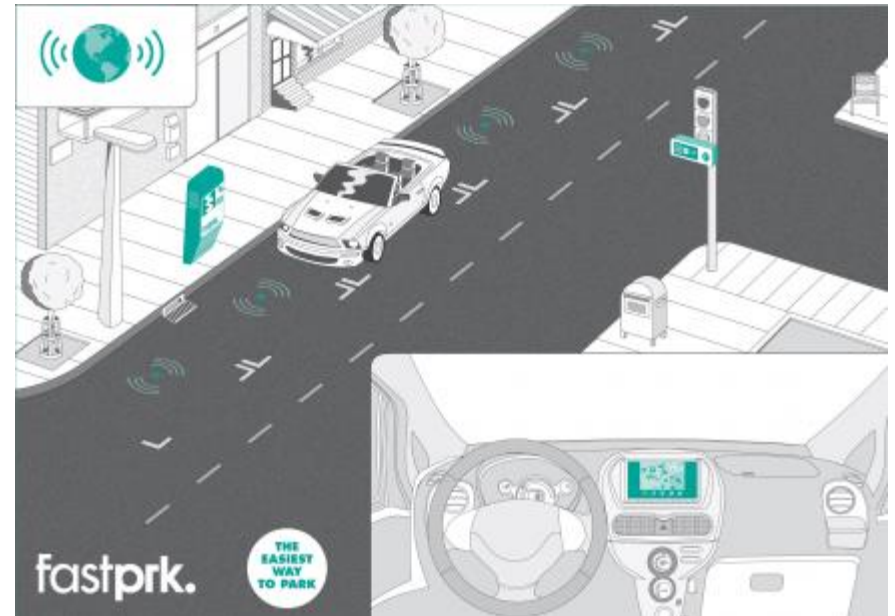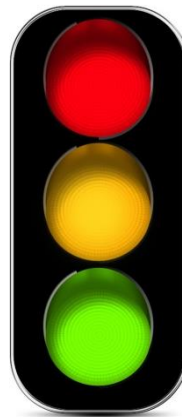Board of Directors, Worldsensing

Editor-in-Chief, ETT

Keynote @ URSI

Paris, France

26/03/2014

1

Smart City Applications

Smart Cities IoT/M2M Applications

Industrial IoT/M2M Applications

Today's Smart City Rollouts

Smart Parking

Traffic Flow

Travel Time

© Worldsensing

Smart City Control Platform
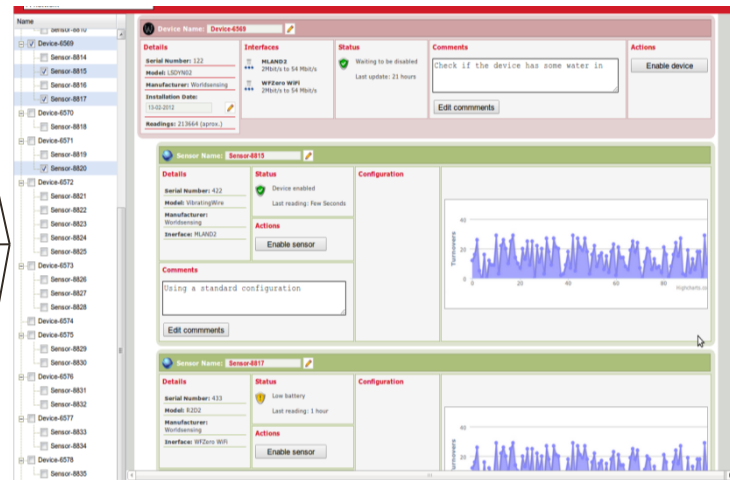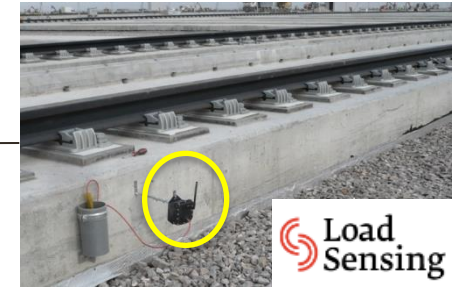
**Proven Technologies
With Solid Deployment
Track-Record Today!**

Smart Bins

Critical Infrastr.

Historic Sites

2
Data Access Technologies

M2M Prime Business Criteria
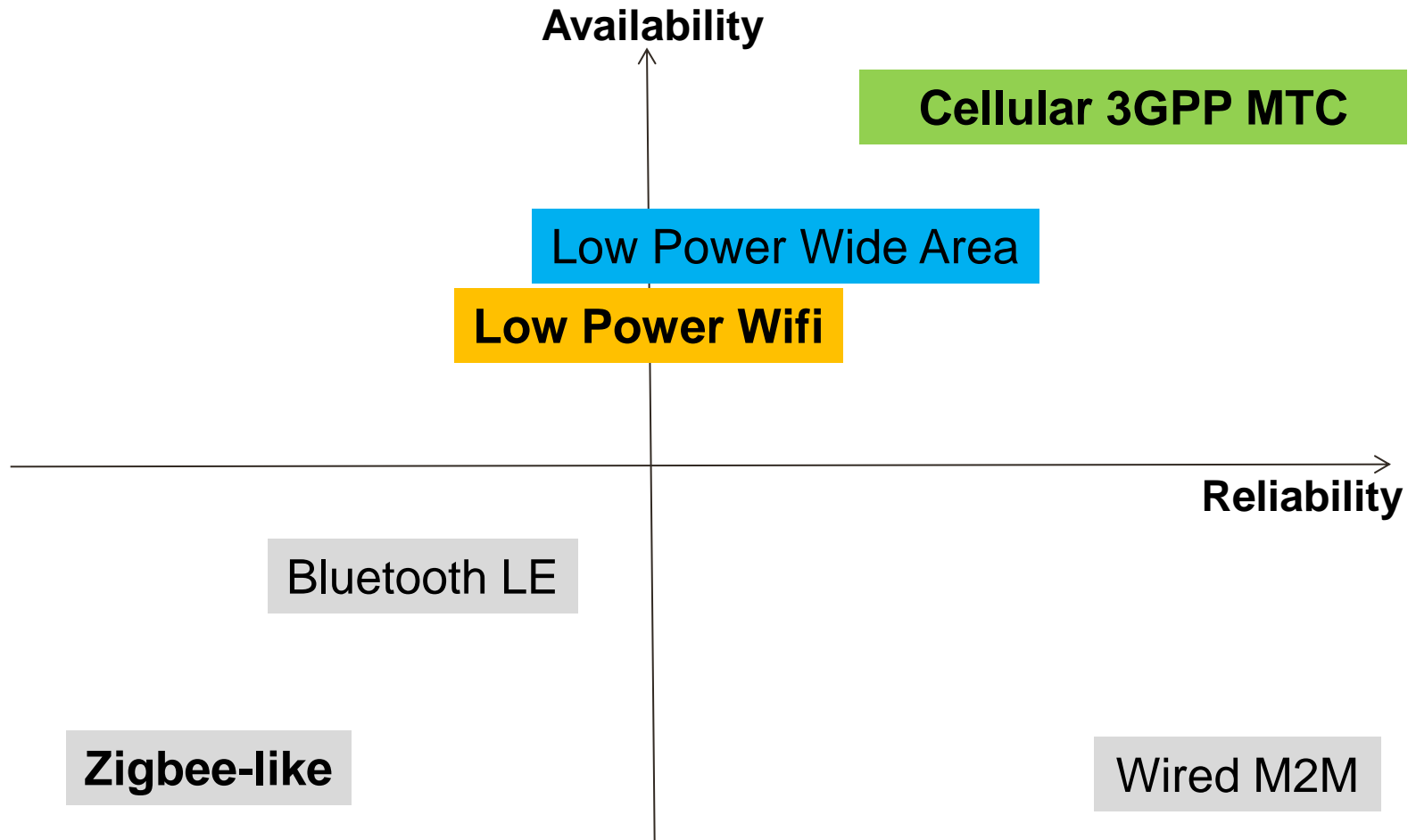
Availability = coverage, roaming, mobility, critical mass in rollout, etc.
Reliability = resilience to interference, throughput guarantees, low outages, etc.
(Total **Cost** of Ownership = CAPEX, OPEX.)

Standardized M2M Protocol Stacks

	Capillary M2M M2M Area Neworks		Cellular M2M
	Zigbee-Like	Low Power Wifi	LTE/LTE-A MTC
Application	IETF CORE	HTTP, etc.	
Transport	Lightweight TCP, UDP	TCP, UDP	LTE/LTE-A Networking Layer
Networking	IETF ROLL	IPv4, IPv6	
	6LowPAN		
	IETF 6TSCH		
MAC	802.15.4 /e Industrial Apps.	802.15.4 /f RFID	802.11g/ac/ad/ah
PHY	802.15.4-2006 /g Smart Grids /k Low-Energy Infrastructure Monitoring		
			LTE/LTE-A Link Layer

IETF

IEEE

3GPP

Problems of ZigBee-like Solutions

Interference in ISM
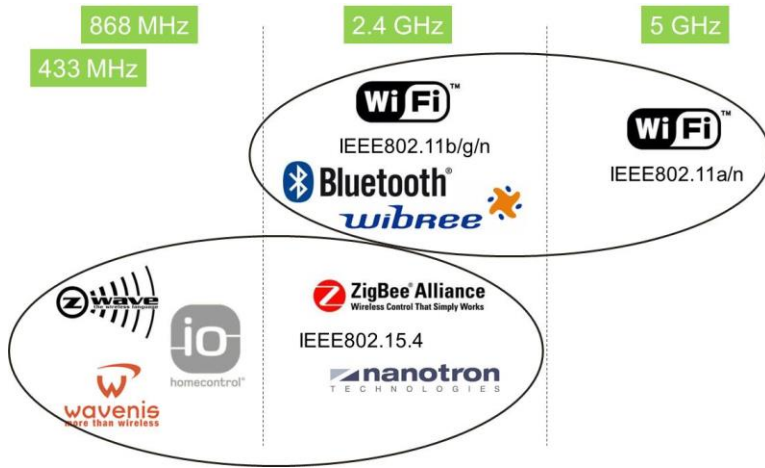
No Global Infrastructure

Lack of Interoperability
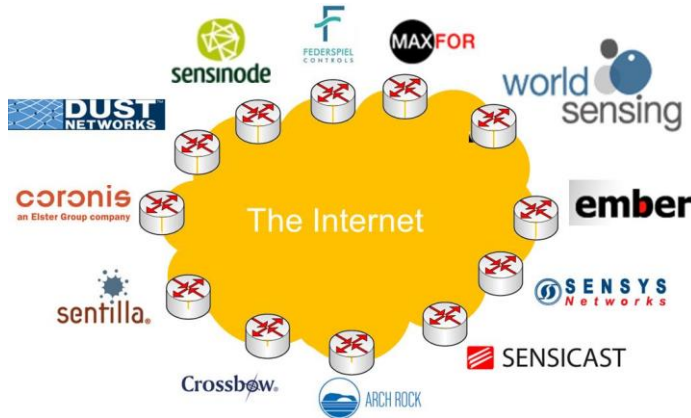
Higher Total Cost
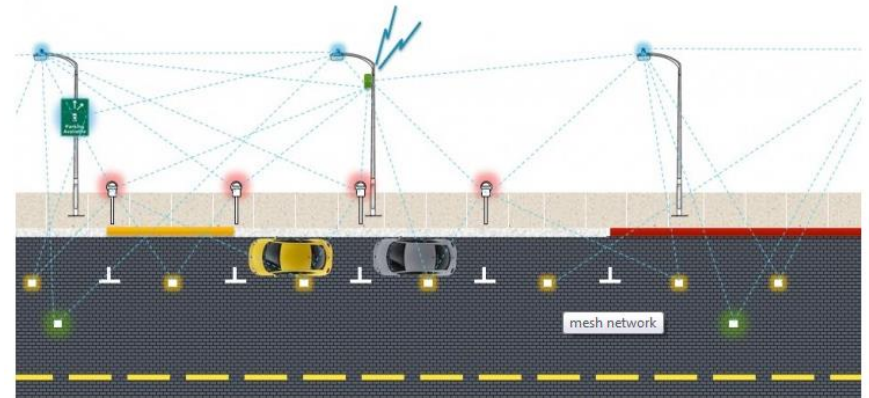
Advantages of Low-Power WiFi

Ubiquitous Infrastructure

Number of Wi-Fi Public Hotspots in the World
(in million), 2009-2015

350%

5.8

4.5

3.3

2.1

1.3

0.5   0.8

2009 2010 2011 2012 2013 2014 2015
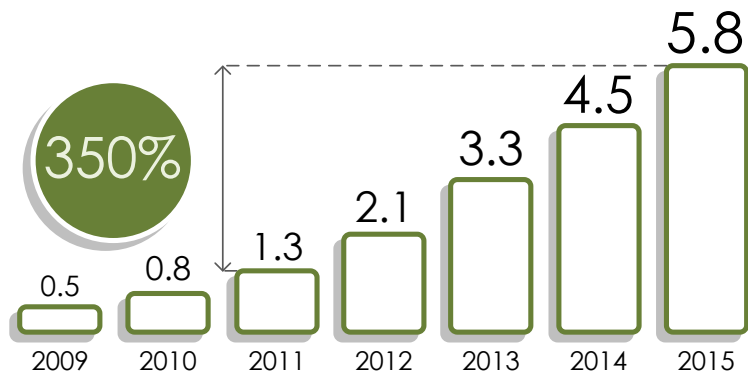
Source: Wireless Broadband Access (WBA), Informa, Nov. 2011

Vibrant Standard

IEEE
802.11™

300 members WiFi

Interference Management

**NAV Medium
Reservation**

Sound Security

WPA2/PSK/TLS/SSL

SECURITY

Advantages of LPWA M2M Networks

Large Coverage

Low Cost

Available Today

Operator Model

Current Eco-System

- **Sigfox** (market leader in Q1 2014):
    - <u>technical</u>: sub-GHz, UNB, very long range, one-way
    - <u>business approach</u>: operator, yearly license fee; Intel Ventures €10 million VC

- On-Ramp:
    - <u>technical</u>: 2.4GHz ISM band; "Random Phase Multiple Access"; 170dB link budget
    - <u>business approach</u>: equipment provider mainly; Managed Service SLA possible

- Cycleo (now Semtech):
    - <u>technical</u>: sub-GHz, CDMA-based, long range
    - <u>business approach</u>: equipment provider

- Neul:
    - <u>technical</u>: initially TVWS only; now shift into other bands too (notably licensed!)
    - <u>business approach</u>: originally only equipment; now SLA possible

Performance Comparison

© Orange, excerpt from PhD Thesis of Dr Quentin Lampin:
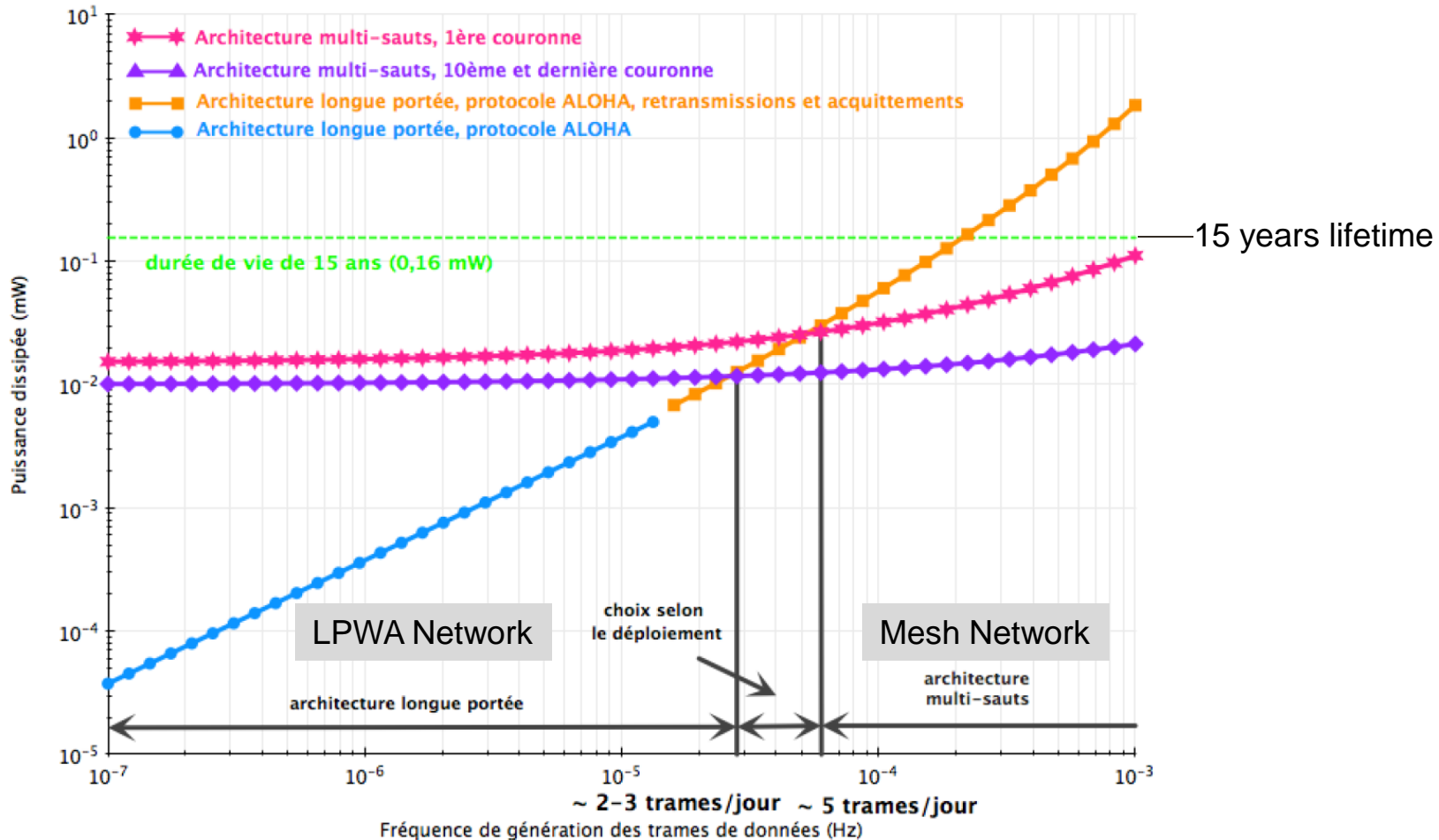
(a) $N = 100$ et $d = 10$

Advantages of Cellular M2M
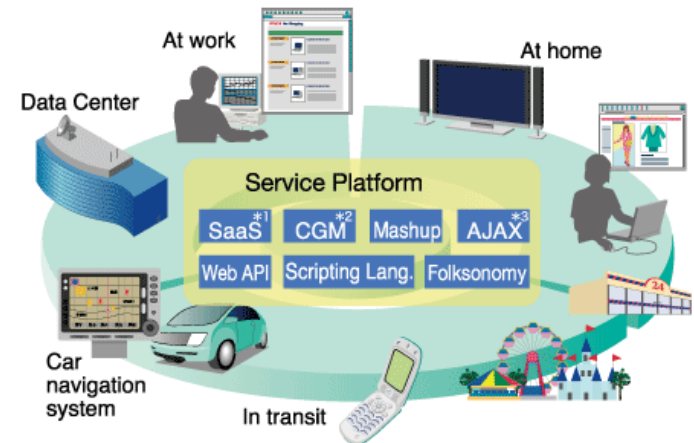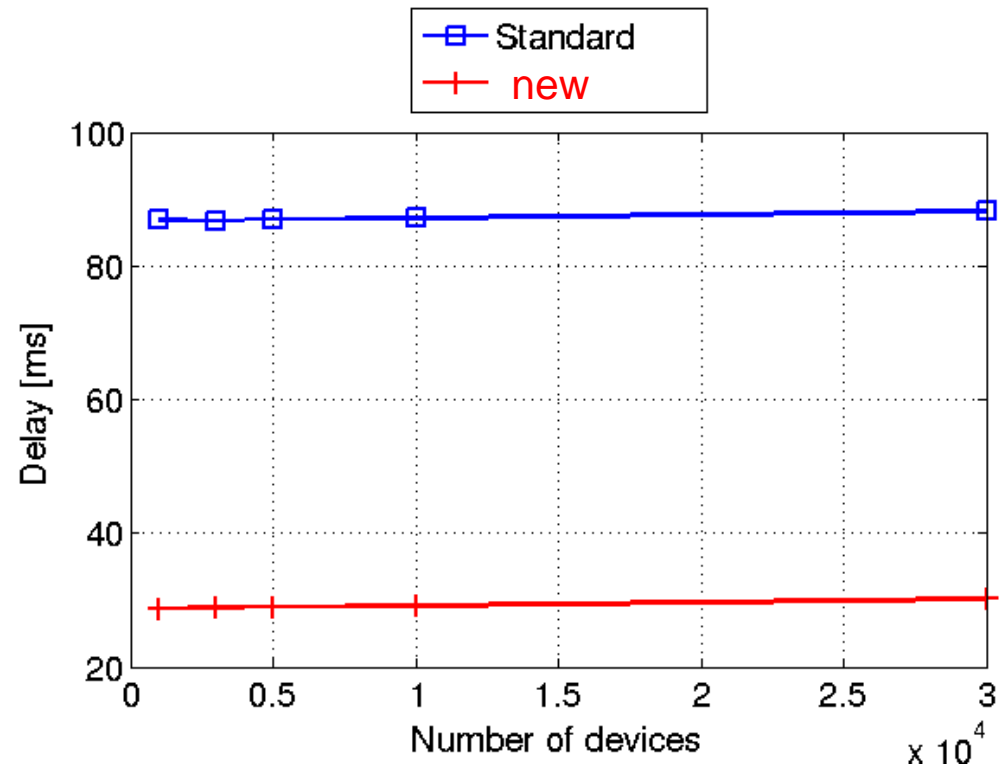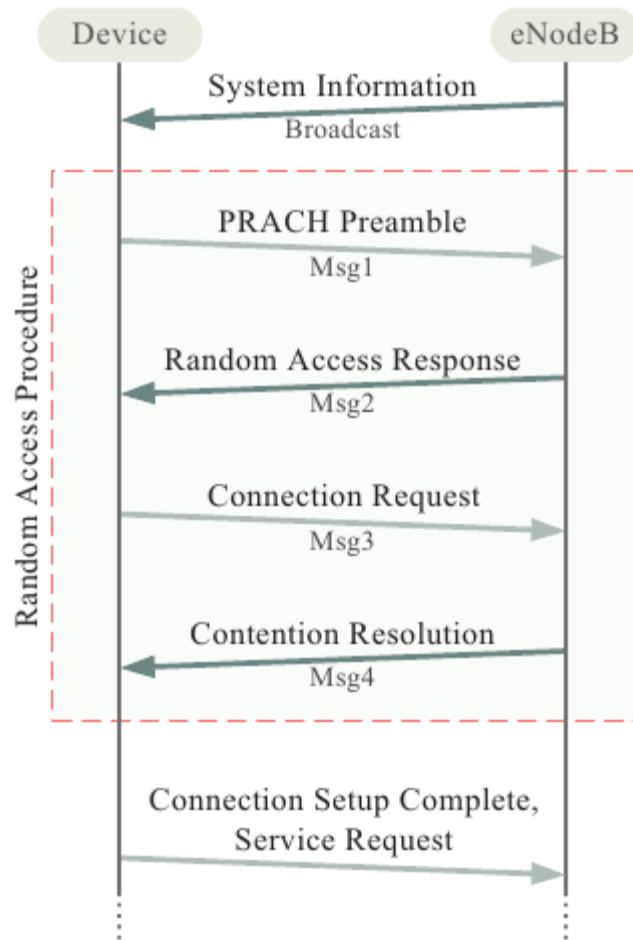
Ubiquitous Coverage

Mobility & Roaming

Interference Control

Service Platforms

Improving RACH Procedure

© Massimo Condoluci, Mischa Dohler, Antonella Molinaro, Giuseppe Araniti

3

Virtualization, Data and Privacy

Virtualization & Cloudification

Citizens, City service providers, application developers …

Service mashup

CSaaS
City application software as a Service

Middleware services

CPaaS City Platform as a Service

Virtualisation

legacy devices

ClaaS
City Infrastructure as a Service

© http://clout-project.eu; partly also developed in ICT-VITRO
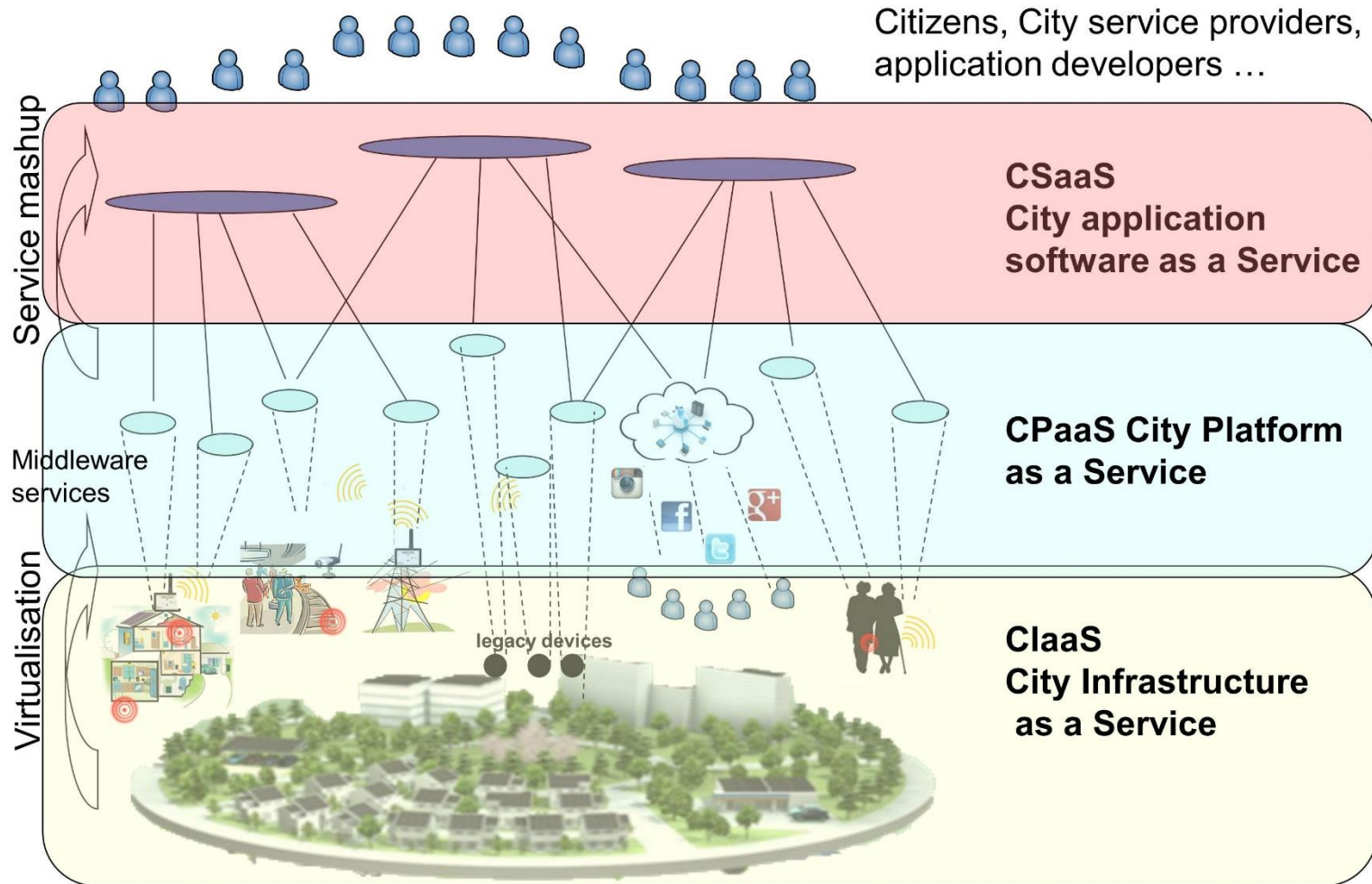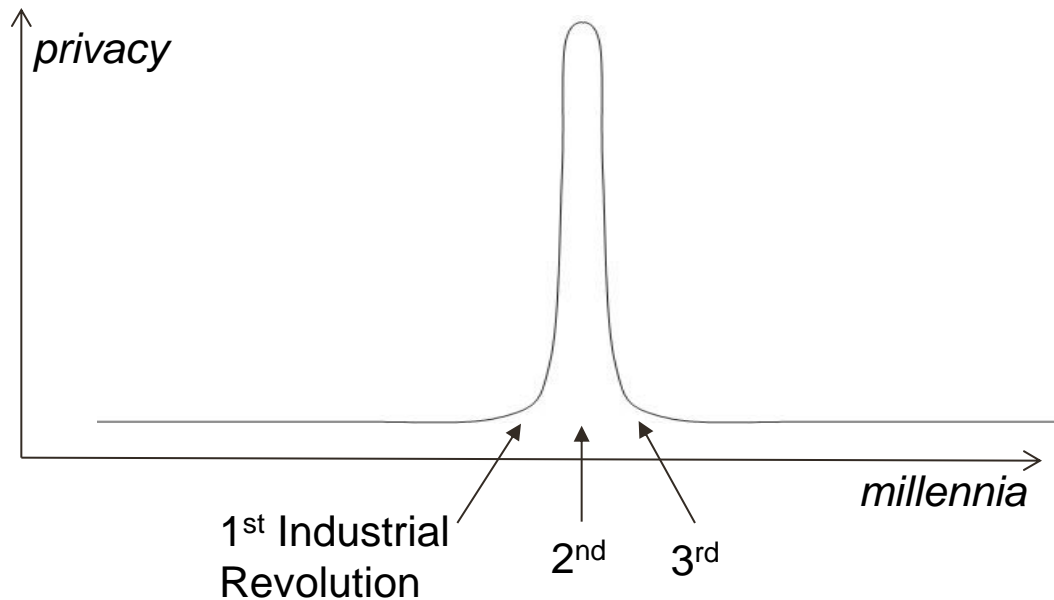
Closing the Data Cycle
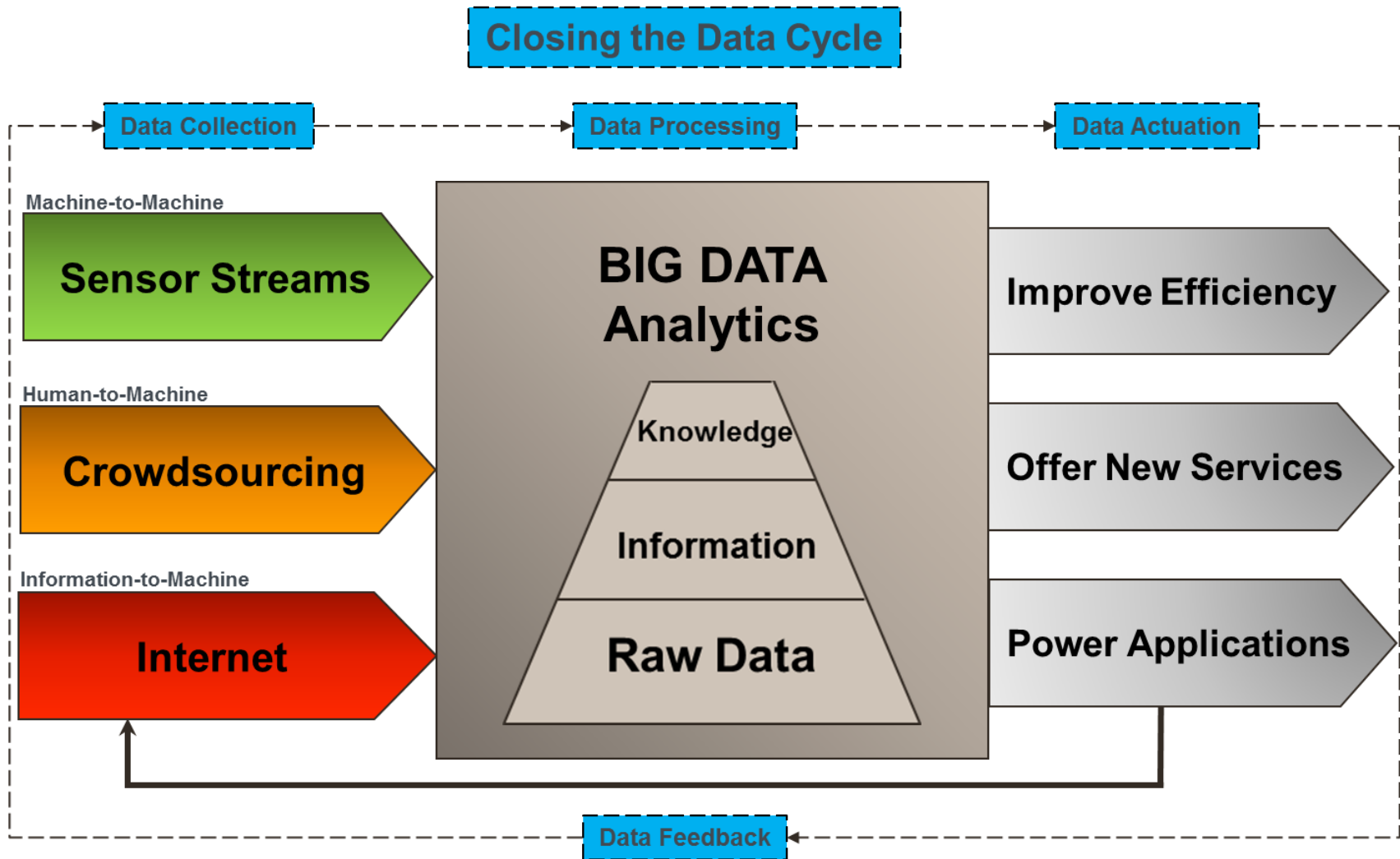
Privacy – Illusion or Fundamental Right?

4

Concluding Remarks

Do citizens care about Smart Cities?

Surprising Correlations

Really Surprising Outcome!

vehemence of "no",
or speed of walking

time

Beginning of
Question

End of
Question
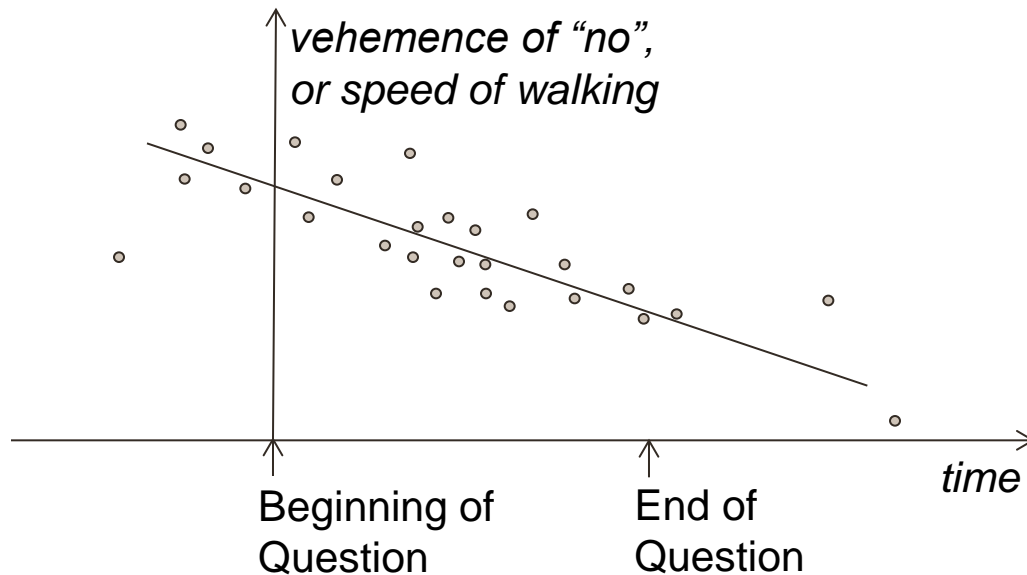
The biggest challenge of this early part of the 21st century is to bootstrap the undoubtedly high-potential smart city market in cities which are essentially broke.

"A developed country is not a place where the poor have cars. It's where the rich use public transportation."
Gustavo Petro, Mayor of Bogota

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