Berner Fachhochschule
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Foundations for a Smart City

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Athens, Greece
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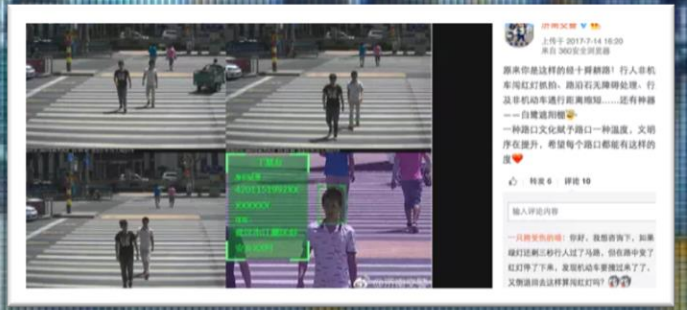
Vision...

Images: Smart City Nansha, ISA Internationales Stadtbauatelier, Wikimedia Commons;

… or Nightmare?



Images: CBS News;
Nanjin Transport Police's public Weibo post;
ABC Australia

Smart City Definitions

„A city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance"

Caragliu et al., 2011

„A smart city is a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development"

Dameri, 2013

„A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operations and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects."

ITU-T, 2016

„Eine Smart City bietet ihren Bewohnern maximale Lebensqualität bei minimalem Ressourcenverbrauch dank einer intelligenten Verknüpfung von Infrastruktursystemen (Transport, Energie, Kommunikation, etc.) auf unterschiedlichen hierarchischen Stufen (Gebäude, Quartier, Stadt).

"Intelligent" ist in diesem Zusammenhang nicht automatisch mit "IT" gleichzusetzen. Bei ähnlicher Performance sind passive oder selbstregulierende Mechanismen den aktiv geregelten Ansätzen vorzuziehen."

P. Richner, EMPA / IG Smart City Schweiz

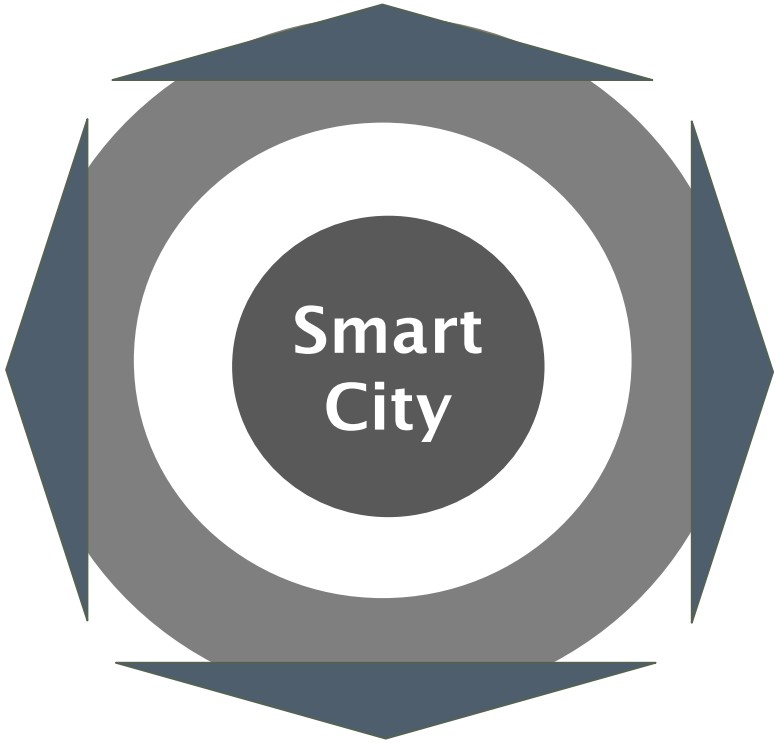
Smart City: Why?

Smart Environment

Environment and ecologic sustainability
Built environment and urban infrastructure
Natural resources and mobility

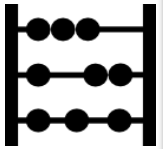
Institutional structure
Transparency and quality
Collaborative services
Participatory decisions

Smart Government



Smart Society

Social and educational capital
Social and ethnic plurality
Flexibility and creativity
Openness and engagement



Smart Economy

Competitiveness and spirit of innovation
Entrepreneurship – networking and flexibility
Economic image and brand

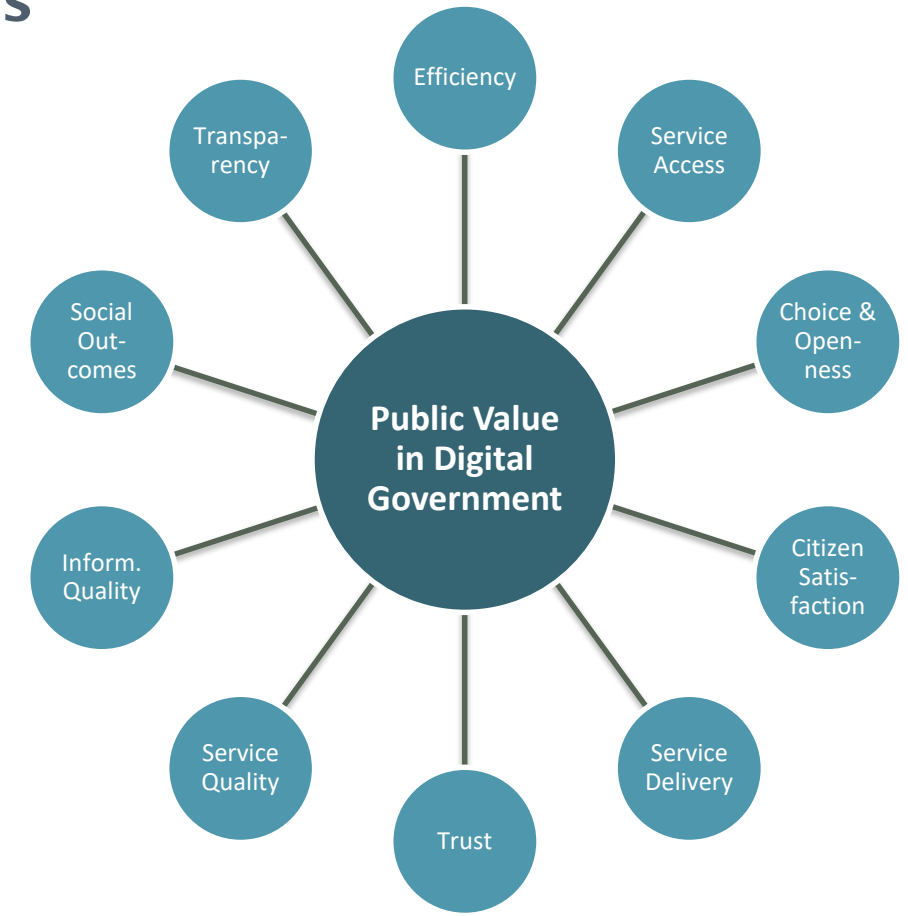
Sources: based on Gil-Garcia et al. 2015, Griffinger et al. 2007

Public Value

Public officials and politicians have different goals than leaders in the private sector

Types of public value (Harrison et al. 2011)

- Financial
- Political
- Social
- Strategic
- Ideological
- Stewardship

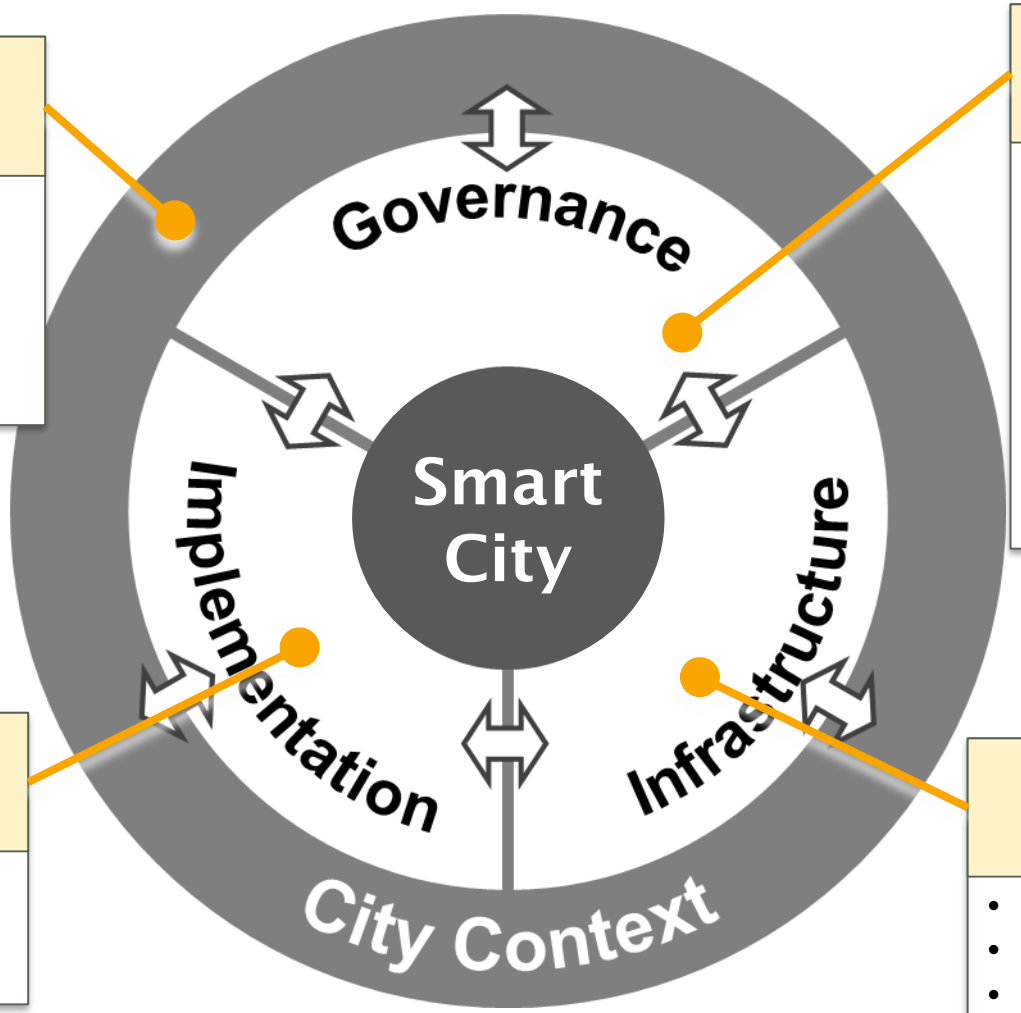


Source: based on Puron-Cid 2017

Dimensions of the Smart City Strategy Framework

City Context

- Population
- Development Stage
- Political System
- Education Level
- Pressures



Governance

- Governance Model
- Citizen Involvement
- Motivation
- City Role
- Process Responsibility
- Business Sector Development
- Approach
- Regional Cooperation

Implementation

- Implementation Model
- Application Domains
- Performance Measures

Infrastructure

- Data Infrastructure
- Networking Infra. (WLAN, IoT)
- Cloud Infrastructure

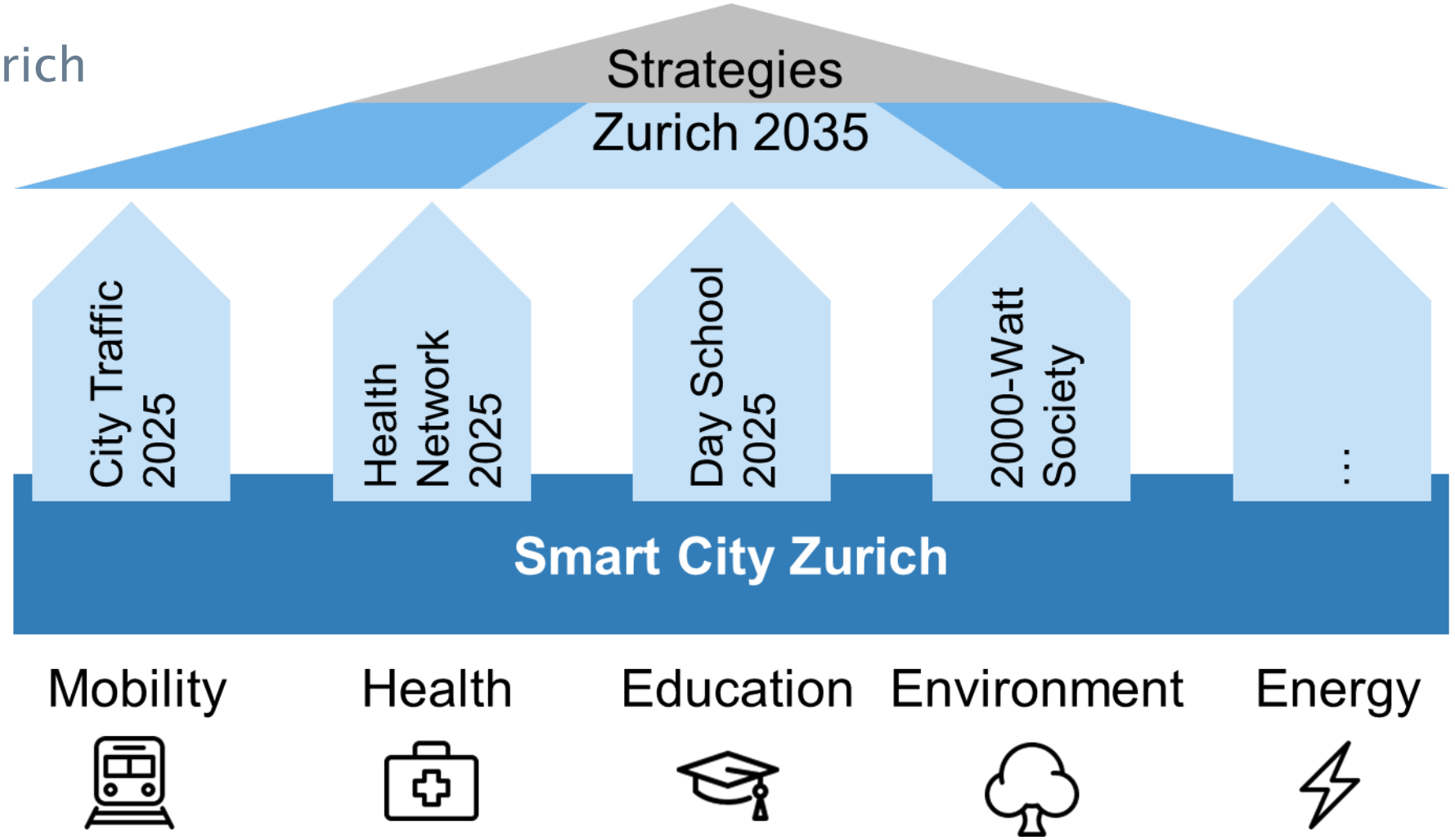
Source: Haller et al. 2018

Governance

- Strategy
- Open Government & Open Data
- Effecting Transformation

Do you need a Smart City Strategy?

Example: Zürich



Source: City of Zurich

What is Open Government?

- **Information Transparency**
  - Freedom of Information
    (focus on access to government information)
  - **Open Data**
    (focus on re-usability of government information & data from a legal and technical perspective)

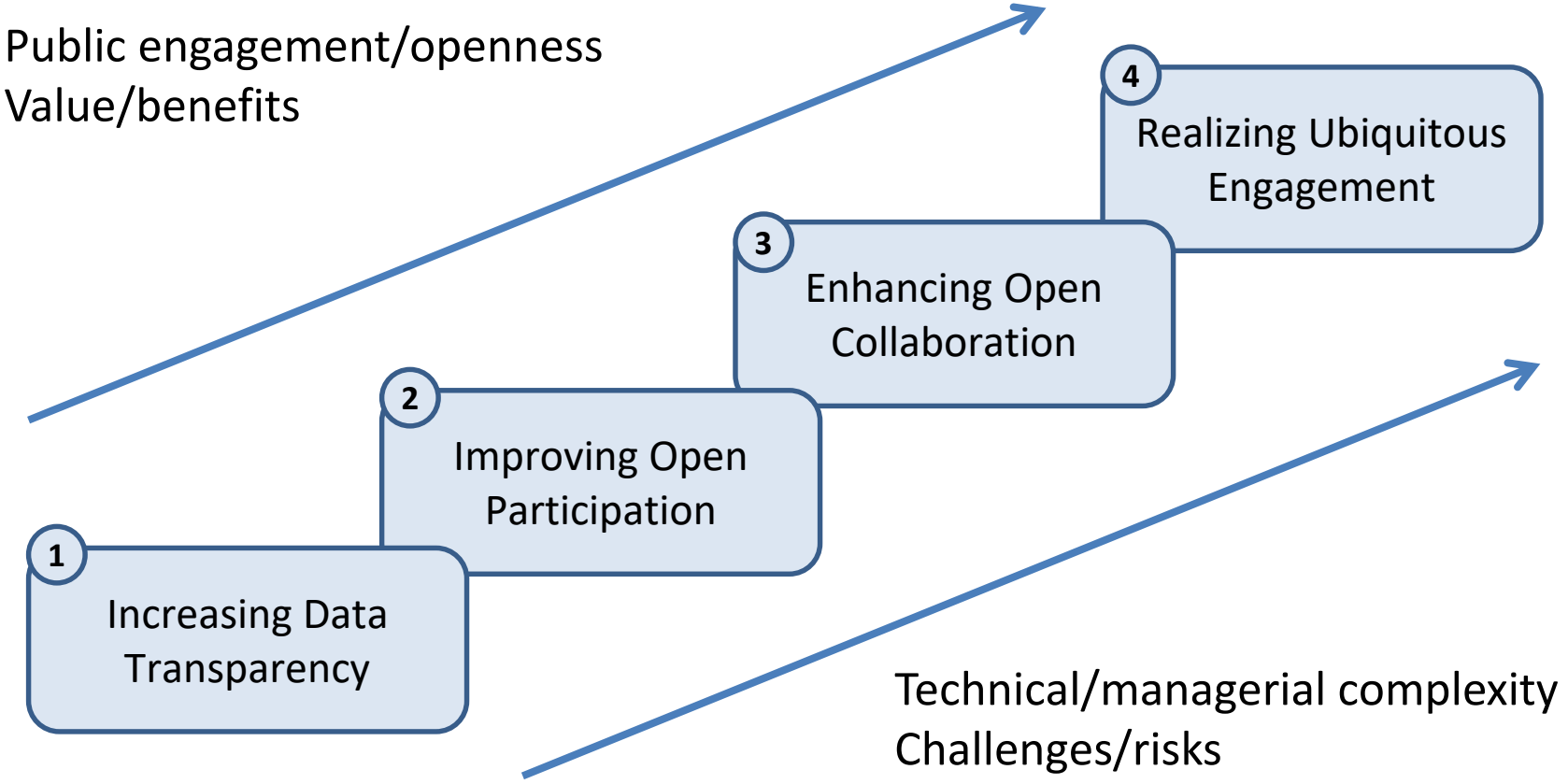
- **Public Engagement** (enhanced by technological advances)
  - **Participation**
  - Collaboration
  - **Innovation**
    (User Innovation, Co-Creation, etc.)

- **Accountability**

Tallin Declaration, see: https://ec.europa.eu/newsroom/document.cfm?doc_id=47559

For an overview of various definitions of Open Government, refer to: http://thegovlab.org/open-government-whats-in-a-name/

Open Government Implementation Model



Source: Lee & Kwak 2011

What is the **Open Data**?

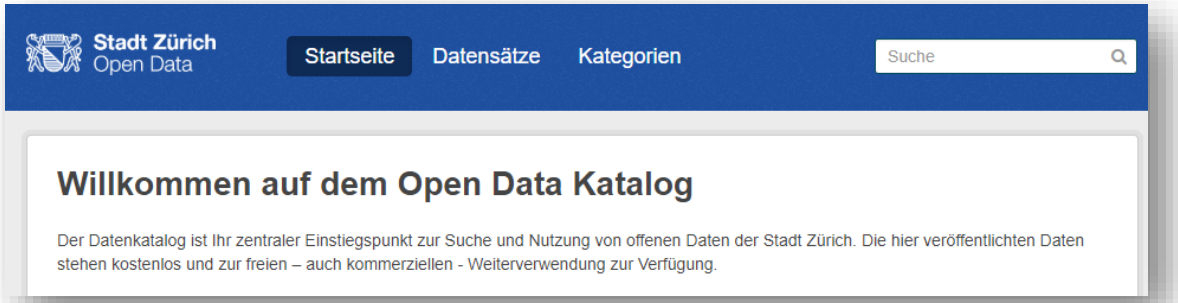
«Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike."

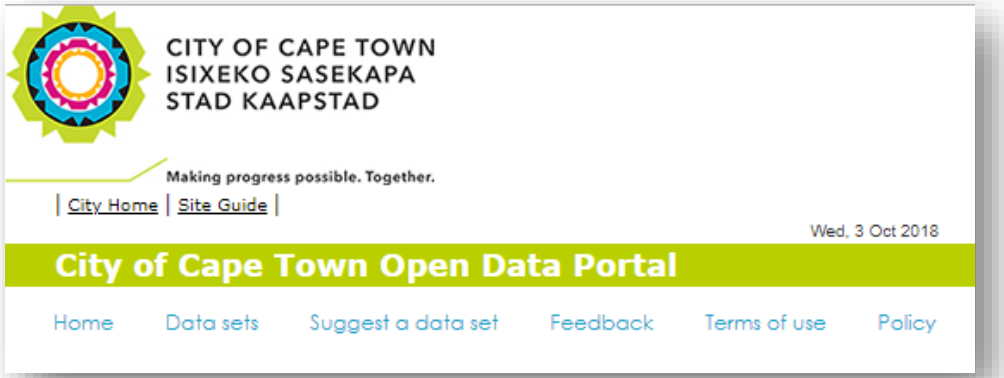
- **Availability and Access**
  The data must be available as a whole and at no more than a reasonable reproduction cost, preferably by downloading over the internet. The data must also be available in a convenient and modifiable form.
- **Re-use and Redistribution**:
  The data must be provided under terms that permit re-use and redistribution including the intermixing with other datasets.
- **Universal Participation**
  Everyone must be able to use, re-use and redistribute - there should be no discrimination against fields of endeavour or against persons or groups. For example, 'non-commercial' restrictions that would prevent 'commercial' use, or restrictions of use for certain purposes (e.g. only in education), are not allowed.(CC-0, CC-BY, CC-BY-SA)

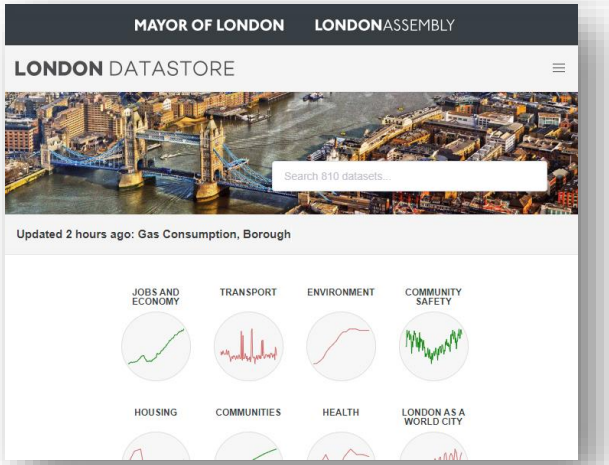
Source: Open Knowledge International

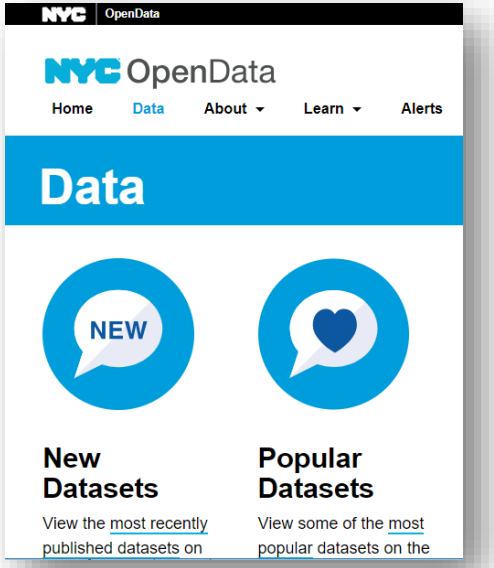
Many Cities have Open Data Portals

… in fact, most Smart Cities do

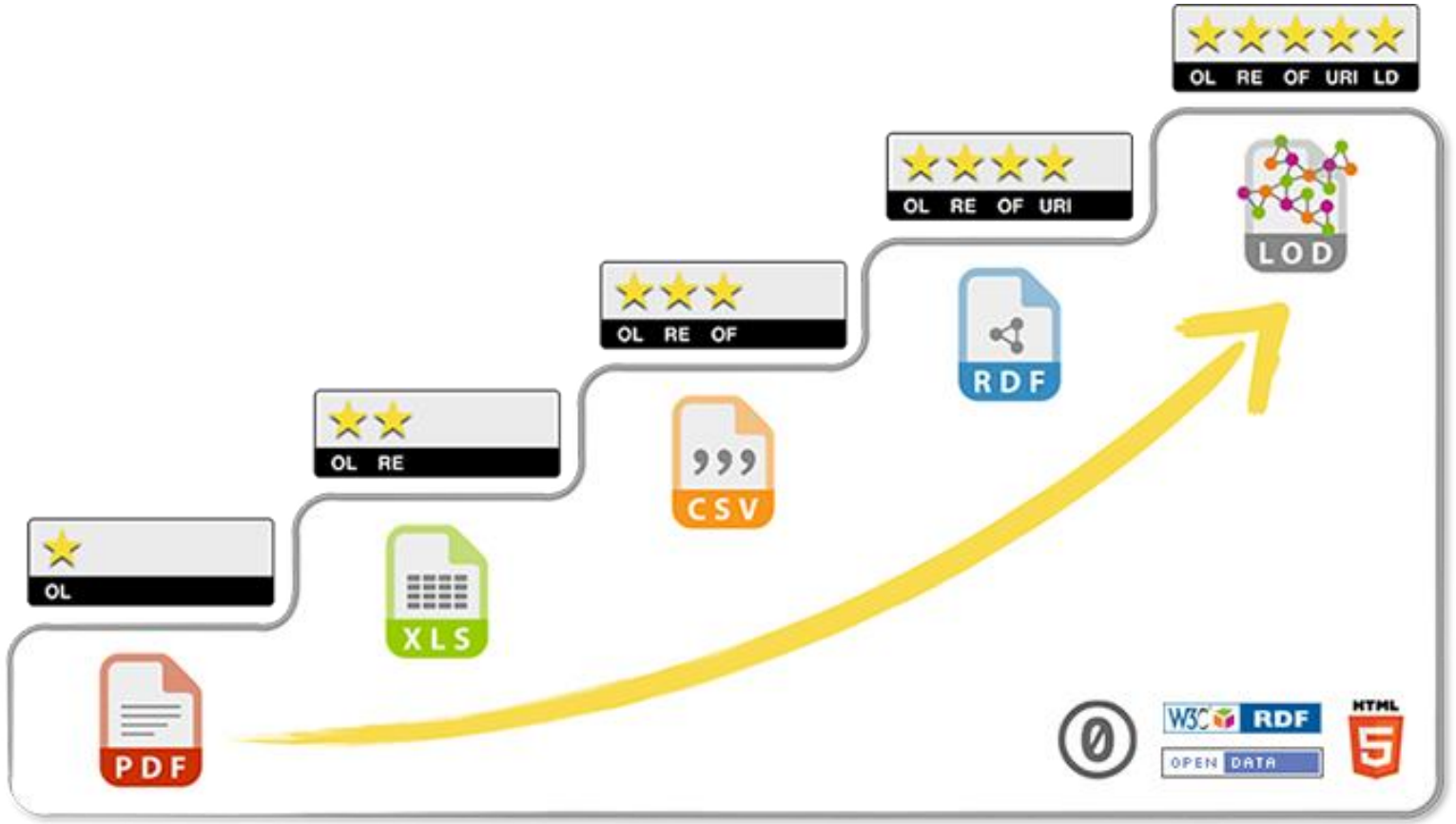






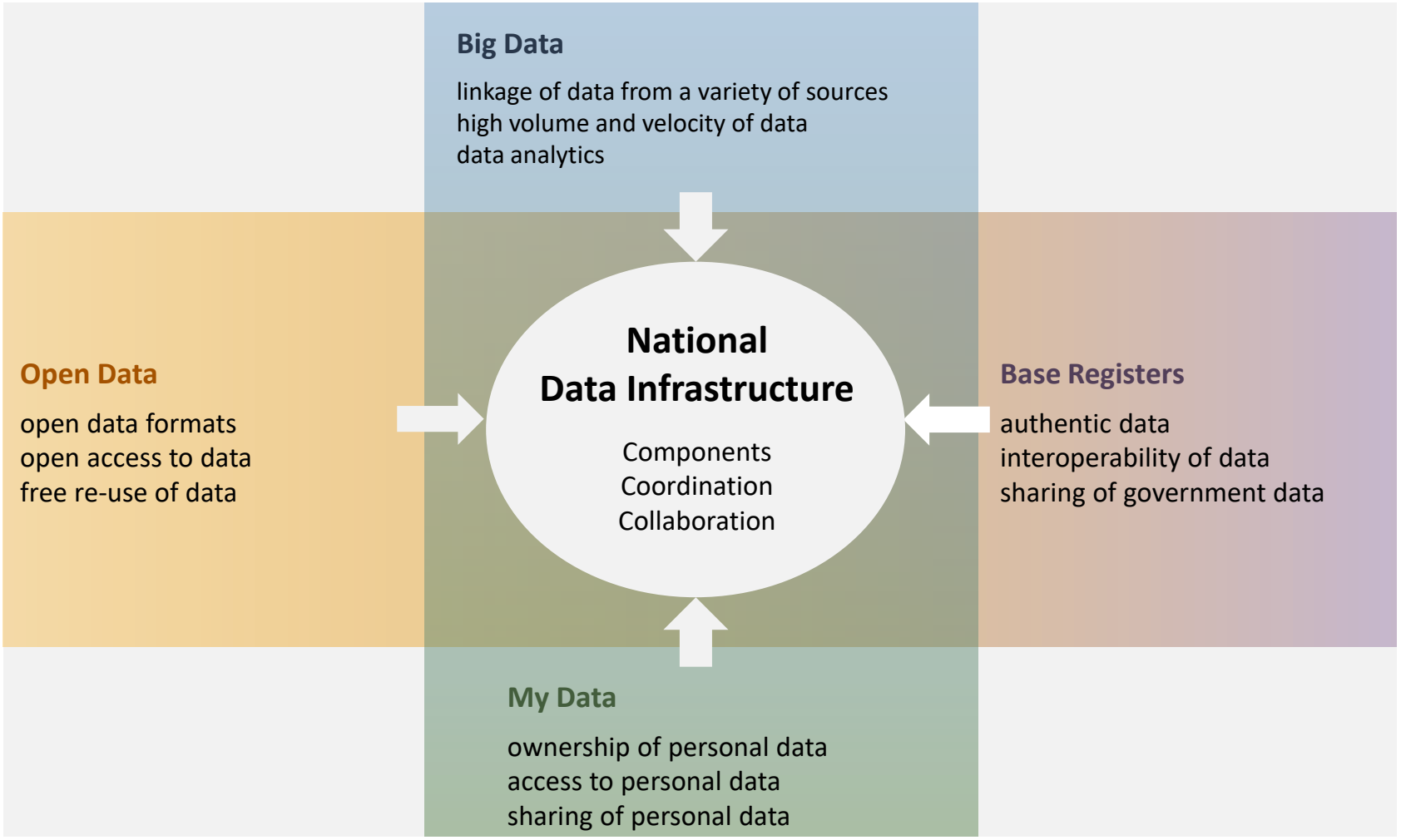


5-Star Model by Tim Berners-Lee



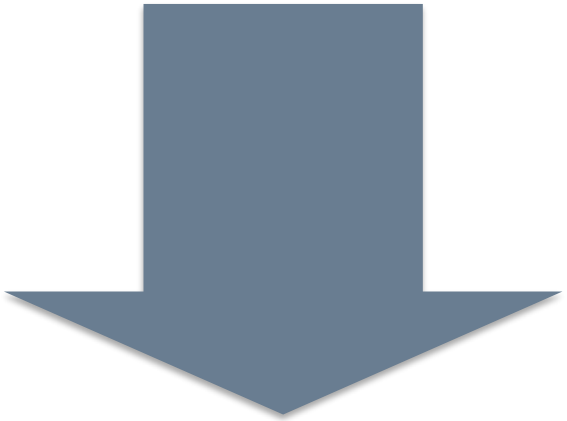
Source: Michael Hausenblas, James G. Kim, Wikimedia Commons

Four Perspectives of a National Data Infrastructure

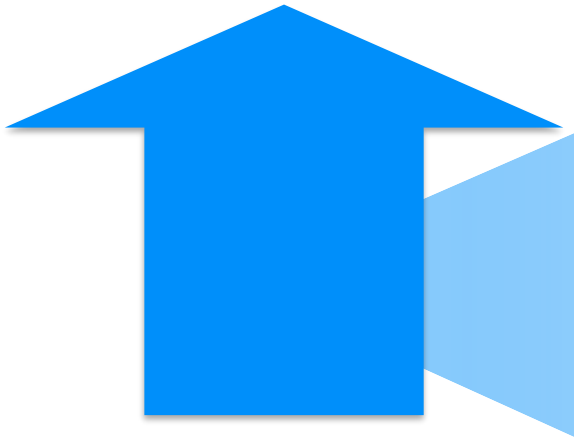


Effecting Transformation & Innovation

Top-Down



- **Traditional** approach
- Often **slow**
- **No failures** accepted



Bottom-Up

- **Co-Creation**, building on knowledge, engagement and true needs of citizens
- **Fast**
- Fail to **learn**

Typical Instruments

- ➜ Citizen Fora
- ➜ Hackathons
- ➜ Community Platforms
- ➜ Business Incubation Services
- ➜ …

Example

- First edition held Dec. 17 – May 18, approx. 100 submissions
- Now running in its 3rd edition

Open Data Challenge for
Public Transportation
in Tokyo

Grand Award
1,000,000 JPY

ODPT Association for Open Data of Public Transportation
INIAD HUB
東京大学 THE UNIVERSITY OF TOKYO
CPaaS.io City Platform as a Service – Integrated and Open

Implementation

- Implementation Model
- Applications

Implementation Models

Anchor

Start with single application, expand from there

Example(s)

- Sapporo
- Winterthur
- Yokosuka

Platform

Platform as a basis for all Smart City applications

Example(s)

- Vienna
- Murcia

Beta-city

Enable different stakeholders to try and test different applications

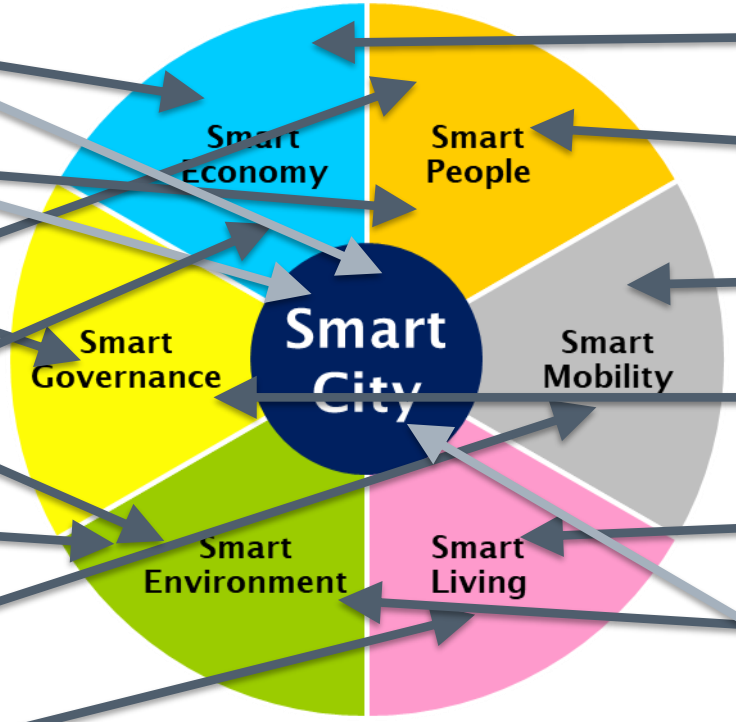
Example(s)

- Amsterdam

Different Smart City Applications

Themes in Amsterdam

- Digital City
- Smart City Academy
- Governance & Education
- Circular City
- Energy
- Mobility
- Citizens & Living

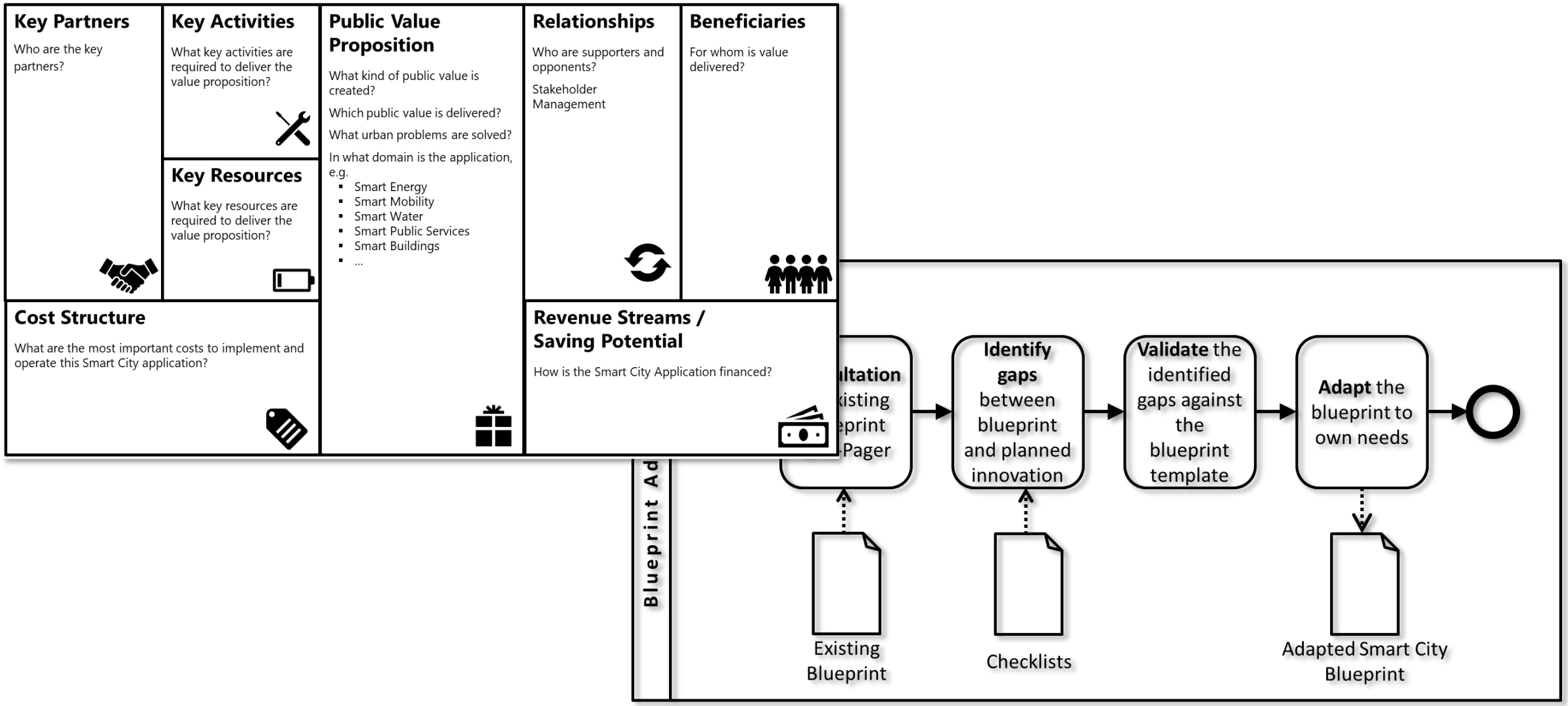


Categories in Vienna

- Innovation
- Bildung
- Mobility
- Location
- Buildings / Health / Social Affairs
- Environment / Energy
- Digital

Sources: Amsterdam Smart City; Cohen 2014; Griffinger al. 2007; Haller 2019; Smart City Wien

Usage of Blueprints for Application Transfer



Infrastructure

- Internet of Things
- Platforms

What is the **Internet of Things**?

«Linking the real physical world with the virtual world of the Internet"

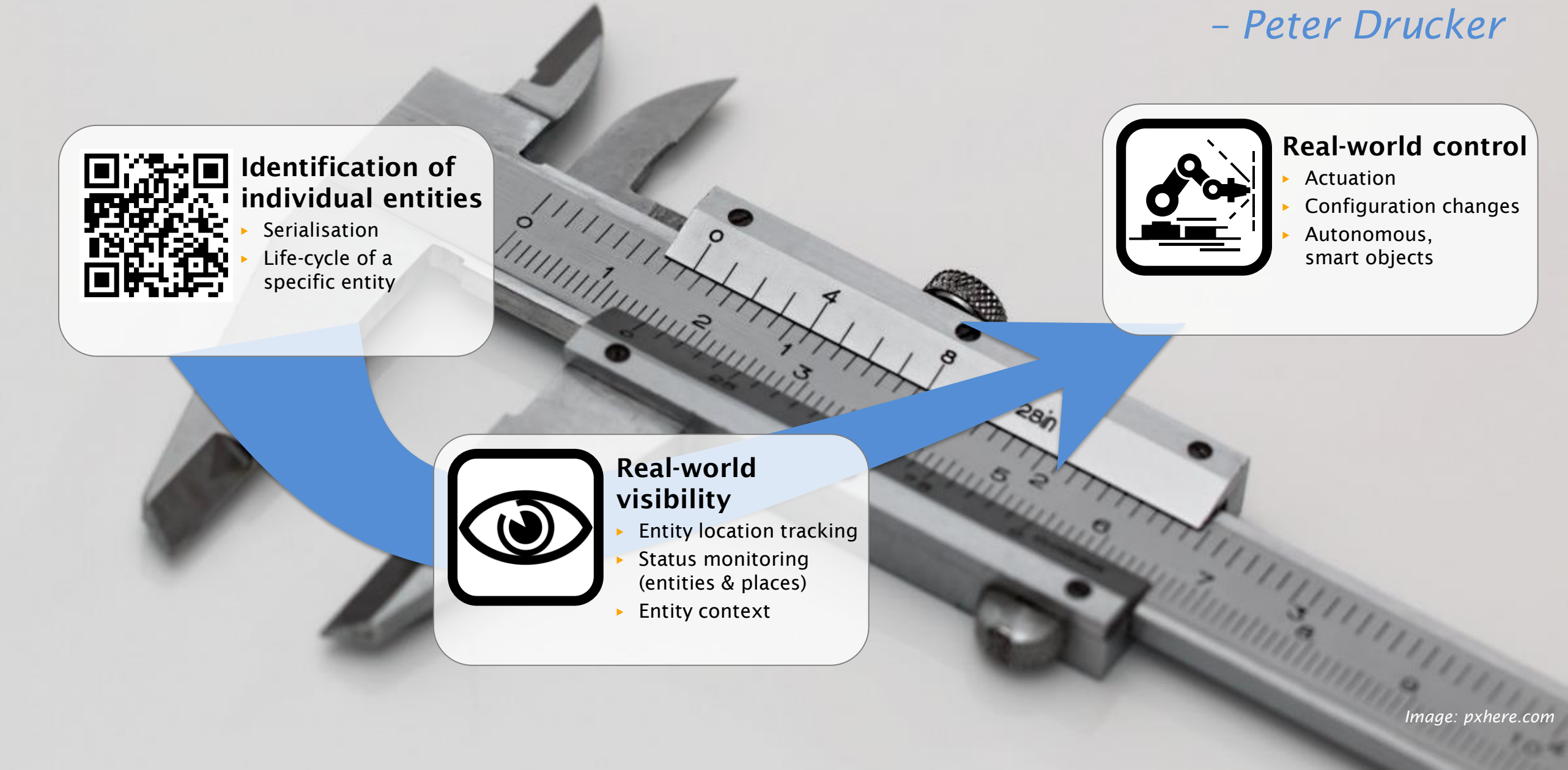
Related Terms

- Cyber-Physical Systems
- Ubiquitous Computing
- Pervasive Computing
- M2M
- Ambient Intelligence
- ...

What is the «Thing»?

or

"If you can't measure it, you can't improve it."
– Peter Drucker



Identification of individual entities

- Serialisation
- Life-cycle of a specific entity

Real-world visibility

- Entity location tracking
- Status monitoring (entities & places)
- Entity context

Real-world control

- Actuation
- Configuration changes
- Autonomous, smart objects

Image: pxhere.com

Example IoT Infrastructure

The Things Network

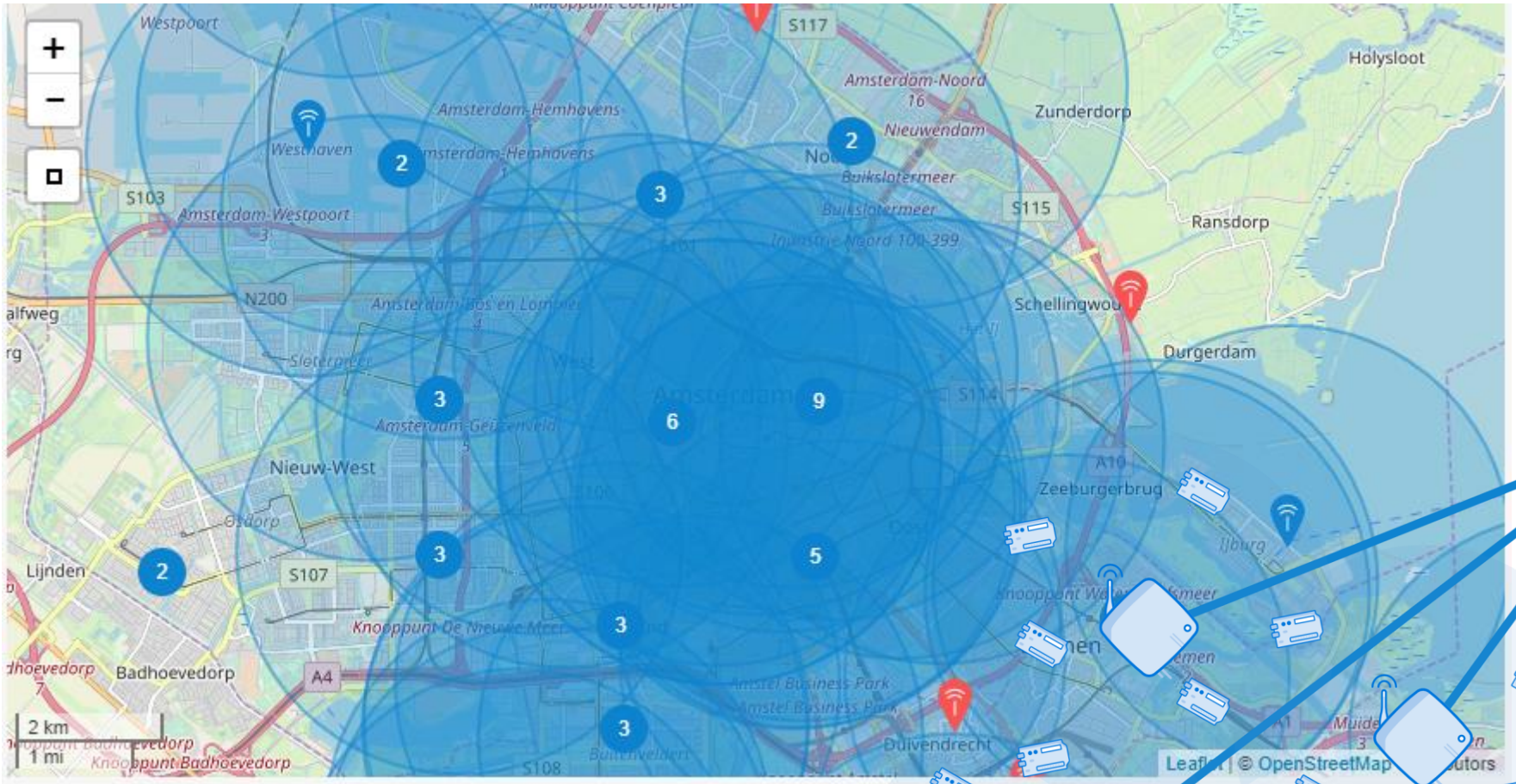
- Community-based effort to build communication infrastructure
- Technology: LoRaWAN
  - **Long range** - multiple kilometers (world record 201 km)
  - **Low power** - can last months (or even years) on a battery
  - **Low cost** - less than 20€ CAPEX per node, almost no OPEX
  - **Low bandwidth** - something like 400 bytes per hour
  - **Secure** - 128bit end-to-end encryptedLoRaWAN
- Commercial LoRaWAN /LPWAN offerings also availble

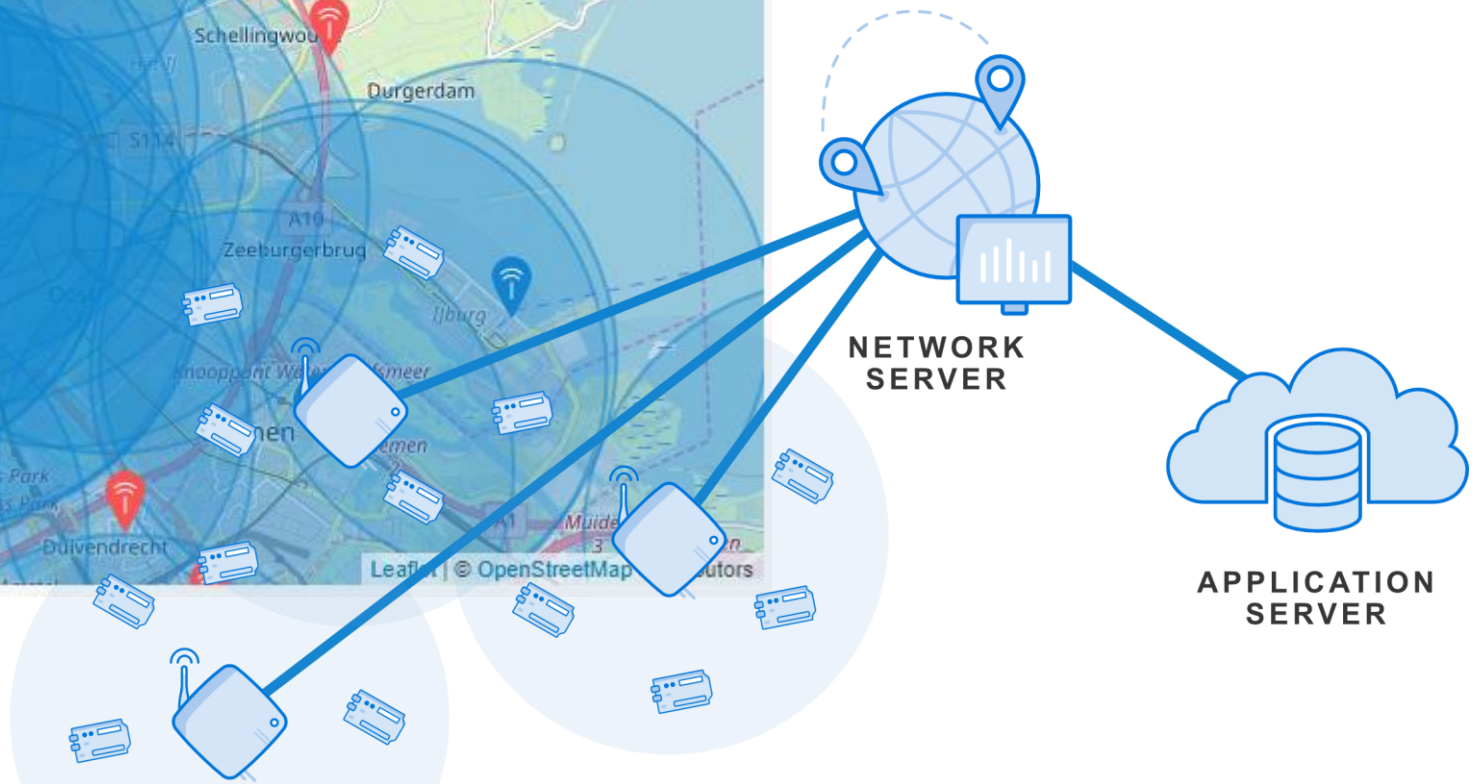
Gateway

End Node

Images: The Things Network

The Things Network: Coverage Amsterdam





Source: The Things Network, https://www.thethingsnetwork.org/community/

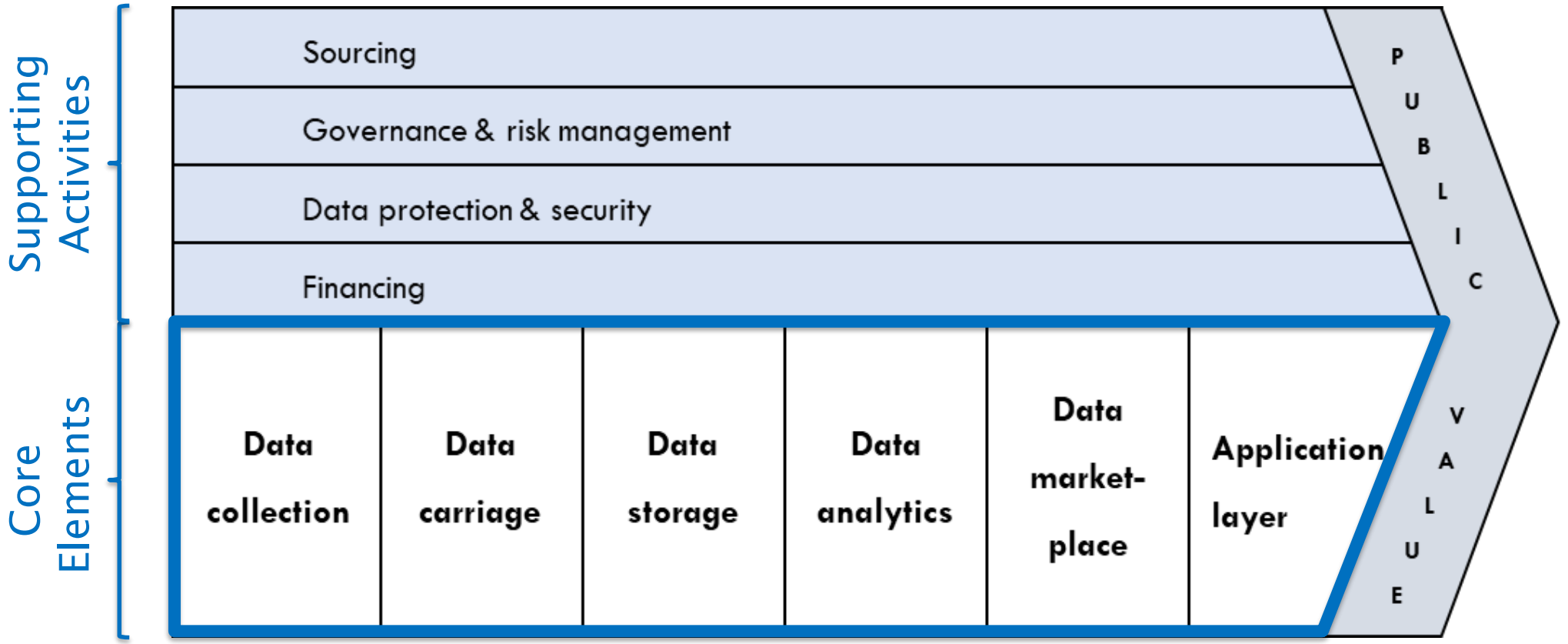
Examples of Smart City Sensors

Smart Lighting Pole, Wädenswil, Switzerland

Smart Parking Sensors, Barcelona, Spain

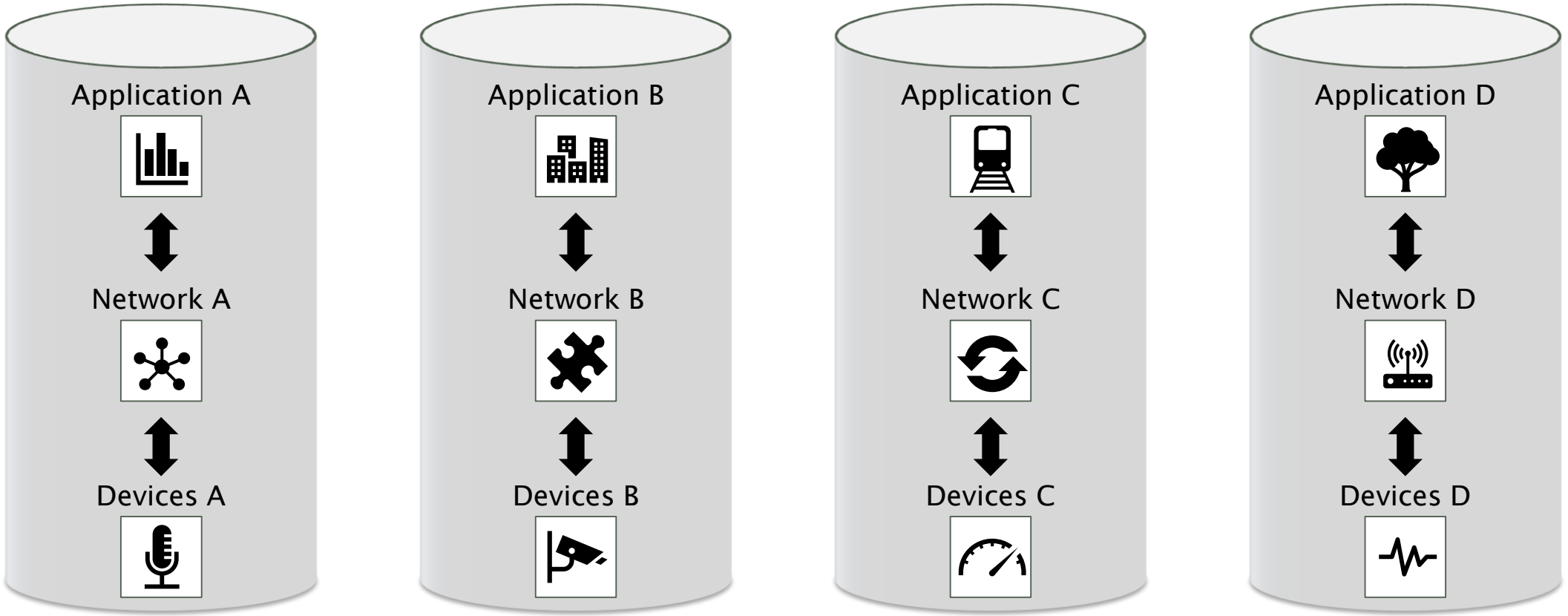
Smart Garbage Bins, New York, USA

Value Chain of Smart City Applications



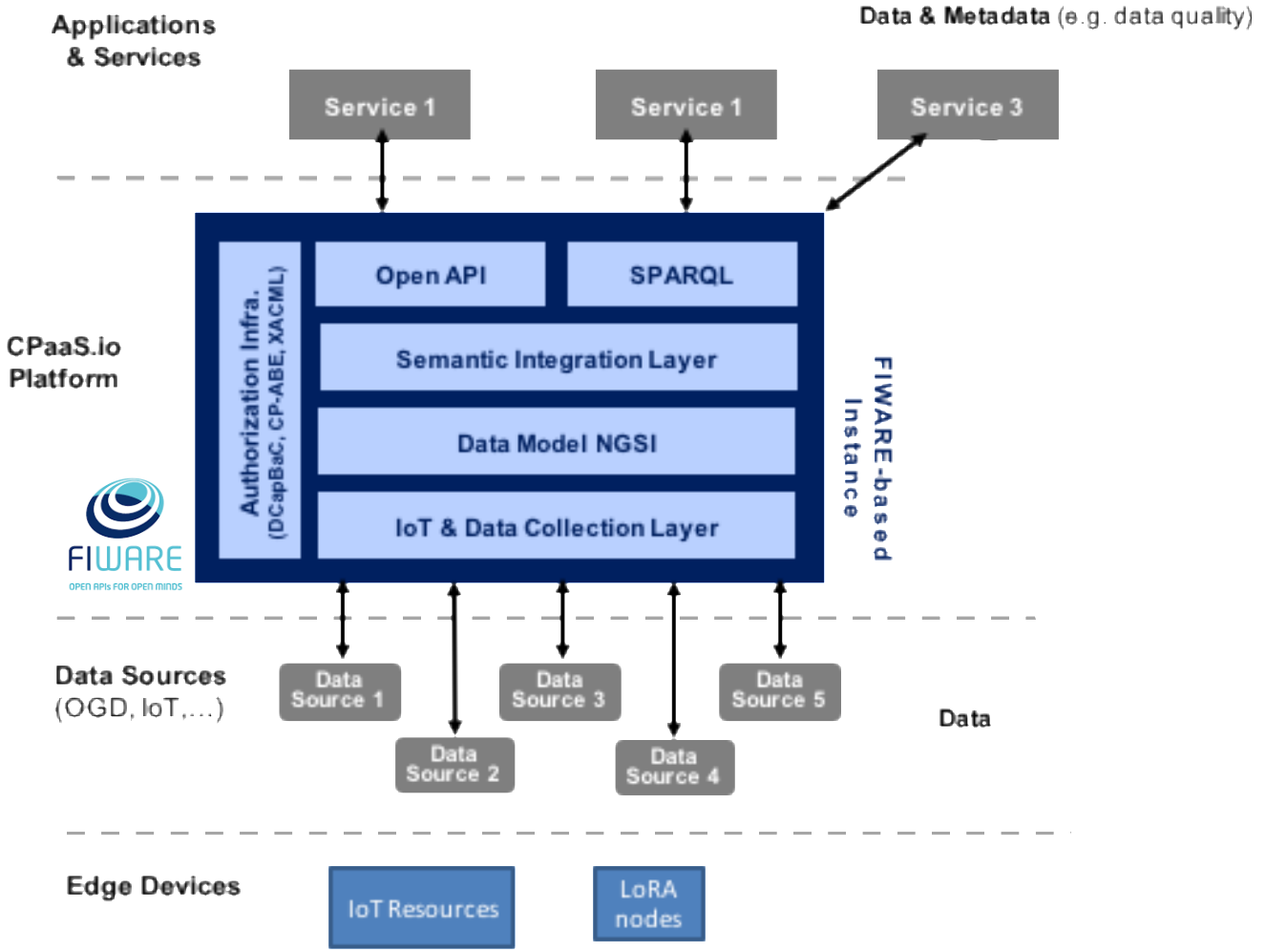
Adapted from (Porter, 1985) and (Laaboudi, D'Ouezzan 2016)

Smart City: Siloed Applications?



Smart City Platform / Urban Data Infrastructure

CPaaS.io
City Platform as a Service – Integrated and Open



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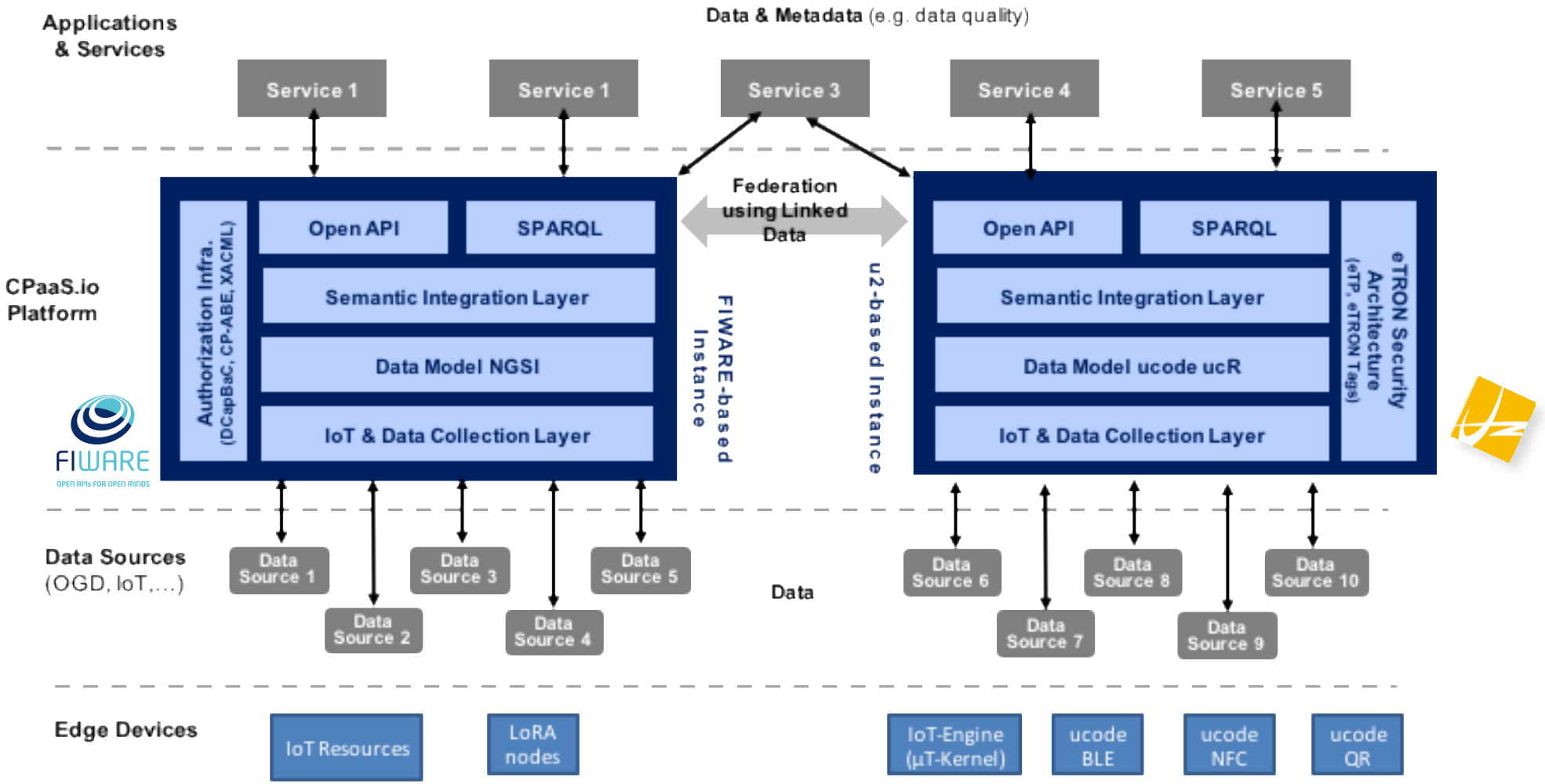

City Dashboard Example: Murcia, Spain

CPaaS.io
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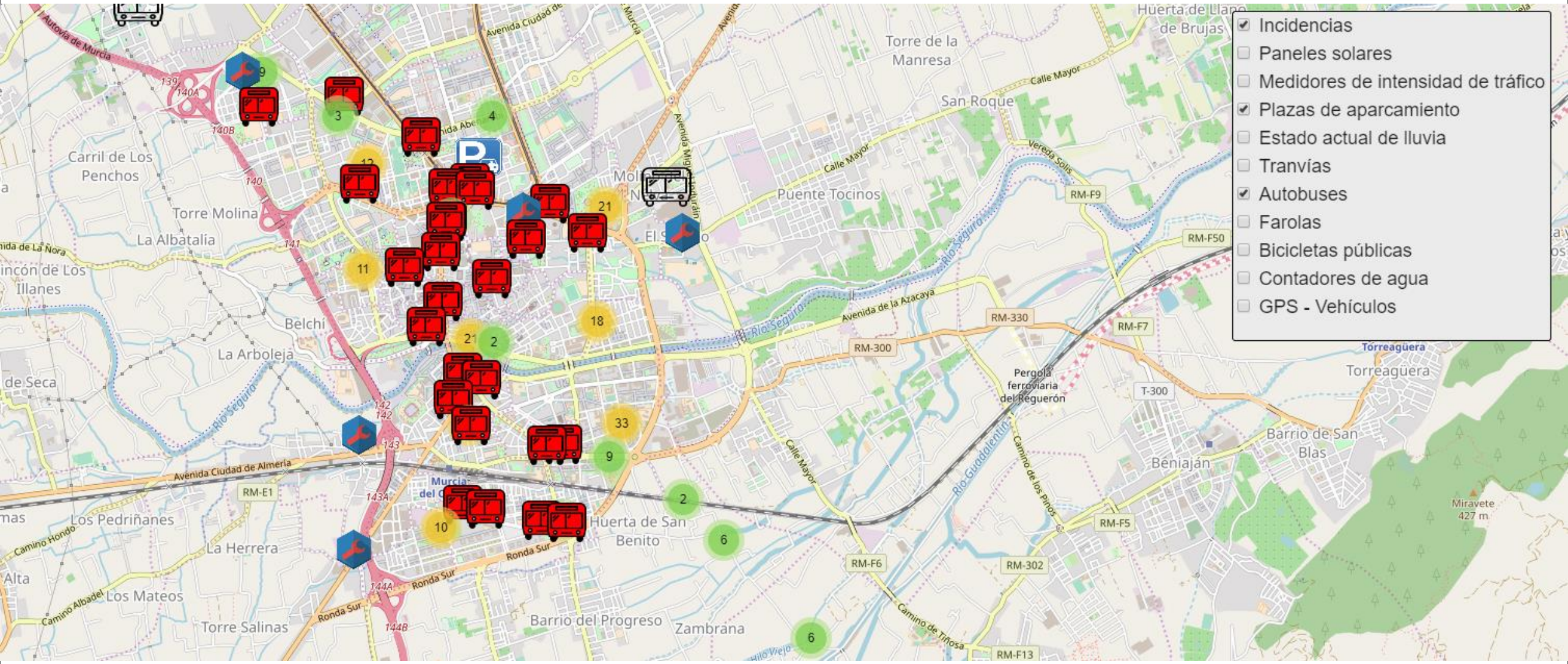
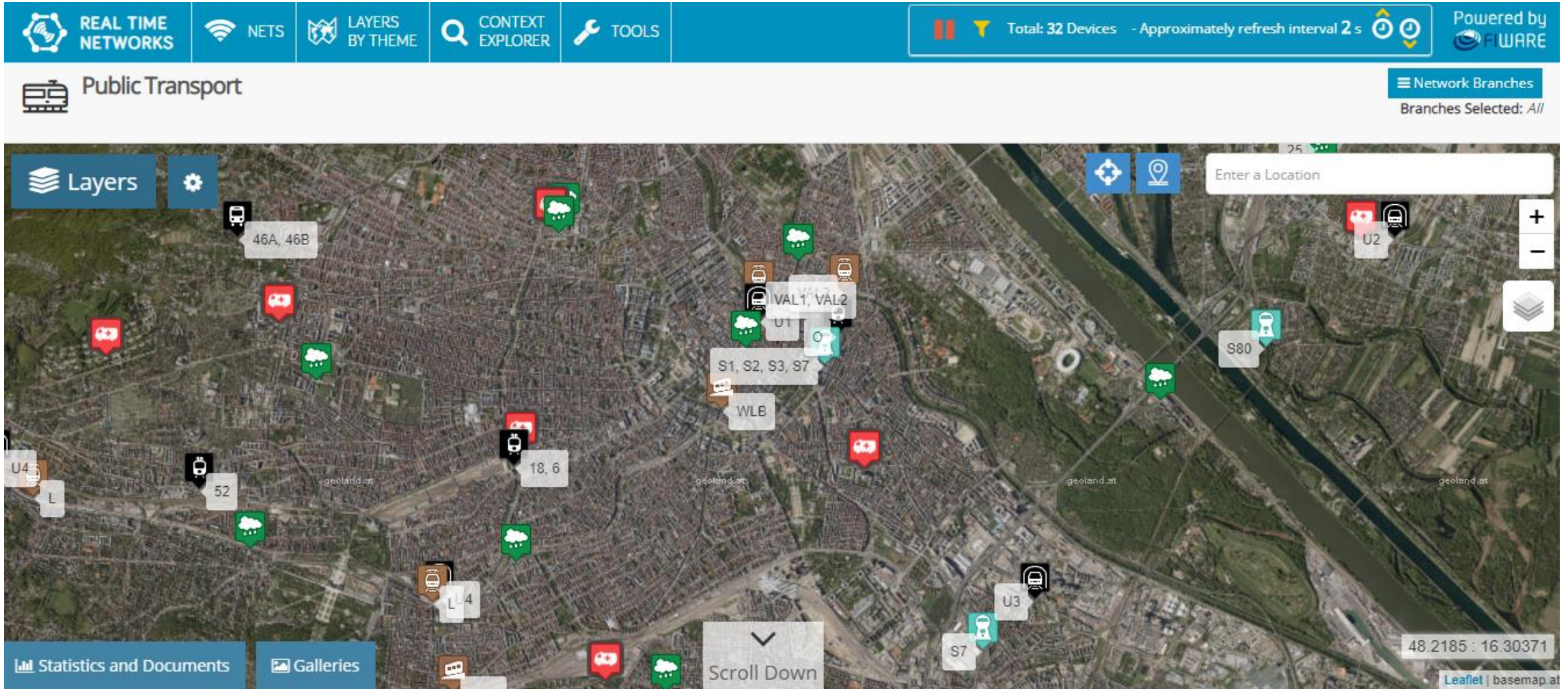


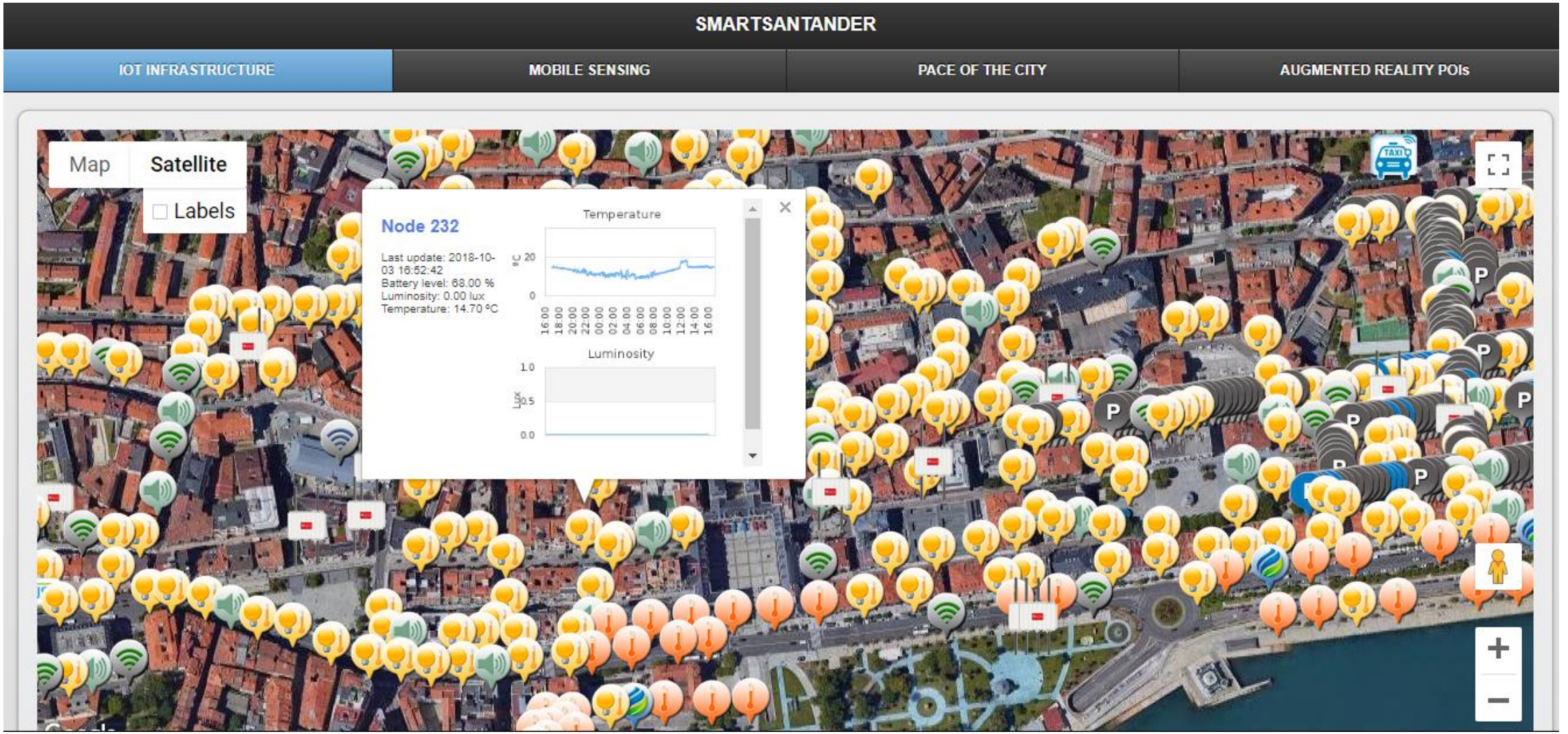
Source: http://mapamurcia.inf.um.es/

City Dashboard Example: Vienna, Austria



Source: https://smartdata.wien/iot/

City Dashboard Example: Santander, Spain



Source: http://maps.smartsantander.eu/

City Dashboard Example: Darmstadt, Germany

Source: The Urban Institute [ui!], https://www.informatik.tu-darmstadt.de/media/telekooperation/teaching_5/vorlesungsmaterialien/materialien_ucg/Ubicomp-Biz-2017-Part-II-LH.pdf

Summary

Success Factor 1 – Involvement of Stakeholders

- Public-Private-Partnerships (PPP) als common model
- Partner ecosystem must be open for new partners
- Important stakeholders:
  - City adminstration
  - Politicians
  - Citizens and end users
  - Enterprises
  - Academia

Bild: pixabay (geralt)

Sources: Walser & Haller 2016; van Winden et al. 2016

Success Factor 2 – Openness and Data

- Open Data (Government, IoT, …)
- Availability of Open Data platforms to enable bottom-up innovation
- Data semantics and an understanding of data quality is important
- Sharing experience and knowledge

Picture: SocietyByte.swiss

Sources: Walser & Haller 2016; van Winden et al. 2016; Fraefel et al. 2017

Success Factor 3 – Scaling Potential

- Realistic business model essential to get beyond a pilot phase
- Social benefits and contribution to sustainability of difficult to translate into concrete financial flows, nevertheless important
- Address scaling potential early

Picture: MaxPixel

Source: van Winden et al. 2016

Concluding Remarks

- Smart City is about more than equipping the city with technology (Internet of Things, sensors)
- It is about quality of life, addressing social, ecological and economic challenges as well as the city's ***capacity for transformation*** → «Resilient City» as a new buzzword
- Open data, openness to exchange experiences with others and participatory approaches, experimentation and a dynamic economic environment are important to ***exploit the city's innovation capacities***

Thank You!

Gracias Mulțumesc 謝謝 Paldies Eskerrik asko Dziękuję Mahalo תודהGo raibh maith agat спасибо Grazzi आभारी Xin cảm ơn 감사합니다 நன்றி Köszönöm مرسي Ndiyabulela Grazia Tak Благодаря Aitäh Terima kasih Děkuji Teşekkür ederim Asante Diolch شكرا Takk Ďakujem Gràcies Kiitos Obrigado Ngiyabonga Þakka þér Grazas Tapadh leibh ขอบคุณ Faleminderit ありがとう Danke Ačiū Merci Grazie Hvala Ευχαριστώ Dankon Tack Dank je Grazcha

References

- Cohen B (2014): The Smartest Cities In The World 2015: Methodology. https://www.fast-company.com/3038818/the-smartest-cities-in-the-world-2015-methodology
- Fraefel M, Haller S, and Gschwend A (2017): Big Data in the Public Sector. Linking Cities to Sensors, In 16th IFIP Electronic Government (EGOV) and 9th Electronic Participation (ePart) Conference, September 2017.
- Gil-Garcia J R, Pardo T A, and Nam T (2015): What makes a city smart? Identifying core components and proposing an integrative and comprehensive conceptualization, Information Polity 2015, 20, 1: 61–87.
- Griffinger R, Fertner C, Kramar H, Kalasek R, Pichler-Milanović N, and Meijers E (2007): Smart cities: Ranking of European medium-sized cities, Final Report, Centre of Regional Science, Vienna UT.
- Haller S, Neuroni A, Fraefel M, and Sakamura K (2018): Perspectives on Smart Cities Strategies: Sketching a Framework and Testing First Uses. In Proceedings of 19th Annual International Conference on Digital Government Research (dg.o'18), Anneke Zuiderwijk A and Hinnant C (Eds.). ACM, New York, NY, USA, Article 4, 9 pages.
- Haller S (2019) Smart Cities and Regions: Die digitale Transformation in der Stadtentwicklung und E-Government. In: Stember J., Eixelsberger W., Neuroni A., Spichiger A., Habbel FR., Wundara M. (eds) Handbuch E-Government. Springer Gabler, Wiesbaden
- Harrison T M, Guerrero S, Burke G B, Cook M, Cresswell A, Helbig N, Hrdinová J, and Pardo T (2011): Open government and e-government: democratic challenges from a public value perspective. In Proceedings of the 12th Annual International Digital Government Research Conference Digital Government Innovation in Challenging Times, June 2011.
- Laaboudi K, and D'Ouezzan S (2016): White Pater: Smart City Value Chain, available from: http://www.e-madina.org/wp-content/uploads/2016/11/White-Paper-e-Madina-3.0-Value-Chain-of-Smart-cities.pdf.
- Lee G, Kwak Y H (2011): Open government implementation model: a stage model for achieving increased public engagement, Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times, ACM (pp. 254-261).
- Porter M E (2014): Wettbewerbsvorteile: Spitzenleistungen erreichen und behaupten = (Competitive Advantage), 8th ed. Frankfurt am Main: Campus-Verlag, 2014.
- Puron-Cid G (2017): From Technology to Social Development: Applying a Public Value Perspective to Digital Government in Local Governments in Mexico. In Proceedings of the 18th Annual International Conference on Digital Government Research - dg.o '17, June 2017.
- Walser K, Haller S (2016): Smart Governance in Smart Cities. In: Meier A, Portmann E (ed), Smart City: Strategie, Governance und Projekte, Springer Vieweg, p 19-46.
- Winden, W van, Oskam, I, Buuse, D van den, Schrama, W, and Dijck, E van (2016): Organising Smart City Projects: Lessons from Amsterdam. Amsterdam: Hogeschool van Amsterdam, http://www.hva.nl/carem/publicaties/content/publicaties-algemeen/2016/organising-smart-city-projects.html