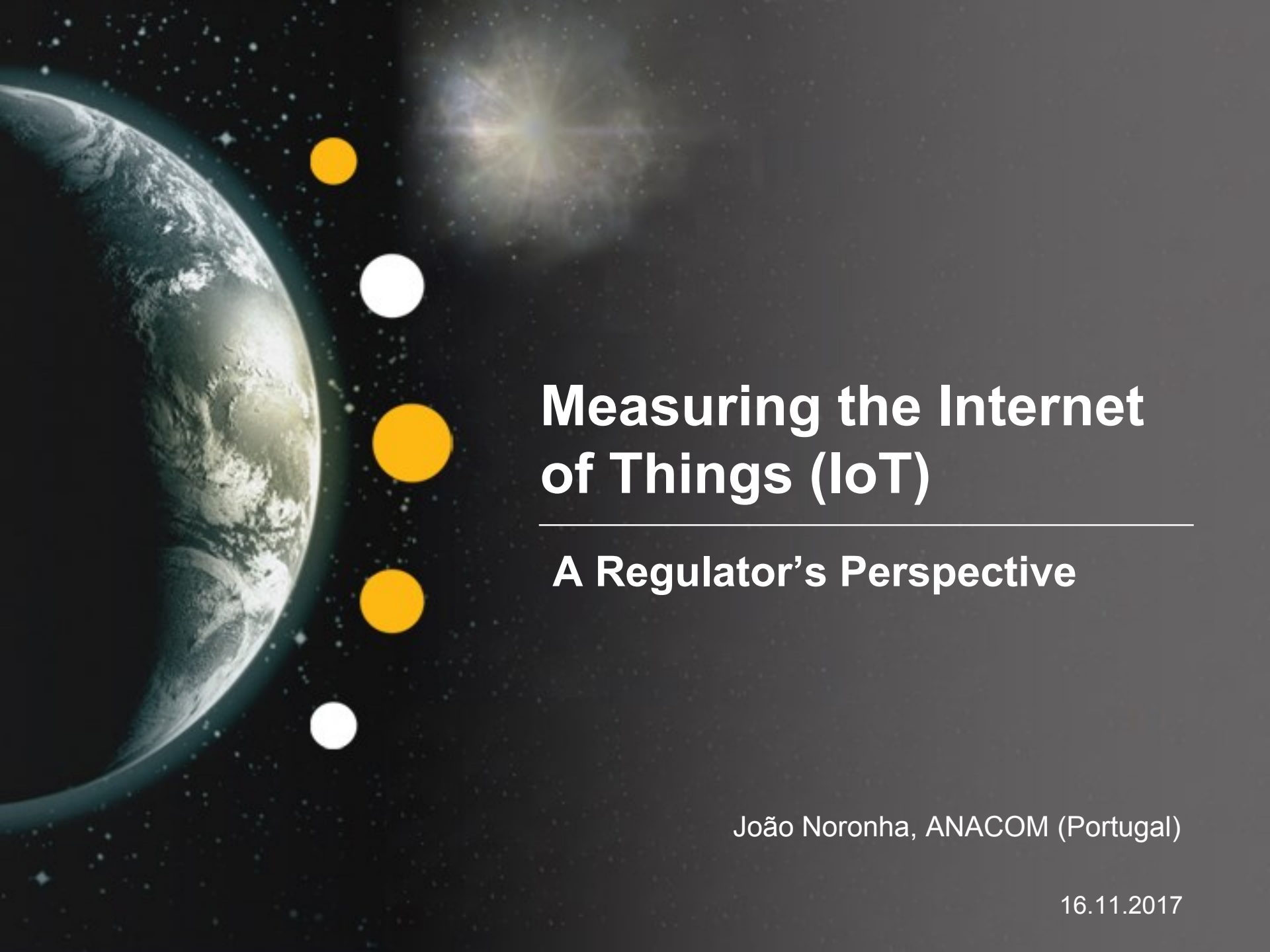

Measuring the Internet of Things (IoT)

A Regulator's Perspective

João Noronha, ANACOM (Portugal)

16.11.2017

Index

1. The Internet of Things (IoT)
2. IoT, public policy and regulation
3. Measuring the IoT
   - Coverage
   - Usage
   - Examples
4. Conclusions

Index

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2. IoT, public policy and regulation
3. Measuring the IoT
   - Coverage
   - Usage
   - Examples
4. Conclusions

A definition of IoT

"*An IoT is a network of **interconnected**, uniquely identifiable **'Things'** which are connected to the Internet and use standard communication protocols.*

*The 'Things' have physical or virtual representation in the digital world, **sensing/actuation capability and/or programmability capabilities**.*

*'Things' **generate information**, including the 'Things' identity, status, location or any business, social or privately relevant information.*

*The 'Things' **offer anywhere/anytime services** that exploit the generated information through an intelligent interface with or without human intervention*"

Source: IEEE (adapted)

The Internet of things (IoT)

28 billion devices

According to the "Ericsson Mobility Report" in 2022 there will be 28 billion connected devices.

Interconnected and communicating

A Massive number of devices will be connecting and communicating through the Internet and other (private) networks

Generating Big Data

Huge amounts of data will be collected, transmitted, analyzed and monetized

Covering all areas of activity

IoT will influence all areas of activity

Connected homes

Home automation, energy management, security, entertainment, assisted living, wearable technology…

Smart farming

Satellite monitoring, plant sensors, smart seeding, smart irrigation,…

Industry 4.0

Cyber physical productions systems

Transport, energy, health, education, consumer services, government,…

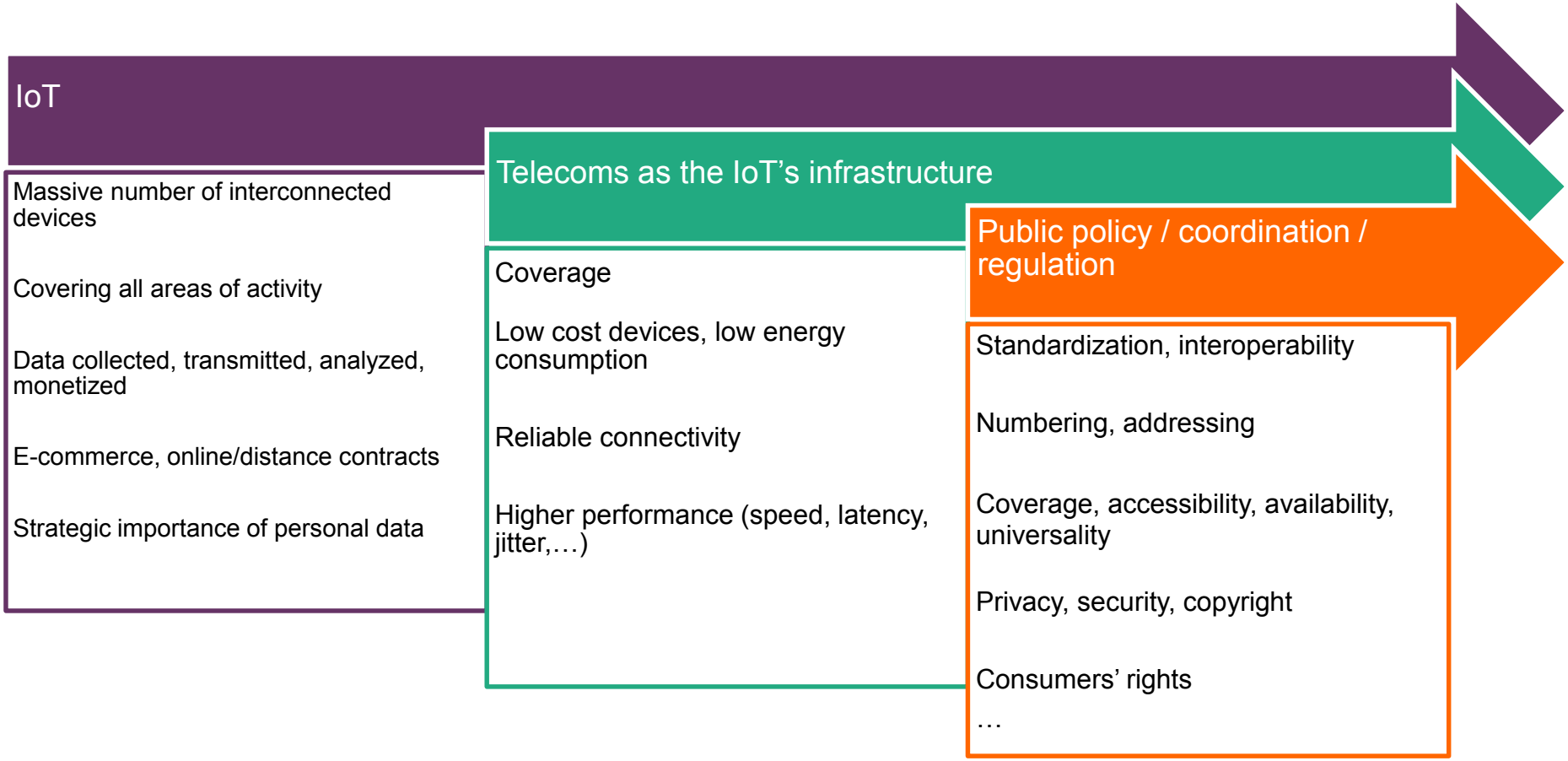
Smart cities, connected health, smart retail, smart supply chain, …

"The new electricity"

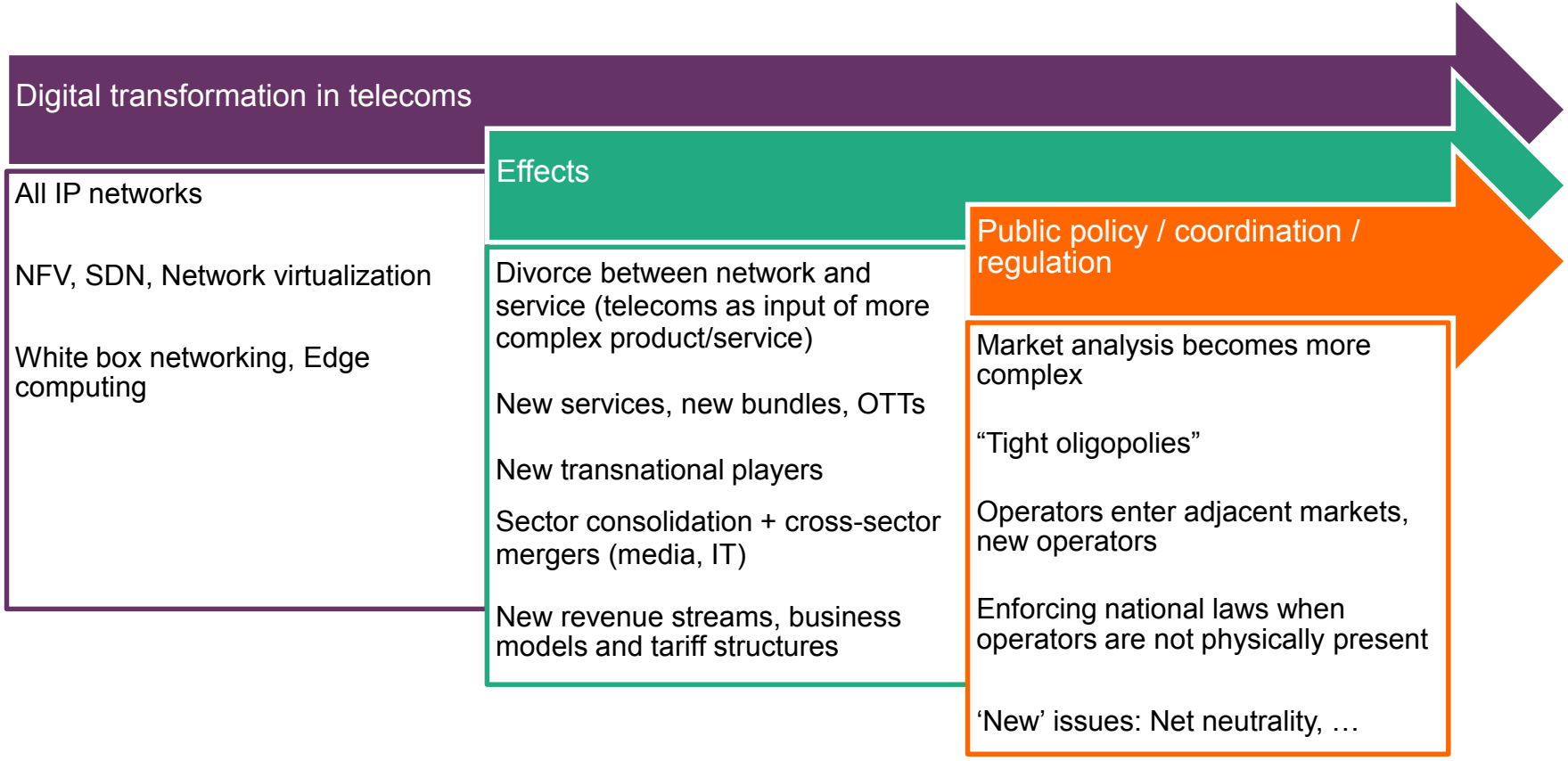
Index

1. The Internet of Things (IoT)
2. IoT, public policy and regulation
3. Measuring the IoT
   - Coverage
   - Usage
   - Examples
4. Conclusions

Regulation & public policy (1)
Telecoms – the IoT's "infrastructure"



Regulation & public policy (2)
Digital transformation in telecoms



The IoT will raise old & new issues for Public policy/regulation

Index

1. A definition of IOT
2. The relevance of the IoT
3. IoT, public policy and regulation
4. Measuring the IoT
   - Coverage
   - Usage
   - Examples
5. Conclusion

IoT indicators for public policy / regulation (1)

Coverage

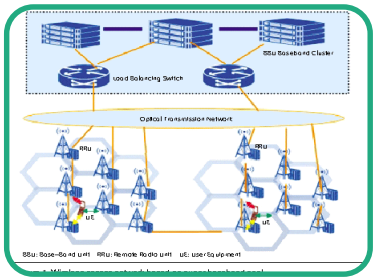
Usage

Devices, connections, subscribers, clients, traffic, revenues

IoT indicators for public policy / regulation (2)

Coverage

IoT indicators for public policy / regulation (3): Coverage



Mobile coverage

- 2G, 2,5G, 3G, 4G
- 5G
- LPWA (feasible/necessary ?)

Fixed coverage

- 90% of wireless traffic supported by fixed networks (Delloite)
- 60% mobile traffic offloaded on to fixed networks (Cisco)
- Short-range IoT, which cover a plurality of devices (Ericsson).

IXPs, datacenters, cloud

- (feasible/necessary ?)

IoT indicators for public policy / regulation (4)

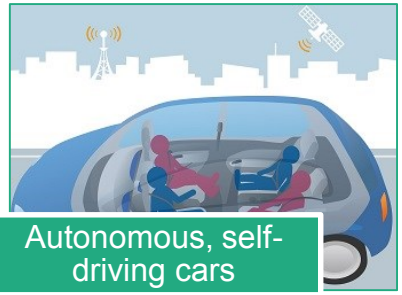
Usage

Devices, connections, subscribers, clients, traffic, revenues

IoT indicators for public policy / regulation (5): IoT applications

Wide area critical applications

- Ultra-reliability
- Availability
- Low latency, high data throughput



Autonomous, self-driving cars

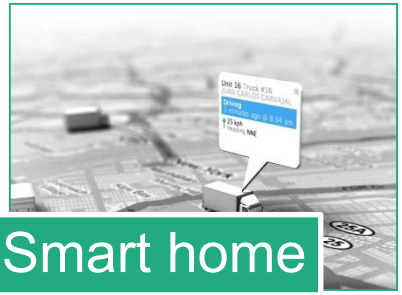
Wide area non-critical applications

- High-connection volumes
- Low traffic
- Low energy consumption
- Low-cost devices

Fleet management

Short range applications

- Typical range of less than 100 m.



Smart home

IoT indicators for public policy / regulation (6): networks & datasources

Wide area critical applications	4G,5G	Supply side (mobile operators)
Wide area non-critical applications	2G, 2,5G, 3G, Cellular LPWA (NB IoT)	
	LPWA (Sigfox, LoRa, RPMA, …)	Supply side (LPWA operators)
Short range applications	Wi-Fi, Bluethooth, ZigBee Fixed / powerline communications	• Device vendors • IaD-*Internet as datasource* • User surveys • …

IoT indicators for public policy / regulation (7): Indicators & challenges

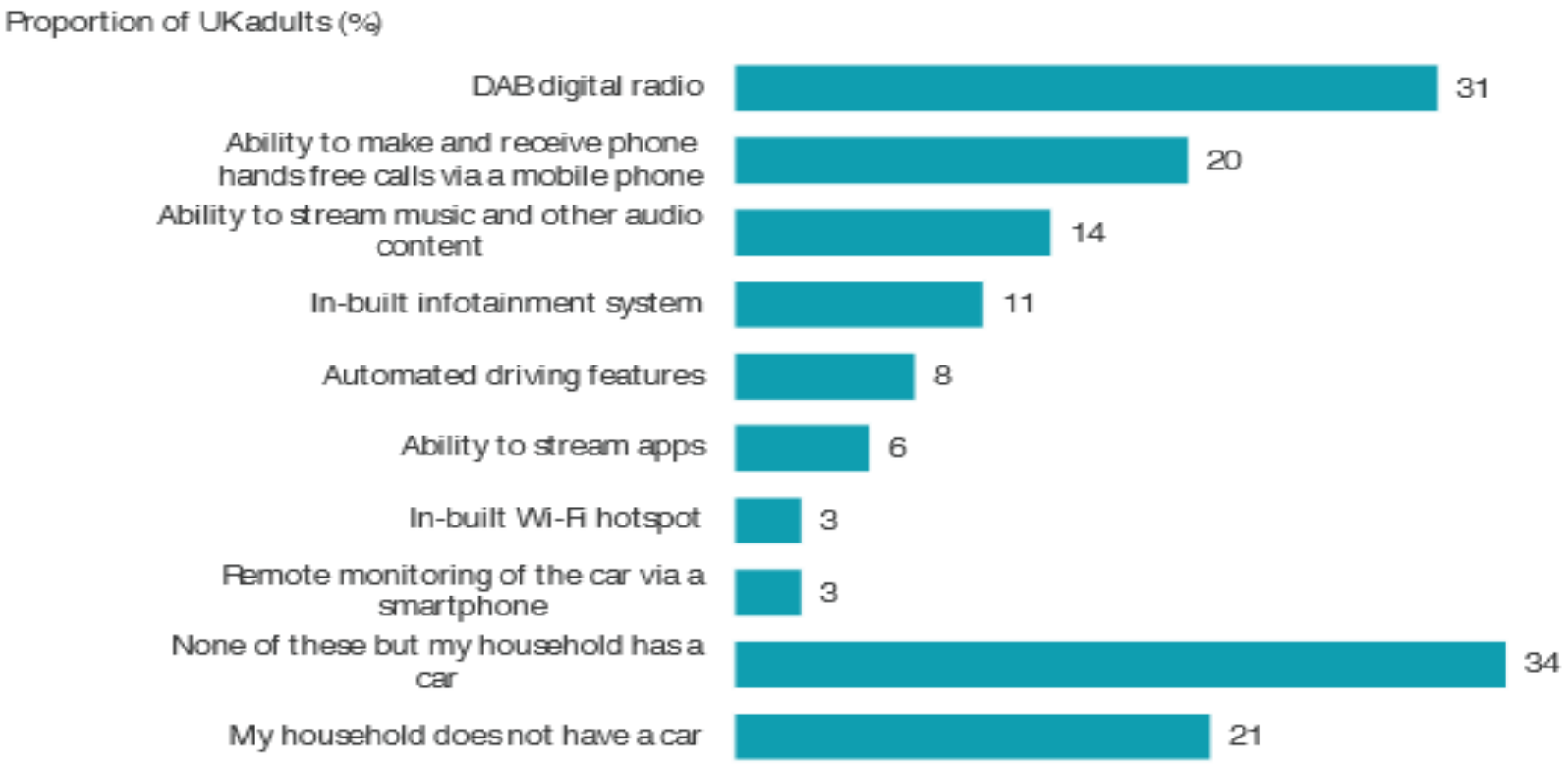
2G, 2.5G, 3G, 4G,5G	M2M-type indicators	• Split by network (…4G, 5G) • Collect data for specific apps/devices (e.g. connected cars ?) • Effect of eSIMS, simultaneous/multi-homing connectivity • Separate P2P & M2M mobile penetration
Cellular LPWA (NB IoT)	N.º devices, clients, traffic, revenues	Transnational corporations offering services across borders
LPWA (Sigfox, LoRa, RPMA, …)	• N.º of devices • Type of devices • Type of applications • …	• Partial data • Users may not know which devices/apps are used (in the case of surveys) • …
Wi-Fi, Bluethooth, ZigBee Fixed / powerline communications		

Example: LPWA services (supply side data)

- In 2016, ANACOM collected data from LPWA providers in Portugal
- Indicators collected included: number of devices, clients, traffic and revenue
- Conclusions were, as expected:
  - Significant number of devices
  - Low volume of traffic per device
  - Low number of (corporate) clients

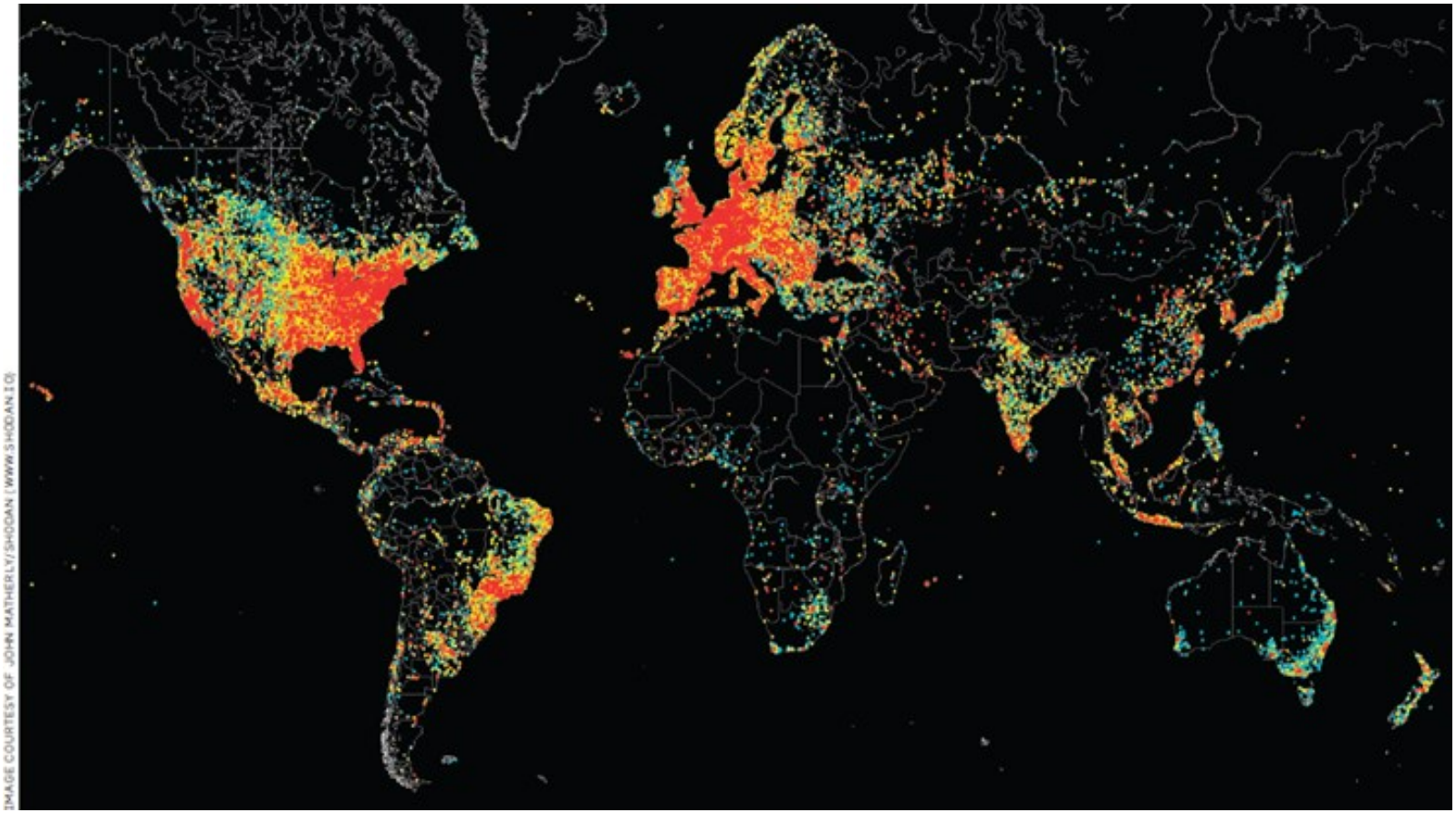
Example: connected cars (consumer survey)

Figure 5.13: Features in car(s) used by household



Source: Ofcom research, 2017
Base: All adults (n = 1062)
Q14: Which of the following features does the car (or cars) used by your household have? Select all that apply, even if you do not personally use the feature [MULTICODE]

Example: *Internet as Datasource*
Shodan, a search engine for the *things*



Source: www.shodan.io, OECD

Index

1. A definition of IOT
2. The relevance of the IoT
3. IoT, public policy and regulation
4. Measuring the IoT
   - Coverage
   - Usage
   - Examples
5. Conclusions

Conclusions

- Coverage:
  - Continue to collect data on fixed and mobile coverage.
  - Develop 5G coverage indicators.
- Compute mobile penetration for P2x and M2M separately.
- Refine M2M and mobile indicators:
  - 2G, 3G, 4G … 5G.
  - By application (?)
  - Investigate effects of e-Sims and simultaneous/multi-homing connectivity.
- Explore alternative data sources: LPWA providers, device vendors, retail outlets, Internet sources (search engines, …), …
- Adapt consumer/enterprise surveys to the IoT: devices, applications, new services,…

Obrigado

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