3.6 | Measuring the Internet of Things

Why are indicators on the Internet of Things needed?

The term "Internet of Things" (IoT) refers to the connection of an increasing number of devices and objects over time to the Internet. Following the convergence of fixed and mobile networks, and between telecommunications and broadcasting, the IoT represents the next step in the convergence between ICTs and economies and societies. It holds the promise to substantially contribute to further innovation, growth and social prosperity, and as with any such development, policy makers and other stakeholders need evidence to inform the decisions they will take in the coming years. Accordingly, the Cancun Declaration (https://oe.cd/DigitalEcoDeclaration) invited the OECD to further work on emerging technologies, including the Internet of Things, to enable countries to fully embrace their benefits and to strengthen the collection of internationally comparable statistics (OECD, 2016).

What are the challenges?

The IoT is expected to grow exponentially, connecting many billions of devices within a relatively short time (OECD, 2015). IoT devices related to energy management, security, entertainment, transport, health, manufacturing and other activities will be present in many homes and workplaces. A key question, therefore, is how to prioritise measurement of those elements of the IoT that are of most relevance to policy makers. For example, in the case of IoT use in manufacturing, sometimes referred to as "Industry 4.0", decision makers may wish to know not only how many robots are in operation, but also how many are connected. Moreover, in the case of fully automated vehicles, they will need to know not only how many units are connected, but also their potential demands on communication infrastructures, such as the flow of large amounts of data.

A single fully automated vehicle, for example, may generate far more data than several thousand mobile users. This could have profound implications for decisions relating to cellular spectrum, the location of data centres, requirements for faster broadband access, and backhaul capacity to name just a few areas. Autonomous vehicles and other technologies will also raise issues around privacy and security (e.g. due to the inclusion of location tracking capabilities, cameras, and so on), as well as interoperability, numbering, and standardisation. Statistical definitions and indicators of IoT should therefore support these diverse policy areas and objectives, to the extent possible.

In addition to information on the growth of demand for communication infrastructures, a further critical aspect for measurement is the impact of the IoT on productivity, GDP, and growth. In order to assess any measure of the influence of IoT on GDP, however, it is important to have a suitable indicator of the size of the IoT. This was made clear by the U.S. Bureau of Economic Analysis (BEA), which endeavoured to measure the influence of the digital economy on GDP (Barefoot et al., 2018) but could not measure the IoT component, despite its importance, given the inherent measurement difficulties and complexity of allocating the "digital" component of the connected devices when accounting for the value added.

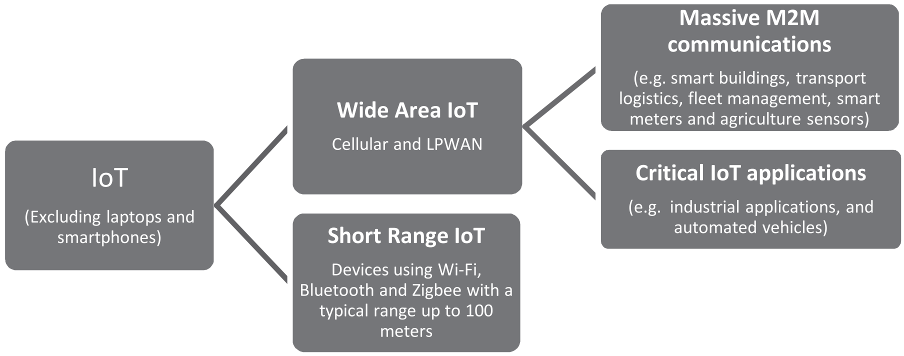
Options for international action

In order to develop measures of the IoT, it is necessary to arrive at a definition. The OECD has adopted the following definition of IoT: "The Internet of Things includes all devices and objects whose state can be altered via the Internet, with or without the active involvement of individuals. While connected objects may require the involvement of devices considered part of the "traditional Internet", this definition excludes laptops, tablets and smartphones already accounted for in current OECD broadband metrics." (OECD, 2018b).

The OECD has also developed a framework (taxonomy) with a breakdown of the IoT into categories, given that different types of connected devices will have different network requirements. For example, critical IoT applications such as remote surgery and automated vehicles will require high reliability and low latency (minimal delay in computer optimisation) connectivity, whereas sensors used for some agricultural applications may be less sensitive to latency or network speeds. Efforts to take into account these subcategories (e.g. massive machine-type communications and critical IoT), are in line with OECD information on country needs related to IoT devices (e.g. from France, Japan, Korea and Portugal), and consistent with the way in which other stakeholders developing IoT business cases are currently measuring the IoT (e.g. Ericsson and CISCO).

One of the key issues for data collection is identifying the best source. One example is data on connected robots; producers of robots and the suppliers of connectivity may both have relevant data but identifying which to use, or how to use both together, is a key challenge. Similarly, information on autonomous vehicles might be available through national vehicle registries, vehicle producers, or connectivity providers. To date, the OECD has gathered data on the number of machine-to-machine (M2M) connections on cellular wireless networks. However, as IoT devices increasingly become Internet Protocol (IP) based and platform-agnostic (i.e. operating on mobile, fixed and other networks), the issue of how to measure the number of such devices and assess their implications for communication networks will increasingly become a challenge.

OECD taxonomy of the IoT for measurement purposes



Source: OECD, 2018.

Policy interest in the diffusion of IoT-enabled devices has guided the introduction of a number of questions in surveys of ICT usage by households and businesses. In the case of households, interest has been focused primarily on the use of smart home appliances (in Australia, Canada, Europe, Japan, Korea, Mexico and the United States), as well as wearable devices (Japan and Korea). The main question is whether household surveys are a reliable source for tracking the diffusion of IoT devices, as respondents may be unaware of whether their devices are connected or not.

With regards to ICT use in business surveys, the focus has been on questions related to RFID (Australia, Europe, Korea and Japan). One promising measurement avenue relates to surveys of business' use of advanced technologies, such as the Statistics Canada Survey of Advanced Technology (SAT). This survey provides a rather unique opportunity for modelling the links between a particularly broad range of technology and business practice use, on the one hand, and innovation behaviour, on the other[1]. Building on technology-based taxonomies, it would be possible to introduce questions on the use of IoT-related technologies and applications, and analyse their diffusion in businesses of different sizes and sectors, as well as the joint impact of IoT and business practices on firms' innovation and performance.

Beyond statistical surveys, the wide range of IoT applications provides new opportunities for measurement, such as IoT search engines that scan the world of connected devices on the Internet, sensor-based data generated by "smart meters", and data transmission between driverless vehicles.

References

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1. The SAT 2014 survey collects, among other things, data on Advanced Material Handling, Supply Chain and Logistics Technologies (including RFID technologies); Advanced Business Intelligence Technologies (including software as a service); Advanced Design and Information Control Technologies (including sensor network and integration) and Advanced Processing and Fabrication Technologies (including robots with sensing and vision systems).