Briefing 1 — March 2018

Internet of Things (connected objects)

Conceptual illustration of a "smart home"
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Summary

- *Gradually, connected objects will be used in all economic sectors (industry, health, sales, etc.).*
- *For example, the use of connected sensors communicating data on the state of the rail network in real time (state of the catenaries, temperature of the rails, etc.) will soon enable the SNCF to predict the maintenance operations to be performed.*
- *Connected objects therefore are very promising. Nevertheless, they pose significant technological and societal challenges.*

Mr. Didier Baichère, MP (National Assembly), Vice-Chairman

The context

Connected objects have existed for many years: (remote signalling, pressure sensors at car park entrances, etc.). These objects, which were previously limited, have recently been perfected and have proliferated to the point that we now talk about the Internet of Things (IoT).

This is due to advances in electronics, telecommunications, data processing and the computing capacity available in the Cloud. As a result, connected objects are no longer mere sensors: they operate within networks and can create, communicate, aggregate, analyse and act on data. These improvements have been accompanied by a significant decrease in the cost of these technologies.

Thus, the Internet of Things sector is likely to increase significantly. Indeed, investments in related technologies are colossal (globally, the equivalent of 700 billion euros were invested in 2017) and the number of connected objects in the world should skyrocket according to specialists in the sector [(1)], reaching several tens of billions by 2020

All sectors are impacted

The Internet of Things affects all sectors of activity: transport, health, housing, industry, sales, public services, etc. For example, the technologies concerned are used to facilitate the maintenance of industrial equipment, rationalise the use of inputs used in agriculture and measure the air quality of metropolises.

Despite the media coverage it enjoys, the consumer market has not reached the same degree of maturity. In view of their price, the duration of their usefulness and their rapid obsolescence, the added value of current connected objects does not seem evident to

> **Some benchmarks:**
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> **1999**: The term Internet of Things was created to refer to the use of RFID tags (Radio Frequency IDentification), with the aim of identifying goods in a distribution chain and transmitting information over the Internet.
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> **2008**: The specification and standardisation of the Internet of Things begins.
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> **2017**: 90% of the data in the world has been created since 2015. Several factors explain these massive volumes of data generated (Big Data), one being the increasingly widespread use of connected objects.
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> **2020**: According to experts, the number of connected objects could range between 30 and 80 billion.

consumers. However, exceptions must be made for the most successful connected objects related to health and well-being.

The example of predictive maintenance

To date, predictive maintenance is one of the most successful applications of the Internet of Things. Used in industry, it relies on wireless sensor networks (WSN).

WSN sensors are placed in strategic locations on the objects to be monitored (infrastructure, production lines, etc.). These sensors, connected together, collect large volumes of data, analysis of which makes it possible to predict malfunctions in a localised manner and, thus, to anticipate maintenance operations.

For example, a WSN consisting of 64 connected sensors has been set up to remotely monitor the mechanical properties of the Golden Gate Bridge in San Francisco. The vibrations measured every thousandth of a second by each sensor are analysed with respect to the theoretical mechanical model of the bridge, in order to predict possible anomalies. The implementation of this WSN therefore reliably ensures the safety of the bridge at a low cost and without interfering with its operation.

Considerable economic stakes

The Internet of Things is a major economic issue. AT Kearney estimates that, through the sale and use of connected objects, value creation for the European Union would amount to around one trillion euros in 2025 [2]:

- 80 billion euros would be generated by the connected objects market itself;
- 210 billion euros would be saved by the reduction of health risks and generated by the saving of time in the daily life of individuals, reused in productive tasks;
- The purchasing power of European citizens could increase by 300 billion euros, mainly because of better control over their energy expenditure;
- 430 billion euros would be due to the increase of productivity in companies.

The risk of capturing value

The advantage of the connected object resides, above all, in the data that it generates, which is necessary for the setting up of services. In particular, the ability to enable connected object networks designed for different applications to function together is essential, since the linking of the data of these networks can lead to solutions with high added economic value.

However, there are hundreds of communication standards applicable to the Internet of Things. In order to enable the aggregation of data generated by networks of various connected objects and to make possible their interaction in a simple and standardised way, platforms tend to emerge. These will be a key element in the interoperability of connected objects.

For France, the risk is that the economic actors who manage to impose their platform by attracting designers of connected objects, associated service providers, application developers, users, etc. may be foreign companies. These would then systematically capture some of their added value.

Uncertain effects on employment

The Internet of Things could enable France to produce more technological solutions with high added value, thus favouring industrial employment. For example, a manufacturer of high-end loudspeakers has been able to establish itself in France and create jobs there, because of the high level of automation of its factory. On the other hand, the optimisation of production lines through connected objects has also been accompanied by major layoff plans in China.

Thus, here as elsewhere, low-skill jobs are likely to be the most affected, while an increased need for labour is expected in the field of information technology and the supervision of industrial equipment.

In addition to socio-professional disparities, the Internet of Things could exacerbate the effects of the digital divide and, economically speaking, favour the best connected regions. From this perspective as from many others, it is therefore necessary to support the development of very high speed internet throughout the country.

The energy stakes

Certain applications of the Internet of Things should make it possible to optimise energy consumption and the management of energy and natural resources.

For example, the principle of the smart grid is to precisely monitor the state of the electricity distribution network (power consumption and transits, currents, etc.) and the state of equipment operation (transformer temperature, etc.).

This monitoring relies on the use of many connected objects along the network such as "high voltage" digital meters, connected transformers and communicating domestic meters. This makes it possible to optimise power generation based on demand (which results in energy savings and better service) and to ensure more efficient maintenance of network equipment.

At the ends of smart grids, smart buildings will also use connected objects. They will be equipped with intelligent lighting, connected airflow control systems and intelligent thermostats.

These advances are a major challenge for France, where the building sector accounts for more than 45% of national final energy consumption and around 25% of greenhouse gas emissions [(3)].

Paradoxically, while certain applications of the Internet of Things thus tend to reduce energy consumption, the consumption of electricity due to connected objects and their data centres is increasing steadily.

A source of electronic waste

In a way analogous to the market for handheld devices (smartphones), there is the question of the lifetime and planned obsolescence of connected objects: certain connected objects are perceived as gadgets and have a short useful life, others are designed without a software update system. Thus, given the expected explosion in the number of connected objects, these could be a massive source of electronic waste.

Public health issues

Connected health objects are full of promises: telemedicine, real-time screening, etc. This is why portable "consumer" connected objects (wearables) are particularly popular. They automate some of our physiological data and provide solutions to improve our health, well-being or physical performance. These solutions are more or less complex, ranging from implementation of a personalised program to the relief of the problem. For example, the "Dreem" headband modulates the brain activity of its wearer, using sound waves to improve the quality of the deep sleep of its user.

This constant connected self-measuring, the quantified self, will make predictive medicine possible. It will no longer be a question of going to the doctor only once one is ill: the interpretation of the measured data will make it possible to anticipate or take charge quickly of health problems and, in parallel, to make considerable savings.

In addition, the use of connected health objects or, even, of connected drugs (the first connected medicine has already been marketed in the United States) could, in the long term, lead to profound changes in the management of health care. While today, taking a connected medicine induces ephemeral action on the body (any trace of the drug being eliminated in the long term), tomorrow, it is likely that we will be permanently connected, for example *via* implant-sensors monitoring our health.

The French department of the Loiret has created a support and protection mechanism for beneficiaries of the personalised autonomy allowance (PAP), based on the low-speed connection technology of a French company [(4)]. With minimal cost and energy consumption, beneficiaries and their families can access all their data in real time *via* a social portal.

Not all healthcare connected objects are portable: for example, health booths (telemedicine), some of which have more than ten connected measurement sensors and make possible a videoconference with the doctor [(5)].

Multiple social issues

The Internet of Things raises many social issues, the first of which is the acceptability of these technologies. The social acceptability of a connected object depends on a range of criteria: the area of use and the applications allowed by the object, the scope of use of the object (collective or domestic), the imposed or voluntary nature of the object, the nature of the intrusion of the object (nominative, personal or statistical), the nature of the user's interaction with the object (passive or active user), etc. Proper consideration of the social acceptability of connected objects used in public projects is essential to avoid situations of tension such as the resistance to the Linky smart meter [(6)].

In addition to acceptability, the very use of connected objects raises many questions of a social nature ([7]). In a sense, connected objects can be providers of freedom. For example, the data collected by smart grids could empower network customers if it were decided that this data would be delivered to them so that they could optimise their electricity consumption. Connected objects can nevertheless create constraints. A lack of perspective on the diagnoses of a connected health object can, for example, encourage the user to comply with a norm that is not necessarily relevant: connected pedometers encourage their users to do "10,000 steps a day", although no scientific study can attest to the benefit obtained.

One can also wonder whether connected objects are creators of social ties or of inequalities. While, on the one hand, the technologies of the Internet of things can help regulate complex social issues (traffic jams, etc.) with the support of everyone, the use of connected objects can also generate exclusion. Indeed, it accentuates the "second degree" digital divide to the detriment of some older people who may find it more difficult to use these technologies.

Finally, "public" connected objects produce large amounts of personal data. Owners of connected objects are not necessarily aware of this, so they do not fully measure the risks to which they are exposing themselves. They are not always aware of the risks of piracy, of the recipient with whom they share their data, of the subsequent use that can be made of it and the consequences for their privacy – or even their individual freedom.

On this sensitive issue of personal data protection, the new General Data Protection Regulation (GDPR), which comes into force on May 25, 2018, brings significant improvements, allowing users to better control their personal data.

French law also protects citizens. For example, contrary to a widely held idea, the insurance and mutuality codes prohibit insurers from modulating their pricing by penalties based on each client's state of health. The Social Security code allows only prevention programs by means of bonuses.

PENETRATION OF CONNECTED OBJECTS IN FRENCH HOMES

Connected object	French people equipped	
	in 2016	in 2017
Television	22%	29%
Security equipment	5%	12%
Watch	6%	11%

Source: OpinionWay (1,070 respondents, margin of uncertainty between 2 and 3%).

A poll [8] conducted in March 2017 by OpinionWay shows that the French are acquiring more and more connected objects and have, therefore, a better understanding. Thus, they are more aware the benefits associated with the use of these objects (remote monitoring of housing, monitoring of health status ...), as well as the associated risks: in 2017, 42% of respondents declared themselves worried about the collecting of their data, as against 33% in 2016.

■ Many technological challenges to overcome

One of the most critical technological constraints when designing a connected object is still energy management [9]. For example, some WSNs require connected objects to work independently for several months without any reloads. These connected objects are often very compact (so that they can be installed everywhere) and therefore carry small batteries. R&D is, therefore, essential in the fields of production technologies, storage and energy management of embedded systems (batteries, "energy harvesting" systems, etc.).

In addition, with the Internet of Things, the exploitation of security gaps could be damaging in a new way, as computer attacks can have a serious impact on the real world; researchers have been able to take remote control of certain models of connected cars.

In addition to being targets, connected objects can be used to participate in attacks on other information systems. Thus, in 2016, the site host OVH was hit for five days by a massive attack involving the hacking of 145,607 connected cameras.

European regulations encourage manufacturers to design secure connected objects which produce and transmit the bare minimum of data. Despite this, the design standards ensuring the computer security of the technologies of the Internet of Things are not yet generalised. Nevertheless, the security defects of networks of connected objects are major risks and special attention must be paid to them.

Lastly, the radio spectrum – the set of frequencies over which radio systems can operate – is now saturated. Optimising the use of the spectrum through regulatory provisions and technological solutions is a key element in the development of connected objects, at a time of predictable explosion in their number.

OPECST websites:

http://www.assemblee-nationale.fr/commissions/opecst-index.asp
http://www.senat.fr/opecst/

Endnotes

[1] *"Le marché des objets connectés (quelques chiffres)"* ["Some figures on the market for Connected Objects"], *Correspondant informatique et libertés du CNRS, 7 septembre 2015:*
http://www.cil.cnrs.fr/CIL/spip.php?article2760
[2] "The Internet of Things: A New Path to European Prosperity", *AT Kearney, January 2016:*
http://www.atkearney.fr/paper/-/asset_publisher/dVxv4Hz2h8bS/content/the-internet-of-things-a-new-path-to-european-prosperity/10192
[3] An OPECST briefing is being prepared on "The energy renovation of buildings"
[4] *Sigfox: https://www.sigfox.com/en*
[5] The Consult Station by the French company Health for Development (H4D)
[6] See the round tables on "The issues of communicating meters" jointly organised on 14 December 2017 by the OPECST and the Economic Affairs Committee of the National Assembly.
[7] This development picks up the argument of point II.B of the first part of the information report n° 4362 of January 10, 2017, on Connected Objects presented by Corinne Erhel and Laure de La Raudière for the Economic Affairs Committee of the National Assembly.
[8] *Les Français et les objets connectés, [French people and connected objects] OpinionWay pour DistreeConnect, mars 2017:*
https://www.opinion-way.com/fr/sondage-d-opinion/sondages-publies/marketing/opinionway-pour-distreeconnect-2017-les-francais-et-les-objets-econnectes-mars-2017.html
[9] Conference "Frequencies in the service of the individual", ANFR, November 27, 2014:
https://www.anfr.fr/fileadmin/mediatheque/documents/Actualites/Les_actes_-_Conference_2014.pdf

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