TEN/342
The Internet of Things

Brussels, 18 September 2008

OPINION

of the
European Economic and Social Committee
on
The Internet of Things
(exploratory opinion)

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On 7 February 2008 the European Commission decided to consult the European Economic and Social Committee, under Article 262 of the Treaty establishing the European Community, on

> *The Internet of Things*
> (exploratory opinion).

The Section for Transport, Energy, Infrastructure and the Information Society, which was responsible for preparing the Committee's work on the subject, adopted its opinion on 16 July 2008. The rapporteur was **Mr Retureau**.

At its 447th plenary session, held on 17 and 18 September 2008 (meeting of 18 September), the European Economic and Social Committee adopted the following opinion by 118 votes with one abstention.

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1. **Conclusions and recommendations:**

The EESC encourages the EU Commission to:

1.1 Invest in research, to support dissemination (such as the past presidency events) and standard setting activities because they consider the Internet of Things (IOT) domain important.

1.2 Take measures to remove barriers that would hamper the taking-up of the technology.

1.3 Assess whether centralised systems will be able to handle the amount of traffic that can be expected of IOT applications and if local governance (of names and services) are a better approach to manage mass deployment.

1.4 Investigate whether the current existing directives handle the data protection and security requirements adequately or if new legislative measures are needed.

1.5 Consider the need for some laboratories in Europe with combined funding from universities and private companies, in order to ensure that research results are taken up in Europe and to counter a brain-drain of researchers to research facilities and enterprises in other parts of the world (US).

1.6 On the issue of eventual electromagnetic risks - the principle of precaution should apply for these new environments with a high density of wave readers, in particular for the workers in such environments. They should be informed about any potential risks and methods of protection should be put in place. All the same, the question should be seriously assessed, through scientific studies.

1.7 Remember that technology development should be done for the people and that there is a need to evaluate the related ethical risks.

1.8 For transeuropean services, the European Commission or the independent administrative authority that may regulate the spectrum in the future, should consider the spectrum needs of the Internet of Things.

1.9 Research will be crucial to win the race to deliver computing capacity to handle future real time Internet of Things applications.

2. **Commission proposals**

2.1 Following its 2007 communication on RFID tags[1] and the conference on this subject held in Lisbon last November, this communication sees the Commission moving into the next phase, which is the Internet of Things[2].

2.2 Reference should also be made to the numerous communications and initiatives which the EESC has produced in recent years[3], including an interim report on the i2010 programme[4].

3. **Comments and analysis**

3.1 **Introduction**

3.1.1 The development of IT is a crucial issue for our societies, especially since Europe's single market puts it in a good position to become a key region in the digital economy, provided that it commits sufficient economic resources to basic research and R&D and political resources to governance for the Internet of the future.

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[1] COM(2007) 96 final, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Radio Frequency Identification (RFID) in Europe: steps towards a policy framework.

[2] See Towards an RFID policy for Europe, Workshop report, Maarten Van De Voort, Andreas Ligtvoet, 31 August 2006.

[3] Such as the EESC opinion, on *Radio Frequency Identification (RFID),* rapporteur Mr Morgan, OJ C 256 of 27.10.2OO7, p. 66 - TEN/293.

[4] Communication on Preparing Europe's digital future: i2010 Mid-Term Review COM(2008) 199 final.

3.1.2 Europe's growth and competitiveness are highly dependent on this and it is time that, in addition to developing technology and investment and the requisite knowledge and know-how, a strong position be taken on political governance of the Internet.

3.1.3 Even with the current interactive, mobile Web 2.0, the Internet still relies on a global network of hundreds of thousands of servers and routers, in other words, fixed computers linked by wire or optic fibres. However, connections to mobile terminals, such as mobile telephones or internet tablets, which are made via electromagnetic waves, are expanding very rapidly, using various different connection standards (3G, 3G+-HSPDA, Edge, WiFi, WiMax).

3.1.4 Web 2.0 is interactive. Users can also create or supply content, either individually or through cooperative or collective formats (such as the Wikipedia encyclopedia and free software). A huge number of SMEs now provide software, creative content and, in particular, a very diverse range of services, from network installation and maintenance to information security and training.

3.1.5 Computer chips are becoming smaller and simultaneously more complex and energy efficient. They are incorporated into increasingly light mobile terminals where the embedded software and calculation power can be used to integrate telephony, internet access and geolocation (e.g. SiRF 3 chips).

3.2 **Towards the Internet of Things**

3.2.1 The Internet of Things is starting to develop in a complex technological context, on the basis of Web 2.0 and other, mostly already operational, associated technologies, whose fusion will represent a major step towards the Internet of Things. These include:

- The Ipv6[5], HTTP[6], and FTP Protocols, amongst others, and a new universal HTML standard for reading sites (which has yet to be developed)
- RFID[7] tags and the radio-frequency readers, which connect them to databases
- Geolocalisation (GPS, and soon Galileo)
- Interconnected networks and data storage capacities
- Artificial intelligence, particularly in Web 3.0 (a semantic web, whose language will be closer to ordinary language) and for inter-machine data management
- Nanotechnology, particularly applied to micro-processors
- 2D labels (barcodes, Datamatrix) which can be re-used, for instance by linking rich context to a Datamatrix coded Internet address, scanned by a portable terminal which is

[5] Internet Protocol version 6.

[6] Hypertext Transfer Protocol (HTTP) is a communications protocol for the transfer of information on intranets and the World Wide Web. Its original purpose was to provide a way to publish and retrieve hypertext pages over the Internet.

[7] Radio Frequency IDentification.

directly connected with the Web Site (multiple uses, including tourism, advertising and information.

3.2.2   As the various components of the future networks are developed, massively parallel IT processing will play an increasingly important role. Hundreds or thousands of processors can function in parallel[8] rather than operating sequentially, which allows for a powerful acceleration of calculation and thence for the design of complex, simultaneous virtual universes. In fact, virtualisation allows for much fuller use of the power of computers by enabling several machines to operate virtually from one single machine, even if they have different operating systems, and this technique is being introduced rapidly.

3.2.3   Europe certainly needs to step up research and to train people to a high theoretical and practical level in these areas in order to prevent a brain-drain of researchers to the big American - and soon also Chinese and Indian - university and private-sector laboratories. There is a clear risk of a sizeable technology gap opening up if no major initiatives are devoted to mastering the Internet of the future.

3.2.4   Mass storage technologies are also developing rapidly. These are absolutely vital for the databases which will contain the descriptions of the objects identified by their Internet address. This storage capacity, combined with the data processing capacity, will pave the way for the Intelligent Internet, which will store new knowledge in more complete databases by combining and processing data received from the identity databases and objects. At the same time, the network will become the PC, storing the programmes that will enable users to access databases and carry out other operations, such as complex searches and reports.

3.3   **Initial applications:**

3.3.1   Some applications are currently being tested and others are already operational using existing means in economic sectors such as:

−   retailing (Wal-Mart),
−   transport logistics and tracking of cargo,
−   security in certain enterprises.

3.3.2   The RFID tags incorporated into objects, ID badges and supermarket products give a reader located relatively nearby (the distance depends on the frequency used) simultaneous access to the address and characteristics of all the objects which are scanned at the same time (i.e. the supermarket trolley or container) and draws the necessary conclusions (i.e. price to be paid, detailed customs declaration). In Japan, it is already possible to use this kind of system for

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[8]   Stanford University is launching a new laboratory, the "Pervasive Parallelism Lab" funded by the key IT companies in the USA, including HP, IBM and Intel.

purchases, which are paid for using another chip contained in the mobile phone (which is actually a multi-purpose terminal).

3.3.3 With respect to transport logistics, in connection with geolocalisation, it is possible to find out everything about an open order, including its geographical location, in real time.

3.3.4 The Internet of Things is pervasive. It is often also referred to as the "Ambient Internet", where the information transmitted by the readers at various stages of processing can be handled automatically.

3.3.5 In some applications, the objects communicate, the network "learns" and can take appropriate decisions. This would apply, for instance, to home systems including applications such as Bio Recognition, door opening, decisions concerning the house and supplies, heating, ventilation and safety warnings for children.

3.3.6 Access to some machines or information can be determined by fingerprint or form recognition scanners.

3.4 **Pervasive networks, privacy and security:**

3.4.1 However, these developments can considerably increase the risks of breaches of privacy for business confidentiality and the relationship between customers and the suppliers of goods and services being undermined, since, to function properly, the Ambient Internet needs to contain large quantities of personal or even, with regard to medical applications, confidential or strictly private information.

3.4.2 The issue must therefore be raised of whether existing EU legal instruments on data protection are sufficient to cover the networks that will be operational in the near future.

3.4.3 Without stronger protection and confidentiality for sensitive data, the ambient network could become a totally transparent instrument for people (as is already the case for pets in the European identification system).

3.4.4 Above all, it is important to monitor the intersections where the disparate data comes together by regulating those which relate to objects and prohibiting those which relate to people. Data will only be disseminated if it has already been rendered anonymous, which removes the objections of those who refuse to give sociological data, for the sake of protecting their privacy. There is no need for people to give prior authorisation if data is made anonymous and translated into statistics before the results are published.

3.4.5 Legally defined confidential data will have to be protected by high-level encryption so that access will only be given to authorised people (or machines).

3.4.6   The question of whether the powerful ultra-high frequencies that will soon be widely used are harmless or involve some degree of risk is, as the Commission acknowledges, still open.

3.4.7   The legislation on the protection of workers against electro-magnetic waves is likely to be inadequate to cover permanent exposure to high and super-high frequencies. Studies in this area, focusing in principle on the possible impact of mobile telephones on users' health, have remained inconclusive. It is vital and urgent that research be conducted more rapidly and extensively into the risks and possible ways of countering them before some new-generation tags are developed in an uncontrolled way[9].

3.4.8   Rules, preferably global but at least European, must be established for the use of RFID tags, prioritising the right to the protection of privacy and using an approach that goes beyond "*natural persons*", since current legislation is applied patchily and does not cover all the various situations connected with the current and future use of RFID tags and the Internet of Things.

3.5   **The Internet of the Future:**

3.5.1   To the extent that is possible to make medium-term forecasts in a field that is constantly evolving, it seems likely that the Internet of the future will be a combination of Web 3.0 and the Internet of Things.

3.5.2   Most of the various components of the Internet of the future either already exist, or are being perfected or implemented, meaning that the new Internet will soon be making its debut. Its new paradigm will redefine the place and role of pervasive networks in people's lives and economic growth on a scale that is still difficult to conceive but which may lead to major social change and be an unprecedented source of development for the businesses and countries which are able to master its vicissitudes, in other words, those who have already taken steps to make the requisite investments in research, training and establishing standards and new services. This could lead to changes in economic and scientific power balances at global level. It is a challenge Europe cannot avoid.

3.5.3   Lastly, the Internet of Things represents a fusion of the physical and digital, the real and virtual worlds. Smart objects are fully incorporated into the ambient ubiquitous network, and will occupy a far greater place than in the humanist participatory Web 2.0, which will be dissolved into and become part of the wider and larger scale network.

3.5.4   Finally, the new network poses problems of governance in view of its scale and new content, the requirements of finding hundreds of billions of names and the universal standards which will need to be used. RFIDs are currently regulated through private standards and commercial

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[9]   A British scientific study on mobile phones has demonstrated over several years that they are harmless. The report can be found at http://www.mthr.org.uk.

relations with global EPC, but will this continue to be a practical solution when the Internet of the future is fully developed?

Brussels, 18 September 2008.

The President	The Secretary-general
of the	of the
European Economic and Social Committee	European Economic and Social Committee

Dimitris Dimitriadis   Patrick Venturini

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