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ICT: A NEW TAXONOMY BASED ON THE INTERNATIONAL PATENT CLASSIFICATION

Takashi Inaba^, Mariagrazia Squicciarini*

ABSTRACT

This work proposes a definition of Information and Communication Technologies (ICT) based on the technology classes of the International Patent Classification (IPC) in which patents are classified. This new taxonomy, called the "J tag", aligns with the definitions of the ICT sector (2007) and of ICT products (2008) put forward by the OECD, and stems from the in-depth knowledge of Japan Patent Office experts, as well of experts from the Intellectual Property (IP) Offices participating in the OECD-led IP Task Force. Expert judgment of patent class content, relevance for ICT-related products, completeness and accuracy are the principles guiding the inclusion of IPC classes in the "J tag" taxonomy. ICT technologies are subdivided into 13 areas defined with respect to the specific technical features and functions they are supposed to accomplish (e.g. mobile communication), and details provided about the ways in which technologies relate to ICT products.

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EXECUTIVE SUMMARY

This paper proposes a definition of Information and Communication Technologies (ICT) that relies on the technology classes of the International Patent Classification (IPC) in which patents are classified.

It stems from a careful analysis of ICT technologies and products and relies on the in-depth knowledge of Japan Patent Office experts, as well of experts from the Intellectual Property (IP) Offices participating in the OECD-led IP Task Force. Compared to the OECD 2003 definition of ICT-related technologies, this new classification excludes patent classes originally tagged as ICT but that mainly or exclusively pertain to other technological domains and that may or may not be used in conjunction with ICT-related technologies (e.g. class B41J, typewriters and printing mechanisms); and adds classes previously overlooked or that did not exist at the time (e.g. class B82Y10, nano-technology for information processing, storage or transmission, as quantum computing or single electron logic).

While being aligned with the OECD (2008) ICT product list identifying ICT goods and services, the proposed technology-based classification differs from the product-based one, as many-to-many correspondences are possible: each product relies on one or more ICT-related technologies, and the very same technology can be used in a wide array of products. For example, products like 'Portable automatic data processing machines weighing not more than 10 kg, such as laptop and notebook computers' rely not only on computer technologies for data processing, but also on telecommunication technologies for network access. The latter are also used in 'Telephones for cellular networks or for other wireless networks'.

Moreover, not all technologies used in ICT products are ICT-related technologies. For example, 'Inkjet printers used with data processing machines', which are considered ICT products, rely on ICT-related technologies (e.g. those needed to transfer printing image data from a computer to a printer and transform images into data for printing), as well as technologies that cannot be regarded as ICT-related, since they are not relevant for information processing nor for communication (e.g. those needed to print on different materials by inkjet).

Especially in the case of ICT, technologies differ considerably from products, as ICT products typically rely on a bundle of technologies. A definition of ICT based on the technology class to which inventions are attributed thus has the advantage of identifying and mapping ICT technologies regardless of the products in which they are used.

The criteria guiding the proposed new definition of ICT technologies are:

- ***Expert judgment of patent class content***. This assessment has been carried out by a patent examiner specialised in ICT-related technologies, who has scrutinised the description of IPC classes at all levels of disaggregation, from section to sub-groups levels. The taxonomy has also benefitted from feedback received from experts from the Intellectual Property (IP) Offices participating in the OECD-led IP Task Force.
- ***Relevance for ICT-related products***. As ICT technologies are used in ICT products, the relevance of the identified technologies for ICT products has been always verified. ICT products, following the definition by the OECD (2008), "must primarily be intended to fulfil or enable the function of

information processing and communication by electronic means, including transmission and display" (p. 11 of OECD, 2008). ICT technologies are therefore intended as technologies fulfilling or enabling the function of processing information and communicating by electronic means.

- ***Completeness***. The identified technologies aim to encompass all ICT technologies used in the ICT products defined in OECD (2008).
- ***Accuracy***. While aiming at identifying each and every ICT-relevant technology, the taxonomy proposed herein leaves aside technologies of general nature and use, which may well be used in ICT products, but do not represent their core, nor relate to information processing and communication.

Statistics based on triadic patent families (TPF), i.e. sets of patents taken at the European Patent Office (EPO), the Japanese Patent Office (JPO), and the US Patent and Trademark Office (USPTO) that share one or more priorities, show that in the period 2000-2012, the overall number of triadic patent families identified as being ICT according to the "J tag" is on average 25% smaller than the number of ICT TPF obtained using the OECD (2003) definition. Also, using the "J tag" leads to a reduction in the number of TPF that varies considerably among countries, with Korea and the People's Republic of China (hereafter "China") experiencing relatively small reductions, while Germany, France, the United Kingdom and Switzerland experience larger reductions in their figures. The new "J tag" leads to a smaller number for Japan than it does for the United States, and reduces the differences that emerge between the two leading countries.

Also, statistics related to the way in which countries contribute to advance growing ICT technology areas show that in the case of mobile communication a number of countries like the United States, Japan and Korea account for a relatively stable share of these technologies, whereas China and India have more than doubled their contribution to the technology area. In the case of 'cognition and meaning' and 'understanding and human interface' technologies, i.e. those technologies that are more related to human-machine interaction and the internet of things, patterns look much more diversified. Between 2005 and 2010 the only country that has continued to contribute to the same extent to the generation of this set of technologies is the United States. Asian countries such as the China, Korea, India and Singapore have markedly increased their relevance for this set of future-looking technologies, whereas Nordic countries such as Finland and Sweden, as well as Germany, the United Kingdom and the Netherlands, have seen a decrease in their relative leadership in the field.

INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT): A NEW TAXONOMY BASED ON THE INTERNATIONAL PATENT CLASSIFICATION (IPC)

Introduction

The importance and pervasiveness of Information and Communication Technologies (ICT) is widely acknowledged and extensively documented (e.g. Jorgenson, 2001; Bloom at al., 2012).

Carefully assessing the extent to which such technologies shape economies and societies depends on a clear understanding of the technological components that constitute the ICT "bundle", the identification of the new technological paradigms that may emerge, and a careful monitoring of their evolution over time. This, in turns, allows definition and more accurate measurement of a set of technologies whose pervasiveness makes it often hard to separate them from the many goods and services they are embedded in or facilitate the production of, without constituting their main component or use.[1]

Aware of this need, the OECD has for more than a decade been concerned with identifying and typifying ICT-related technologies, products and industries. A classification based on the technology classes in which patents are filed, the International Patent Classification (IPC), was first proposed in 2003 (OECD, 2003). It covers a wider range of ICT-related technology domains, and aligns with the 2002 OECD's definition of the ICT sector (OECD, 2002). [2]

The 2003 taxonomy has remained basically intact over the years, with minor updates reflecting the changes in the IPC classification through time[3]. While playing an important role in identifying and monitoring the technological developments in ICTs for more than a decade, the 2003 classification appears outdated at present, as technology changed dramatically over the last ten years. This can be easily seen by looking at the four categories contemplated in the 2003 taxonomy, namely: (1) Telecommunications, (2) Consumer electronics, (3) Computers, office machinery, and (4) Other ICT, and their inadequacy to encompass technological trajectories or paradigm shifts such as home automation (domotics) or the 'internet of things.'[4]

The need for a revised taxonomy further stems from the fact that the OECD has in the meantime proposed revised definitions of the ICT sector (2007) and of ICT products (2008), making the 2003 patent-based classification partially misaligned with the newer ICT-related definitions.

With the aim to fill this gap, this paper proposes a revised definition of ICT-related technologies that relies on the international technology classes in which patents are classified, the International Patent Classification (IPC).[5] The new taxonomy proposed stems from a careful analysis of ICT technologies and products and relies on the in-depth knowledge of a Japan Patent Office expert specialised in the examination of ICT-related patents. Compared to the 2003 definition, it excludes patent classes originally tagged as ICT but that mainly or exclusively pertain to other technological domains and that may or may not be used in conjunction with ICT-related technologies. An example is class B41J (typewriters and printing mechanisms). However, it also adds classes that had previously been overlooked, but which expert judgment suggests to be part of ICTs for example, G08B25 (i.e. alarm systems in which the location of the alarm condition is signalled to a central station). Furthermore, it includes patent classes that did not exist at the time of the 2003 classification, since they first appeared in later versions of the IPC taxonomy, such as

B82Y10 (i.e. nano-technology for information processing, storage or transmission, as quantum computing or single electron logic).

The remainder of this paper is as follows. Section 2 provides an overview of existing patent-based ICT taxonomies and compares them with ICT products-based classifications. Section 3 outlines the criteria used to develop the new IPC-based ICT taxonomy, subdivides technologies into main areas, and details the IPC codes belonging to each of the areas considered. Section 4 proposes a few descriptive statistics based on the new taxonomy, and compares some figures based on the old and the new IPC-based classification of ICT technologies.

ICT: a brief overview of existing taxonomies

ICT technologies

Among the ICT technologies-related taxonomies proposed in recent years there are: OECD (2003), ISI-OST-INPI (2005), Schmoch (2008), Van Looy et al. (2014), and the classification proposed by the Japan Patent Office (JPO).[6]

OECD (2003)

The 2003 OECD taxonomy was developed by Ulrich Schmoch of the Fraunhofer Institute Systems and Innovation Research (Germany). ICT-related IPC codes were identified using details at the section and sub-group levels, and ICT-related technologies got subdivided into four main categories, namely: 'Telecommunications'; 'Consumer electronics'; 'Computers and office machinery'; and 'Other ICTs'.

'Telecommunications' include various types of communication-related technologies, ranging from devices (e.g. H01P: waveguides) to basic functions and methodologies (e.g. H03M: coding, H04J: multiplexing). 'Consumer electronics' IPC classes mainly relate to technologies in the audio-visual device space (e.g. H04N: television; H04S: stereo), although general-purpose ICT technologies (e.g. H03F: amplifier) are also included. The 'Computers and office machinery' category includes technologies related to various electronic devices other than audio-visual devices (e.g. B41J: typewriters; G06: computing). Finally, 'Other ICTs' are grouped general-purpose devices and methods (e.g.G02B6: light guide; G01B,C, etc.: measuring) as well as special applications (G08G: traffic control; G09B: educational appliances).

This taxonomy appears very closely related to ICT products, with the first three categories that basically correspond to the 'communication equipment', 'consumer electronic equipment', and 'computers and peripheral equipment' products categories listed in the 2008 OECD definition of ICT products (OECD, 2008).

The OECD (2003) includes some IPC codes whose relevance to ICT technologies needs to be re-examined. Examples are B07C (postal sorting) and B41J (typewriters), representing technologies which are both obsolete, at least to some extent, and relevant to a broader set of technologies than ICT alone. The inclusion of other sub-classes, such as G01 (measuring) should also be reconsidered, as these IPC codes encompass a wide range of measuring techniques which are by no means exclusive to ICT technologies. Moreover, in line with the 2007 OECD definition of the ICT sector, IPC classes related to the activities of companies concerned with 'electronic processing to measure physical phenomena' should also be removed from the ICT list, as such activities are no longer considered part of the ICT sector. Finally, and more generally, as ICT technologies are often embedded in a variety of products and their use changes rapidly, categorising technologies on the basis of products might not be the best way to identify ICT-related technologies.

Schmoch (2008)

Schmoch's (2008) classification, last revised in 2013, subdivides all patentable technologies into six main technology areas, namely: 'Electrical engineering'; 'Instruments'; 'Chemistry and pharmaceuticals'; 'Process engineering and special equipment'; 'Mechanical engineering and machinery'; and 'Consumption'. While no ICT group exists, as such, ICT technologies are part of the 'Electrical engineering' area and are subdivided into 8 main groups, namely: (1) 'Electrical engineering'; (2) 'Audio-visual technology'; (3) 'Telecommunications'; (4) 'Digital communications'; (5) 'Basic communication process'; (6) 'Computer technology'; (7) 'IT methods for management'; and (8) 'Semiconductors'. For example, 'Digital communications' include code H04L (transmission of digital information) and 'Basic communication processes' include IPC H03 (basic electronic circuitry).

ISI-OST-INPI (2005)

The ISI-OST-INPI (2005) taxonomy can be considered a precursor of Schmoch's (2008) classification, and was the result of joint work by the Fraunhofer Institute Systems and Innovation Research (ISI, Germany), the French Office of Science and Technology (OST) and the French National Institute of Industrial Property (INPI).

While 'Electrical engineering' is defined in the same way as in Schmoch (2008), the taxonomy appears somewhat less refined when higher levels of disaggregation are considered. In particular, 'Electrical engineering' is subdivided into 5 groups, namely: (1) 'Electrical machinery and apparatus'; (2) 'Audio-visual technology'; (3) 'Telecommunications'; (4) 'Information technology'; and (5) 'Semiconductor', rather than in 8 as it is done in Schmoch (2008). In Schmoch (2008) 'Telecommunications' are broken down into 'Telecommunication', 'Digital communication', and 'Basic communication process', while 'Information technology' is divided into 'Computer technology' and 'IT methods for management'.

Van Looy et al. (2014)

Van Looy et al. (2014), developed in collaboration with Sogeti Luxembourg S.A. and the European Patent Office, provides a concordance between IPC version 8 and NACE Rev. 2. It matches sub-classes of IPC to 70 industry sector classes, such as 'Manufacture of Food Product' and ' Manufacture of Dairy Products'. While it does not include classes explicitly named as ICT, it includes 9 sector-related classes which can be relevant to ICT, namely: (1) 'Manufacture of Electronic Components and Boards', (2) 'Manufacture of computers and peripheral equipment', (3) 'Manufacture of Communication Equipment', (4) 'Manufacture of Consumer Electronics', (5) 'Manufacture of Instruments and Appliances for Measuring. Testing and Navigation; Watches and Clocks', (6) 'Manufacture of irradiation. Electro-medical and electrotherapeutic equipment' (7) 'Manufacture of Optical Instruments and Photographic Equipment, (8) 'Manufacture of Magnetic and Optical Media', and (9) 'Computer Programming. Consultancy and Related Activities'.

Japan Patent Office

To try and identify ICT-related technologies, JPO has categorised the different areas in which information and communication technologies are developed and implemented and monitors the number of patents published in each of the areas considered.

At present, ICT areas are classified as follows: (1) 'High-speed networks'; (2) 'Security'; (3) 'Home-electronics networks'; (4) 'High-speed computing'; (5) 'Simulation'; (6) 'Large-capacity and high-speed storage'; (7) 'Input-output'; (8) 'Cognition and meaning understanding'; (9) 'Human-interface evaluation'; (10) 'Software'; (11) 'Devices'; and (12) 'Others'.

While JPO's IPC-based ICT taxonomy is not available to the public, statistics related to ICT technologies and based on this taxonomy can be found in recent reports, which are accessible through JPO's webpage.[7]

Technology-based taxonomies vis-à-vis ICT product lists

An ICT product list identifying ICT goods and services was first developed in 2002 (OECD, 2002) and has been revised several times since. At present the list includes more than 100 products, ranging from 'point of sale terminals' to 'installation services of radio, television and communications equipment'.

Product-based taxonomies differ from technology-based classifications as many-to-many correspondences are possible: each product relies on one or more ICT-related technologies, and the very same technology can be used in a wide array of products. For example, products like 'Portable automatic data processing machines weighing not more than 10 kg, such as laptop and notebook computers' rely not only on computer technologies for data processing, but also on telecommunication technologies for network access. The latter are also used in 'Telephones for cellular networks or for other wireless networks'.

Moreover, not all technologies used in ICT products are ICT-related technologies. For example, 'Inkjet printers used with data processing machines', which are considered ICT products, rely on ICT-related technologies (e.g. those needed to transfer image data from a computer to a printer and transform images into data for printing), as well as technologies that cannot be regarded as ICT-related technologies, since they are not relevant for information processing or communication (e.g. those needed to print on different materials by inkjet).

A new ICT taxonomy: guiding principles and operational choices

Especially in the case of ICT, technologies differ considerably from products, as ICT products typically rely on a bundle of technologies. A definition of ICT based on the technology class to which inventions are attributed thus has the advantage of identifying and mapping ICT technologies regardless of the products in which they are used.

A number of criteria have guided the proposed new definition of ICT technologies:

- **Expert judgment of patent class content.** This assessment has been carried out by a patent examiner specialised in ICT-related technologies, who has scrutinised the description of IPC classes at all levels of disaggregation, from section to sub-groups levels.
- **Relevance for ICT-related products.** As ICT technologies are used in ICT products, the relevance of the identified technologies for ICT products has been always verified. ICT products, following the definition by the OECD (2008), "must primarily be intended to fulfil or enable the function of information processing and communication by electronic means, including transmission and display" (p. 11 of OECD, 2008). ICT technologies are therefore intended as technologies fulfilling or enabling the function of processing information and communicating by electronic means.
- **Completeness.** The identified technologies aim to encompass all ICT technologies used in the ICT products defined in OECD (2008).
- **Accuracy.** While aiming at identifying each and every ICT-relevant technology, the taxonomy proposed herein leaves aside technologies of general nature and use, which may well be used in ICT products, but do not represent their core, nor relate to information processing and communication.

ICT technology areas

The proposed ICT taxonomy subdivides technologies into areas defined by the specific technical features and functions they are supposed to accomplish. Areas have been identified building on existing technology-based taxonomies, particularly JPO's.

Table 1 lists the technology areas identified, describes their possible purpose or use and lists the type of products and functions they encompass.

Table 1. ICT Technology areas

Technology area	Enables	Encompasses
High speed network	High speed communication through networks. Enhances communication ability.	Digital transmission, network (protocols, architecture, etc.), telephone communication, broadcasting, and transmission, reception, channels (see e.g. Haykin, 2001; ATIS, 2001). Wireless network technologies are not included.
Mobile communication	Wireless communication by portable devices.	Cellular systems, wireless Local Area Networks (LAN) and Personal Area Networks (PAN). (see e.g. Stüber, 2011).
Security	Security in information processing and communication	Secret-coding, authentication, and electronic payment (see e.g. ATIS, 2001).
Sensor and device network	Communication among sensors and devices.	'Ubiquitous Sensor Networks', i.e. networks of intelligent sensors (see e.g. ITU, 2008).
High speed computing	High speed data processing. Enhances data processing ability of computers.	Computer architecture, composition of hardware (arithmetic, logic, control, input/output, and storage units), computer programs, and operating systems (see e.g. Hennessy at al., 2012; ATIS, 2001).
Large-capacity and high speed storage	Storage of large-capacity data and high speed storage.	Various storage device-related technologies (e.g. semiconductor memory, magnetic storage, optical storage, etc.); network (e.g. network attached storage, NAS; storage area network, SAN); and file systems (see e.g. ATIS, 2001).
Large-capacity information analysis	Dealing with large amounts of data for analysis.	Database and numerical analysis, computational science, and computer aided engineering (see Date, 2005; Teorey at al., 2011; Strang, 2007).
Cognition and meaning understanding	High-level concept understanding.	Cognitive computing (see Wang at al., 2010).
Human-interface	Operability by human beings.	Human-interface technologies (see e.g. Raskin, 2000).
Imaging and sound technology	Processing and transmission of images and sound data.	Video equipment, television, image processing, acoustic equipment, and audio signal processing-related technologies (see e.g. Rosenfeld at al., 2014; Bovik, 2010; Spanias at al., 2006; ATIS, 2001).
Information communication device	Electronic components (both active and passive devices) realising function of information processing or communication.	Electronic circuits, communication cables, semiconductor lasers, etc. (see e.g. ATIS, 2001).
Electronic measurement	Electronic measurement technologies utilising information processing and communication.	Radio navigation, radio direction-finding, etc. (see e.g. Klaassen, 1996).
Others	Residual category. ICT related technologies not belonging to any of above categories.	Data input and output, hybrid computer, etc. (see e.g. ATIS, 2001)

Source: authors' own compilation based on cited sources.

Annex 1 further illustrates the relationships that can be envisaged between ICT products and ICT technology areas, especially the way in which products relate to technology areas, often in a many-to-many fashion.[8]

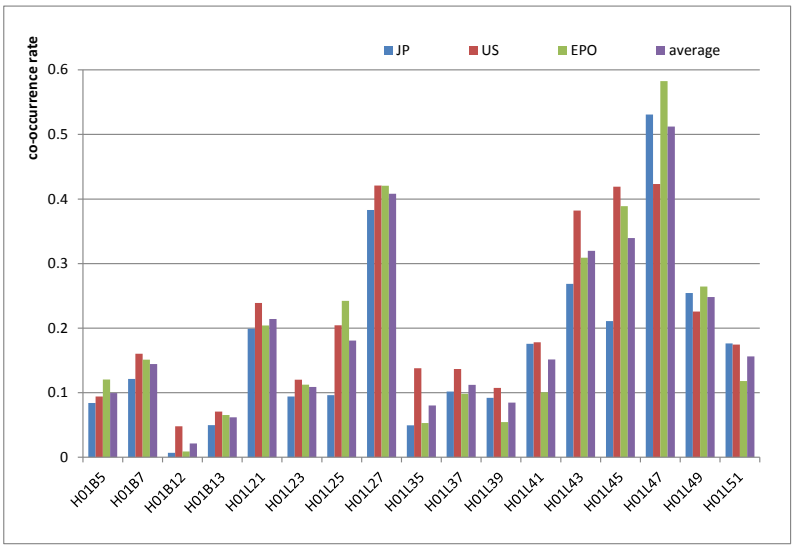
While most IPC classes were straightforward to identify as ICT-related, others were more doubtful and were finally included or excluded from the taxonomy on the basis of statistical analysis. In particular, when inclusion of IPC classes could not be decided solely on an analysis of their content and description, their relevance for ICT technologies was assessed using statistics about the extent to which inventions are simultaneously classified in the doubtful classes as well as ICT classes (i.e. their co-occurrences). As patent examiners are expected to list in patent documents all IPC fields to which an invention is related to, this can be interpreted as a signal that the technology at stake is indeed relevant and /or needed for ICT, and thus key to ICT products and developments.

An example of such 'doubtful classes' is class H01B5: 'Non-insulated conductors or conductive bodies characterised by their form'. It encompasses conductors used for information communication in computers, as well electrodes used in non-ICT devices. Also, several classes under H01L were identified as doubtful, despite their having been included in existing OECD definitions of ICT technologies. For example, H01L21: 'the manufacture or treatment of semiconductor or solid state devices' was regarded as doubtful, because solid state devices may or may not be relevant to information processing and communication, and this class encompasses various types of semiconductors. The list of all doubtful classes and their description can be seen in Annex 2.

To assess the extent to which doubtful classes co-occur with ICT ones, all patent documents containing any such class and designing two or more IPC classes were considered as the reference population.[9] The co-occurrence rate was then calculated as the average of the ratio between the number of ICT IPCs and the overall the number of IPCs contained in a patent.

Figure 1 shows the co-occurrence rates for all doubtful IPC classes considered, calculated using patents filed at Japan Patent Office (denoted as 'JP'), United States Patent and Trademark Office ('US'), and European Patent Office ('EPO'). Some IPCs, such as H01L47, exhibited a strong co-occurrence with ICT classes, whereas the rate remained around 0.1 for about half of doubtful IPCs.

Figure 1. Co-occurrence of 'doubtful IPCs' and ICT IPC codes

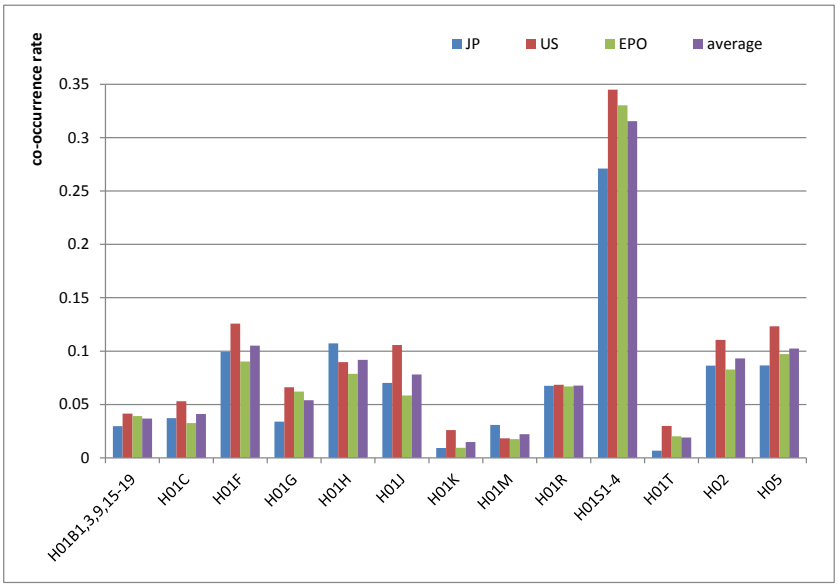


Source: Authors' own compilation based on the Worldwide Patent Statistical Database, EPO, December 2014.

To identify the most appropriate co-occurrence threshold guiding the inclusion or exclusion of some classes in the ICT taxonomy a comparative analysis was performed. The analysis, focussing on section H's non-ICT and doubtful ICT classes, aimed at comparing *like with like* when assessing the extent to which technologies relate or not to ICT ones. To this end, the co-occurrence rate of (clearly) non-ICT IPCs and ICT IPCs was compared to the co-occurrence of doubtful ICT IPCs and ICT IPCs.

Figure 2 shows the co-occurrence rates of non-ICT IPCs in Section H. For most IPCs, the rate remained (well) below 0.1, some IPCs slightly exceeded 0.1 and H01S1-4 went beyond 0.15.

Figure 2. Co-occurrence of 'non-ICT IPCs' with 'ICT IPCs' in Section H



Source: Authors' own compilation based on the Worldwide Patent Statistical Database, EPO, December 2014.

Based on these results, it was decided that doubtful classes whose co-occurrence rate with ICT IPCs exceeded 0.15 at all three patent offices considered would be included in the ICT taxonomy, whereas those whose co-occurrences always remained below 0.15 would be excluded. As a result, H01L21, H0L27, H01L43, H01L45, H01L47, and H01L49 were included. H01B5, H01B12, H01B13, H01L35, H01L37, and H01L39 were conversely excluded.

In the case of classes H01B7, H01L25, H01L41, and H01L51 further investigation was required to assess their co-occurrence with ICT classes and with 'ICT doubtful' ones. On the basis of an analysis similar to the one described above it was decided to include in the ICT taxonomy classes H01L25, H01L51, and to exclude H01B7, H01L4.[10] Annex 3 lists all IPCs codes included in and excluded from the new and the existing ICT taxonomy, and outlines the key reasons for their inclusion/exclusion.

The "J tag": a new IPC-based taxonomy of ICT technologies

The new IPC-based ICT taxonomy, called the "J tag" because it has been developed in collaboration with an expert from the Japan Patent Office, can be seen in Table 2. This shows the 13 technology areas of the "J tag", its sub-areas, and the IPC codes of each area. An asterisk precedes those IPC codes that are relevant, although of secondary importance, for the technology area considered, and that may conversely be key in other ICT areas. They are indicated to facilitate the compilation of comprehensive statistics by technology areas and should be disregarded when compiling overall ICT statistics, to avoid repetitions and double counting. Excluding 'secondary' importance classes leads to a stricter definition of the technology

area considered. An extended version of Table 2, also highlighting the rationale behind the inclusion or exclusion of the different IPC codes considered, can be seen in Annex 4.

Some IPC codes in G01 (Measuring; Testing) were excluded from the "J tag" classification, since they do not necessarily relate to information processing and communication. Such an exclusion is in line with the revised definition of the ICT sector proposed in 2006, where "electronic processing to detect, measure and/or record physical phenomena" was excluded from the definition. Also, an example of an IPC class which appeared in existing classifications but has been excluded from the "J tag" is B41J. While B41J technologies (Typewriters; Selective printing mechanisms) are used in ICT products, and inkjet printers and laser printers feature among ICT products, they cannot be regarded as ICT technologies because they do not relate to information processing or communication[11]. Subgroups of B41J1/00 include technologies related to components such as levers, rods, and axis of rotation and these also cannot be considered as ICT-related. Finally classes as H01J (Electric discharge tubes or discharge lamps) have also been excluded given that electric tubes once used in electronic circuits for modulation, amplification, etc., have been replaced by semiconductor devices, and can no longer be regarded as devices related to data processing or communication.

Table 2. The "J tag": a new IPC-based taxonomy of ICT technologies

Technology area	Sub area	IPC
1. High speed network	Digital communication technique	H03K, H03L, H03M, H04B1/69-1/719, H04J, H04L (excluding H04L9, H04L12/14) *H04L9, *H04L12/14
	Exchange, selecting	H04M3-13,19,99, H04Q
	Others	H04B1/00-1/68, H04B1/72-1/76, H04B3-17 (excluding H04B1/59, H04B5, H04B7), H04H *H04B1/59, *H04B5, *H04B7
2. Mobile communication		H04B7, H04W (excluding H04W4/24, H04W12) *H04W4/24, *H04W12
3. Security	Cyphering, authentication	G06F12/14, G06F21, G06K19, G09C, G11C8/20, H04K, H04L9, H04M1/66-665, H04M1/667-675, H04M1/68-70, H04M1/727, H04N7/167-7/171, H04W12
	Electronic payment	G06Q20, G07F7/08-12, G07G1/12-1/14, H04L12/14, H04W4/24 *G06Q30/02
4. Sensor and device network	Sensor network	G08B1/08, G08B3/10, G08B5/22-38, G08B7/06, G08B13/18-13/196, G08B13/22-26, G08B25, G08B26, G08B27, G08C, G08G1/01-065 *G06F17/40, *H04W84/18
	Electronic tag	H04B1/59, H04B5 *G01S13/74-84, *G01V3, *G01V15
	Others	*H04W84/10
5. High speed computing		G06F5, G06F7, G06F9, G06F11, G06F13, G06F15/00, G06F15/16-15/177, G06F15/18, G06F 15/76-15/82
6. Large-capacity and high speed storage		G06F3/06–3/08, G06F12 (exclude G06F12/14), G06K1-7, G06K13, G11B, G11C (exclude G11C8/20), H04N5/78-5/907 *G06F12/14, *G11C8/20
7. Large-capacity information analysis	Database	G06F17/30, G06F17/40
	Data analysis, simulation, management	G06F17/00, G06F17/10-17/18, G06F17/50, G06F19, G06Q10, G06Q30, G06Q40, G06Q50, G06Q90, G06Q99, G08G (exclude G08G1/01-065, G08G1/0962-0969) *G08G1/01-065, *G08G1/0962-0969
8. Cognition and meaning understanding		G06F17/20-17/28, G06K9, G06T7, G10L13/027, G10L15, G10L17, G10L25/63,66 *G06F15/18
9. Human-interface		H04M1 (exclude H04M1/66-665, H04M1/667-675, H04M1/68-70, H04M1/727), G06F3/01-3/0489, G06F3/14-3/153, G06F3/16, G06K11, G06T11/80, G08G1/0962-0969, G09B5, G09B7, G09B9 *H04M1/66-665, *H04M1/667-675, *H04M1/68-70, *H04M1/727, *G06F17/50, *G06K9, *G06T11, *G06T13, *G06T15, *G06T17-19
10. Imaging and sound technology	Imaging technique	H04N (excluding H04N5/78-5/907, H04N7/167-7/171), G06T1-9 (excluding G06T7), G06T11 (excluding G06T11/80), G06T13, G06T15, G06T17-19, G09G *H04N5/78-5/907, *H04N7/167-7/171, *G06T7, *G06T11/80
	Sound technique	H04R, H04S, G10L (excluding G10L13/027, G10L15, G10L17, G10L25/63,66) *G10L13/027,* G10L15, *G10L17, *G10L25/63,66
11. Information communication device	Electronic circuit	H03B, H03C, H03D, H03F, H03G, H03H, H03J
	Cable and conductor	H01B11
	Semiconductor	H01L29-33, H01L21, 25, 27, 43-51
	Optic device	G02B6, G02F, H01S5
	Others	B81B7/02, B82Y10, H01P, H01Q
12. Electronic measurement		G01S, G01V3, G01V8, G01V15
13. Others	Computer input-output	G06F3/00, G06F3/05, G06F3/09, G06F3/12, G06F3/13, G06F3/18
	Other related technique	G06E, G06F1, G06F15/02, G06F15/04, G06F15/08-15/14, G06G7, G06J, G06K15, G06K17, G06N, H04M15, H04M17

Source: authors' own compilation.

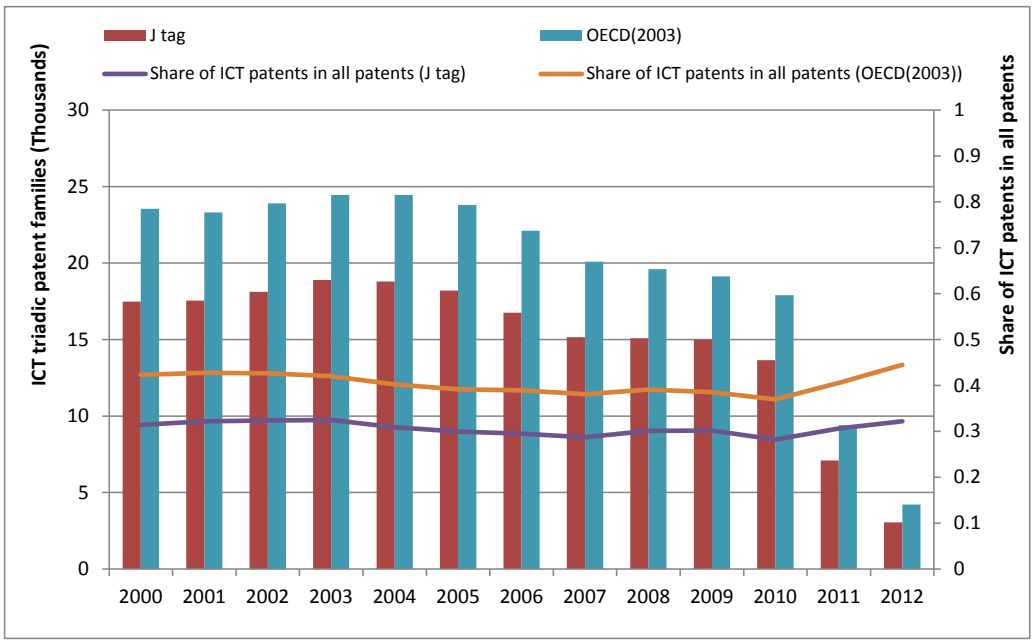
Legend: An asterisk precedes those IPC codes that are relevant, although of secondary importance, for the technology area considered, and that may conversely be key in other ICT areas.

On the other hand, the "J tag" taxonomy includes IPCs classes that were never previously included in ICT taxonomies, such as B82Y10 "Nano-technology for information processing, storage or transmission". This was created in 2011, and tries to better allocate classes to the most suitable technology area(s). For instance, G06's subclasses (Computing) are now subdivided across 7 technology areas, to enable a more accurate analysis of computing technologies.

The "J tag" taxonomy of ICT technologies: some stylised facts

In what follows, a number of statistics based on the new "J tag" are proposed, and compared to similar figures based on the OECD (2003) definition of ICT. Most of these statistics are based on triadic patent families (TPF), which are sets of patents taken at the European Patent Office (EPO), the Japanese Patent Office (JPO), and the US Patent and Trademark Office (USPTO) that share one or more priorities.[12] Figure 3 shows that in the period 2000-2012, the overall number of TPF identified as being ICT according to the "J tag" is on average 25% smaller than the number of ICT TPF obtained using the OECD (2003) definition. The drivers of this difference are shown in Table 3, which lists the IPC codes that featured in the OECD (2003) taxonomy but have not been included in the "J tag", and the few IPC codes added *ex novo* in the "J tag" classification.

Figure 3. ICT triadic patent families, OECD (2003) definition and "J tag"



Note: The share of ICT patents corresponds to the number of ICT TPF over the number of total TPF, on a yearly basis, during the period considered.

Source: authors' own compilation based on based on the Worldwide Patent Statistical Database, EPO, December 2014.

Table 3. OECD (2003) vs "J tag": IPCs codes excluded and added

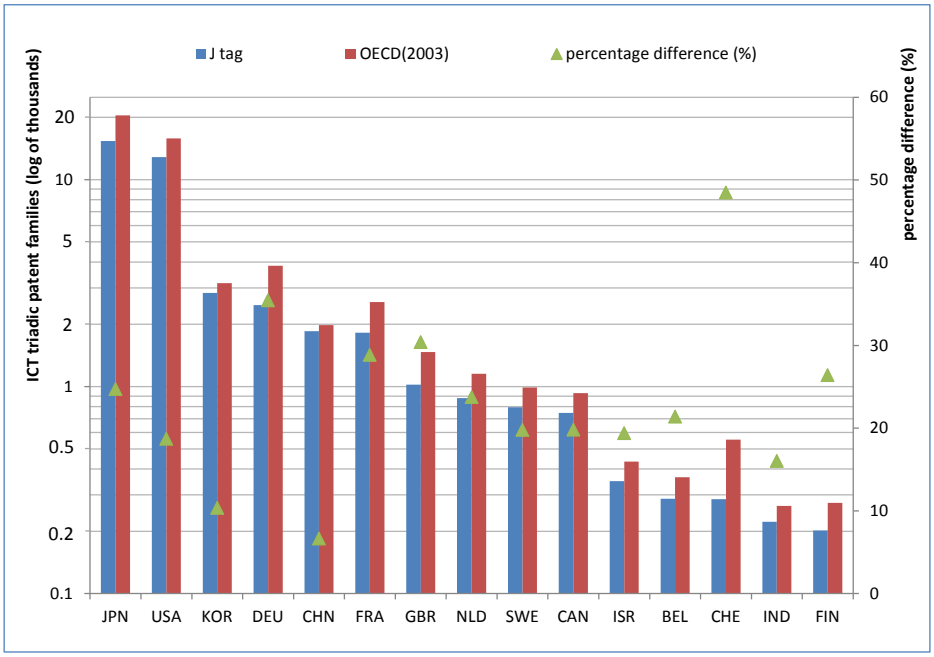
IPCs in the OECD(2003) excluded from the "J tag"	**Number of TPF in 2008-2010**
B07C,B41J,B41K	1309
G01(except G01S,G01V3,8,15)	8821
G03G, G05F	1295
G06C,G06D,G06G1-5,99,G06K21,G06M	20
G07(except G07F7/08-12,G07G1/12,14)	251
G09B1-3,G09B11-29,G09D,F	350
H01J	1034
H01L23,H01L35-41	776
IPCs included ex novo in the "J tag"	**Number of TPF in 2008-2010**
B81B7/02, B82Y10	13
G08B1/08,3/10,5/22-38,7/06,13/18-13/196,G08B25-27	47

Note: Statistics based on simple counts (may entail some double counting in the extent to which the codes above appear jointly in patent documents).

Source: authors' own compilation based on the Worldwide Patent Statistical Database, EPO, December 2014.

Figure 4 illustrates the extent to which statistics of TPF by country change when the new "J tag" is used, as compared to the OECD (2003) definition. Countries are ordered according to the number of TPF belonging to them, and green triangles highlight the percentage differences of TPF resulting from the "J tag" as compared to the figures obtained using the OECD (2003) definition. Using the "J tag" leads to a reduction in the number of TPF that varies considerably among countries, with Korea and China experiencing relatively small reductions, while Germany, France, the United Kingdom and Switzerland experience larger reductions in their figures. The new "J tag" leads to a smaller number for Japan than it does for the United States, and reduces the differences that emerge between the two leading countries.

Figure 4. ICT triadic families: comparing OECD 2003 vs "J tag" (2008-2010)



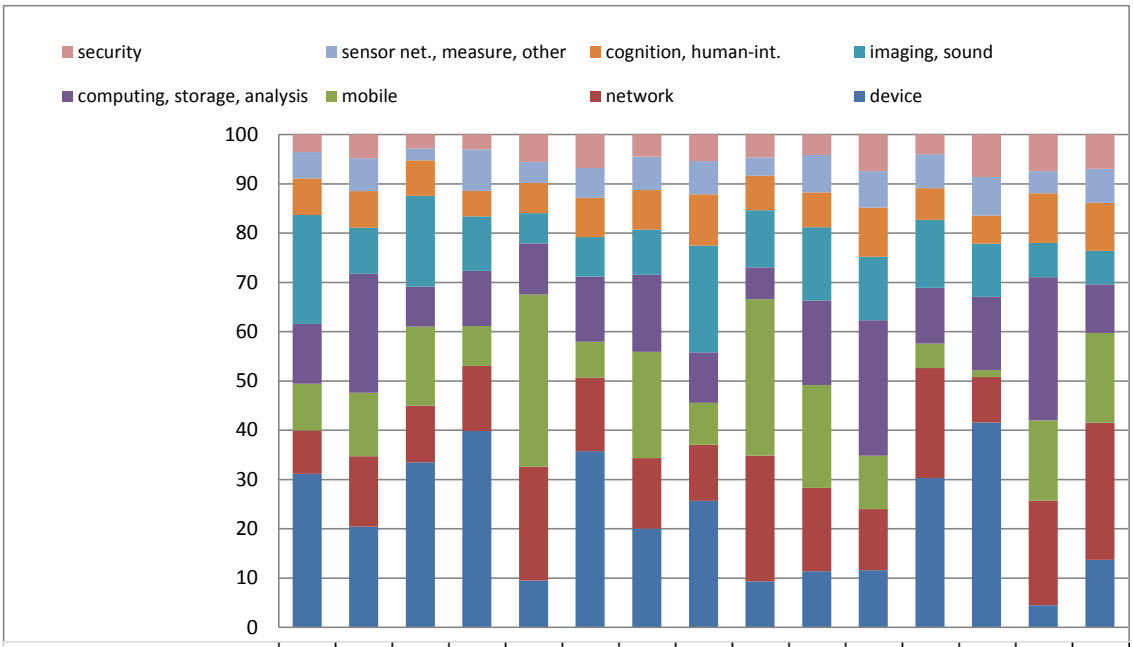
Note: the left y axis is shown in logarithmic scale. The percentage difference displayed on the right Y axis is calculated as the difference in the number of TPF identified using, respectively, the OECD(2003) taxonomy and the "J tag", over the number of ICT TPF identified by the former.

Source: authors' own compilation based on the Worldwide Patent Statistical Database, EPO, December 2014.

Very similar patterns in the number of patents identified as ICT-related by the OECD (2003) and the "J tag" classification emerge when Patent Cooperation Treaty (PCT) patent applications are considered, rather than TPF.

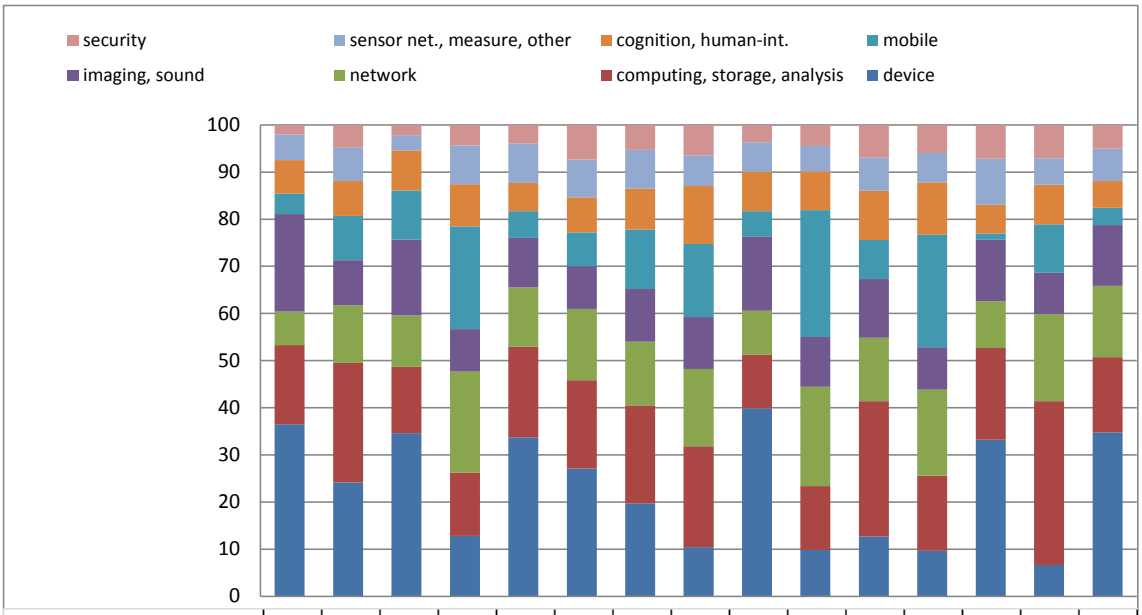
Figures 5 and 6 show the composition of the patent portfolios owned by the top 15 ICT patenting countries in terms of the new technology areas identified by the "J tag". The graphs are based on two sets of figures for the period 2008-2010: a) triadic patent families and b) IP5 families.[13] The latter are families of patent applications with members filed in at least one of the IP5, i.e. EPO, JPO, USPTO, the Korean Intellectual property office (KIPO) and the Chinese Intellectual Property Office (SIPO), excluding single filings. This implies that applications filed only in one of the IP5 offices are considered conditional on their having another family member filed in any other office worldwide (see Dernis et al, 2015, for a more details about IP5 families).

Figure 5. ICT portfolio of top 15 ICT patenting economies (2008-2010): Triadic Patent Families



	JPN	USA	KOR	DEU	CHN	FRA	GBR	NLD	SWE	CAN	ISR	BEL	CHE	IND	FIN
security	3.5	4.8	2.8	3.0	5.6	6.8	4.5	5.4	4.6	4.1	7.4	4.0	8.6	7.5	6.9
sensor net., measure, other	5.3	6.7	2.4	8.4	4.3	6.1	6.8	6.8	3.8	7.6	7.4	6.9	7.8	4.5	6.9
cognition, human-int.	7.4	7.5	7.2	5.1	6.1	7.9	8.0	10.4	7.0	7.1	10.0	6.4	5.7	10.1	9.8
imaging, sound	22.1	9.3	18.5	11.1	6.2	8.1	9.2	21.7	11.6	14.9	12.9	13.8	10.8	6.9	6.8
computing, storage, analysis	12.1	24.2	8.1	11.2	10.4	13.2	15.6	10.2	6.4	17.2	27.5	11.3	14.9	29.1	9.8
mobile	9.5	12.9	16.1	8.1	34.9	7.2	21.6	8.5	31.8	20.8	10.9	5.0	1.4	16.2	18.3
network	8.8	14.3	11.5	13.2	23.1	14.9	14.3	11.4	25.5	16.9	12.4	22.3	9.2	21.3	27.8
device	31.2	20.5	33.5	39.9	9.5	35.8	20.1	25.7	9.3	11.4	11.6	30.3	41.6	4.5	13.7
Total number of ICT patent (Thousands)	15.4	12.9	2.8	2.5	1.9	1.8	1.0	0.9	0.8	0.7	0.3	0.3	0.3	0.2	0.2

Figure 6. ICT portfolio of top 15 ICT patenting economies (2008-2010): IP5 patent families



	JPN	USA	KOR	CHN	DEU	FRA	GBR	CAN	NLD	SWE	ISR	FIN	CHE	IND	BEL
security	2.02	4.86	2.17	4.33	3.89	7.36	5.28	6.45	3.7	4.44	6.93	5.98	7.19	7.06	5.01
sensor net., measure, other	5.44	7.07	3.23	8.22	8.43	7.99	8.25	6.49	6.2	5.43	7.04	6.18	9.69	5.6	6.92
cognition, human-int.	7.11	7.4	8.51	8.95	5.97	7.44	8.65	12.3	8.4	8.21	10.4	11.1	6.15	8.39	5.63
mobile	4.32	9.35	10.4	21.8	5.7	7.16	12.7	15.5	5.36	26.9	8.28	23.9	1.34	10.3	3.71
imaging, sound	20.7	9.56	16.2	9.03	10.5	9.1	11.1	11	15.7	10.5	12.5	9	13.1	8.81	12.8
network	7.14	12.3	10.9	21.5	12.5	15.1	13.5	16.4	9.34	21.1	13.4	18.2	9.9	18.4	15.1
computing, storage, analysis	16.8	25.3	14.1	13.4	19.3	18.7	20.8	21.4	11.4	13.6	28.7	16	19.4	34.7	15.9
device	36.5	24.1	34.6	12.8	33.7	27.1	19.7	10.4	39.9	9.85	12.7	9.64	33.2	6.67	34.8
Total number of ICT patent (Thousands)	244	161	93.5	36.8	35.8	18.2	14.4	11.6	10.8	8.97	5.07	5.02	4.11	3.03	2.78

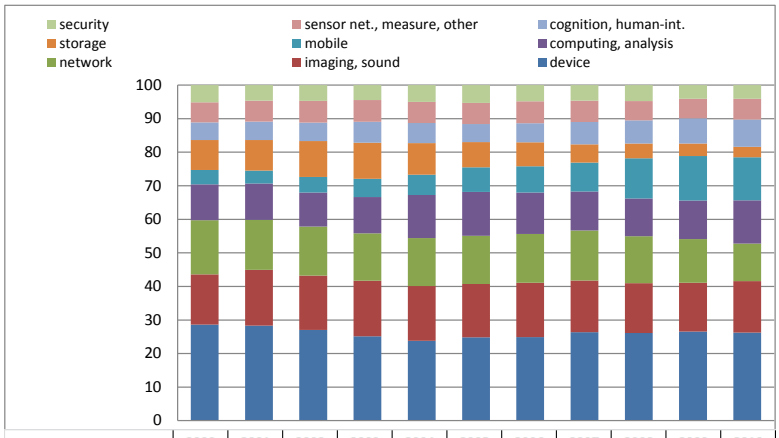
Note: some technology areas have been aggregated to avoid cluttering and make figures more clearly visible.

Legend: the following abbreviations have been used for the technology areas: 'Device' for Information communication device; 'Network' for high speed network; 'Mobile' for mobile communication; 'Computing' for high speed computing; 'Storage' for large-capacity and high speed storage; 'Analysis' for large-capacity information analysis; 'Imaging, sound' for imaging and sound technology; 'Cognition' for cognition and meaning understanding; 'Human-int.' for human-interface; 'Sensor net' for sensor and device network; 'Measure' for electronic measurement; 'Security' for security and 'Other' for others.

Source: authors' own compilation based on the Worldwide Patent Statistical Database, EPO, December 2014.

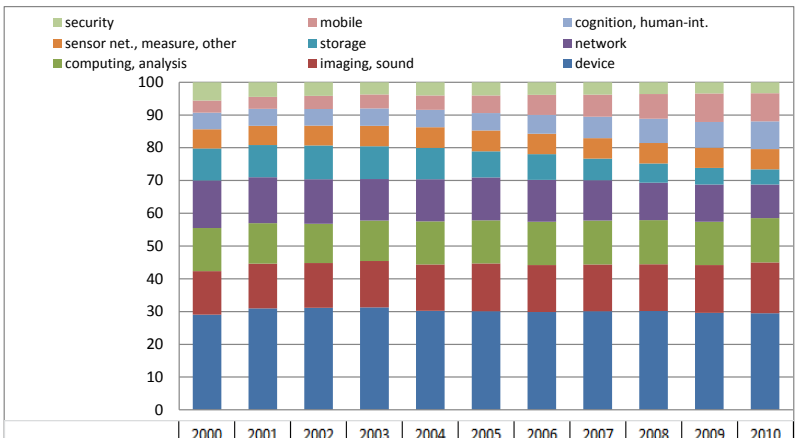
Figures 7 and 8 show the distribution of ICT patents across technology areas for the period 2000-2010, based on triadic patents (Figure 7) and IP5 families (Figure 8), respectively. They suggest that while some technology areas have accounted for basically the same share of overall ICT TPF or IP5 patents throughout the period considered (e.g. sensors and imagining and sound), other areas have increased substantially in relative importance. Examples are cognition and human interface and mobile. Finally, technologies such as storage and networks have declined in terms of relative importance among other ICT technologies.

Figure 7. Distribution of ICT patents across technology areas, 2000-2010: Triadic Patent Families



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
security	5.1	4.7	4.7	4.5	5.0	5.3	4.8	4.6	4.7	4.1	4.1
sensor net., measure, other	5.9	6.2	6.5	6.5	6.3	6.3	6.5	6.4	5.8	5.8	6.2
cognition, human-int.	5.3	5.5	5.5	6.2	6.0	5.4	5.7	6.6	6.9	7.5	8.1
storage	8.9	9.1	10.7	10.7	9.4	7.5	7.1	5.4	4.4	3.7	3.1
mobile	4.3	3.9	4.7	5.4	6.1	7.3	7.8	8.7	12.0	13.2	12.9
computing, analysis	10.7	10.8	10.1	10.8	12.8	13.0	12.3	11.6	11.3	11.5	12.9
network	16.1	14.9	14.6	14.2	14.3	14.4	14.6	14.9	14.0	13.0	11.2
imaging, sound	15.0	16.6	16.2	16.5	16.3	15.9	16.1	15.4	14.9	14.5	15.4
device	28.6	28.3	27.0	25.1	23.8	24.8	24.9	26.3	26.1	26.6	26.2
total number of ICT patent (Thousands)	17.5	17.5	18.1	18.9	18.8	18.2	16.8	15.1	15.1	15.0	13.6

Figure 8. Distribution of ICT patents across technology areas, 2000-2010: IP5 patent families



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
security	5.6	4.5	4.1	3.8	4.0	4.0	3.9	3.8	3.6	3.4	3.4
mobile	3.7	3.6	4.0	4.3	4.4	5.4	6.1	6.7	7.6	8.7	8.5
cognition, human-int.	5.1	5.2	5.1	5.3	5.3	5.3	5.7	6.6	7.4	7.9	8.5
sensor net., measure, other	5.8	5.9	6.1	6.3	6.3	6.4	6.2	6.2	6.2	6.2	6.2
storage	9.8	9.8	10.3	10.0	9.6	8.0	7.8	6.6	5.9	5.1	4.6
network	14.5	14.1	13.6	12.6	12.8	13.1	12.8	12.3	11.5	11.4	10.2
computing, analysis	13.2	12.3	12.0	12.4	13.2	13.1	13.2	13.4	13.4	13.2	13.6
imaging, sound	13.3	13.6	13.7	14.1	14.2	14.6	14.4	14.3	14.3	14.6	15.5
device	29.0	31.0	31.1	31.3	30.2	30.1	29.8	30.1	30.2	29.6	29.5
total number of ICT patent (Thousands)	197.5	205.0	226.2	244.8	258.5	266.9	258.7	246.1	239.3	233.4	236.3

Note: some technology areas have been aggregated to avoid cluttering and make figures more clearly visible. Technologies areas are staggered on the basis of average importance throughout the countries considered. Countries are listed on the basis of their importance, in relative terms, in the most important technology area, i.e. device.

Legend: the following abbreviations have been used for the technology areas: 'Device' for Information communication device; 'Network' for high speed network; 'Mobile' for mobile communication; 'Computing' for high speed computing; 'Storage' for large-capacity and high speed storage; 'Analysis' for large-capacity information analysis; 'Imaging, sound' for imaging and sound technology; 'Cognition' for cognition and meaning understanding; 'Human-int.' for human-interface; 'Sensor net' for sensor and device network; 'Measure' for electronic measurement; 'Security' for security and 'Other' for others.

Source: authors' own compilation based on the Worldwide Patent Statistical Database, EPO, December 2014.

Finally, Figures 9 and 10 propose some statistics related to the way countries contribute to advancing growing ICT technology areas, such as mobile communication and cognition and human interface, and the extent to which their contribution has changed over time, in particular between 2005 and 2010. As can be seen, in the case of mobile communication, a number of countries appear to account for a relatively stable share of these technologies, while China and India have more than doubled their contribution to the technology area. In the case of 'cognition and meaning understanding' and 'human interface' technologies, i.e. those technologies that are more related to human-machine interaction and the internet of things, patterns look much more diversified. Between 2005 and 1010, the only country that has continued to contribute to the same extent to the generation of this set of technologies is the United States. Asian countries such as China, Korea, India and Singapore have markedly increased their relevance for this set of future-looking technologies. Finally Nordic countries as Finland and Sweden, as well as Germany, the United Kingdom and the Netherlands, have seen a decrease in their relative leadership in the field.

Figure 9. ICT TPF, top 15 patenting economies, selected technology areas, 2005 and 2010: 'Mobile communication'

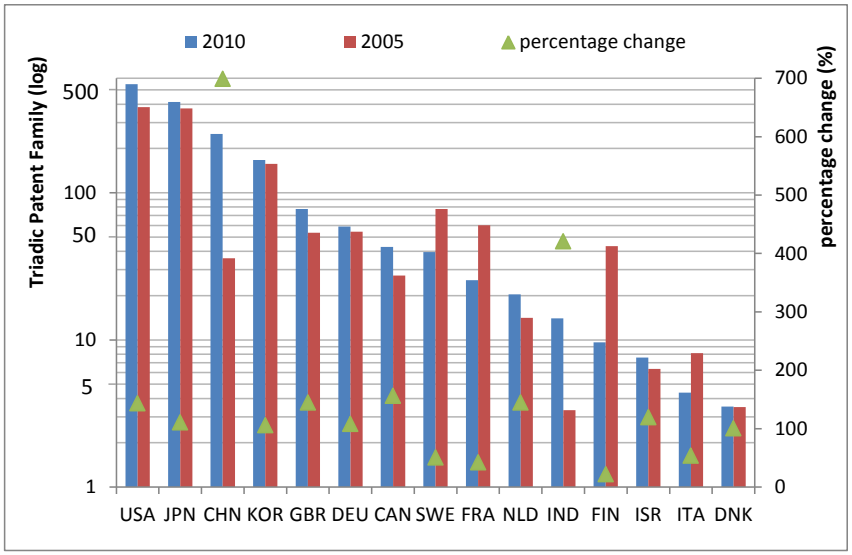
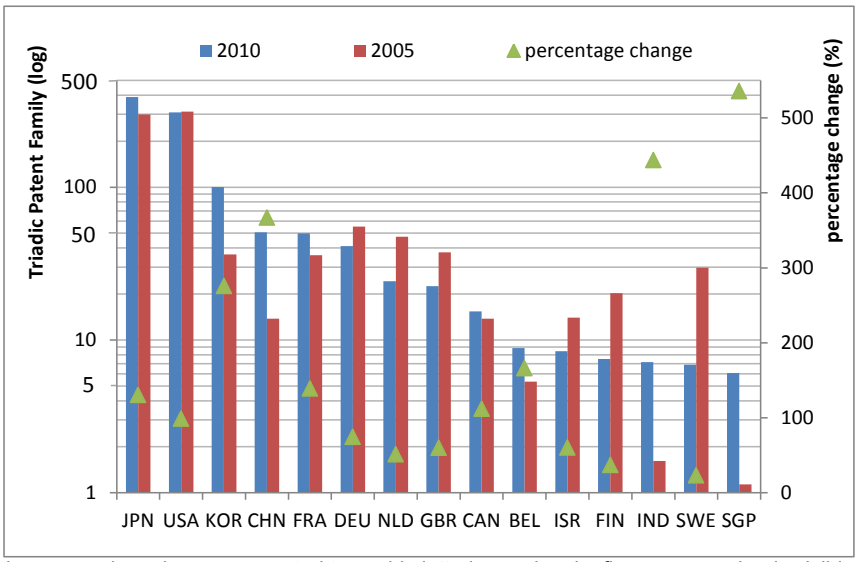


Figure 10. ICT TPF, top 15 patenting economies, selected technology areas, 2005 and 2010: 'Cognition and meaning understanding', 'Human-interface'



Note: some technology areas have been aggregated to avoid cluttering and make figures more clearly visible.
Legend: the statistics in figure 10 rely on data about two technology areas, namely 'Cognition and meaning understanding' and 'Human-interface'.

Source: authors' own compilation based on the Worldwide Patent Statistical Database, EPO, December 2014..

Conclusions

This paper proposes a new taxonomy of ICT technologies based on the technology classes in which patents are filed, which aligns with the most recent definition of the ICT sector (2007) and of ICT products (2008) put forward by the OECD.

The proposed "J tag" classification stems from a careful analysis of ICT technologies and products and relies on the in-depth knowledge of a Japan Patent Office expert specialised in the examination of ICT-related patents. It removes from the OECD (2003) definition patent classes originally tagged as ICT but that mainly or exclusively pertain to other technological domains and that may or may not be used in conjunction with ICT-related technologies, and adds classes that had previously been overlooked but that expert judgment suggests to be indeed part of ICTs and others that did not exist in 2003. It further subdivides ICT technologies in areas corresponding to specific functions and uses and provides details about the ways in which technologies related to ICT products.

The proposed new definition of ICT technologies has been guided by criteria such as expert judgment of patent class content, relevance for ICT-related products, completeness and accuracy.

Statistics based on triadic patent families, i.e. sets of patents taken at the European Patent Office (EPO), the Japanese Patent Office (JPO), and the US Patent and Trademark Office (USPTO) that share one or more priorities, show that in the period 2000-2012, the overall number of triadic patent families identified as being ICT according to the "J tag" is on average 25% smaller than the number of ICT TPF obtained using the OECD (2003) definition. Also, using the "J tag" leads to a reduction in the number of TPF that vary considerably among countries, with Korea and China experiencing relatively small reductions, and countries as Germany, France, the United Kingdom and Switzerland experiencing relatively larger reductions in their figures. The new "J tag" leads to a smaller number for Japan than it does for the United States, and reduces the differences that emerge between the two leading countries.

Also, statistics related to the way in which countries contribute to advance growing ICT technology areas show that in the case of mobile communication a number of countries like the United States Japan, Korea account for a relatively stable share of these technologies, whereas countries like China and India have more than doubled their contribution to the technology area. In the case of cognition and meaning understanding and human interface-related technologies, i.e. those technologies that are more related to human-machine interaction and the internet of things, patterns look much more diversified. Between 2005 and 2010, the only country that has continued to contribute to the same extent to the generation of this set of technologies is the United States. Asian countries such as China, Korea, India and Singapore have markedly increased their relevance for this set of future-looking technologies. Finally Nordic countries as Finland and Sweden, as well as Germany, the United Kingdom and the Netherlands, have seen a decrease in their relative leadership in the field.

ANNEX 1. RELEVANCE OF J TAG TECHNOLOGY AREAS FOR ICT PRODUCTS

**: key underlying technology *: complementary technology

CPC Ver.2 subclass	ISIC Rev.4 class	Product Description	High speed network	Mobile communication	Security	Sensor and device network	High speed computing	Large-capacity and high speed storage	Large-capacity information analysis	Cognition and meaning understanding	Human-interface	Imaging and sound technology	Information communication device	Electronic measurement
Computers and peripheral equipment														
45142	2620	Point-of-sale terminals, ATMs and similar machines			**						*			
45221	2620	Portable automatic data processing machines weighing not more than 10 kg, such as laptop and notebook computers	*	*	*		*	*			*		*	
45222	2620	Personal digital assistants and similar computers					*	*		*	*		*	
45230	2620	Automatic data processing machines, comprising in the same housing at least a central processing unit and an input and output unit, whether or not combined					*	*					*	
45240	2620	Automatic data processing machines presented in the form of systems	*				*	*					*	
45250	2620	Other automatic data processing machines whether or not containing in the same housing one or two of the following types of units: storage units, input units, output units					*	*			*		*	
45261	2620	Input peripherals (keyboard, joystick, mouse, etc.)									*			
45262	2620	Scanners (except combination of printer, scanner, copier and/or fax)									*	**		
45263	2620	Inkjet printers used with data processing machines					*				*	**		
45264	2620	Laser printers used with data processing machines					*				*	**		
45265	2620	Other printers used with data processing machines					*				*	**		
45266	2620	Units performing two or more of the following functions: printing, scanning, copying, faxing									*	**		
45269	2620	Other input or output peripheral devices									*			
45271	2620	Fixed media storage units						**						
45272	2620	Removable media storage units						**						
45289	2620	Other units of automatic data processing machines					*							

CPC Ver.2 subclass	ISIC Rev.4 class	Product Description	High speed network	Mobile communication	Security	Sensor and device network	High speed computing	Large-capacity and high speed storage	Large-capacity information analysis	Cognition and meaning understanding	Human-interface	Imaging and sound technology	Information communication device	Electronic measurement
45290	2620	Parts and accessories of computing machines									**			
47315	2620	Monitors and projectors, principally used in an automatic data processing system									*	**		
47550	2620	Solid-state non-volatile storage devices						**						
Communication equipment														
46921	2630	Burglar or fire alarms and similar apparatus			*	**				*				*
47211	2630	Transmission apparatus incorporating reception apparatus	*										*	
47212	2630	Transmission apparatus not incorporating reception apparatus	*										*	
47213	2630	Television cameras								*	*	**		
47221	2630	Line telephone sets with cordless handsets	*	*	*									
47222	2630	Telephones for cellular networks or for other wireless networks	*	**	*								*	*
47223	2610, 2630	Other telephone sets and apparatus for transmission or reception of voice, images or other data, including apparatus for communication in a wired or wireless network (such as a local or wide area network)	*	*	*									
47401	2630	Parts for the goods of subclasses 47221 to 47223											*	
Consumer electronic equipment														
38581	2640	Video game consoles									*	**		
47214	2640	Video camera recorders						*			*	**		
47215	2670	Digital cameras								*	*	**		
47311	2640	Radio broadcast receivers (except of a kind used in motor vehicles), whether or not combined with sound recording or reproducing apparatus or a clock	*	*							*			
47312	2640	Radio broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles	*	*							*			
47313	2640	Television receivers, whether or not combined with radio-broadcast receivers or sound or video recording or reproducing apparatus	*	*							*	**		
47314	2640	Monitors and projectors, not incorporating television reception apparatus and not principally used in an automatic data processing system										**		

CPC Ver.2 subclass	ISIC Rev.4 class	Product Description	High speed network	Mobile communication	Security	Sensor and device network	High speed computing	Large-capacity and high speed storage	Large-capacity information analysis	Cognition and meaning understanding	Human-interface	Imaging and sound technology	Information communication device	Electronic measurement
47321	2640	Sound recording or reproducing apparatus								*		**		
47323	2640	Video recording or reproducing apparatus								*		**		
47330	2640	Microphones and stands therefor; loudspeakers; headphones, earphones and combined microphone/speaker sets; audio-frequency electric amplifiers; electric sound amplifier sets								*		**		
47402	2640	Parts for the goods of subclasses 47321, 47323 and 47330											*	
Miscellaneous ICT components and goods														
45281	2610	Sound, video, network and similar cards for automatic data processing machines	*		*		*					**	*	
47130	2610	Printed circuits	*				*						*	
47140	2610	Thermionic, cold cathode or photo-cathode valves and tubes (including cathode ray tubes)											**	
47150	2610	Diodes, transistors and similar semi-conductor devices; photosensitive semi-conductor devices; light emitting diodes; mounted piezo-electric crystals											**	
47160	2610	Electronic integrated circuits	*				*						*	
47173	2610	Parts for the goods of subclasses 47140 to 47160											*	
47403	2630, 2640, 2651	Parts for the goods of subclasses 47211 to 47213, 47311 to 47315 and 48220											*	
47530	2680	Magnetic media, not recorded, except cards with a magnetic stripe						**						
47540	2680	Optical media, not recorded						**						
47590	3290	Other recording media, including matrices and masters for the production of disks						**						
47910	2680	Cards with a magnetic stripe			*			*						
47920	2610	“Smart cards”			*		*	*						
48315	2610, 2670	Liquid crystal devices n.e.c.; lasers, except laser diodes; other optical appliances and instruments n.e.c.											**	
48354	2610, 2670	Parts and accessories for the goods of subclass 48315											*	

CPC Ver.2 subclass	ISIC Rev.4 class	Product Description	High speed network	Mobile communication	Security	Sensor and device network	High speed computing	Large-capacity and high speed storage	Large-capacity information analysis	Cognition and meaning understanding	Human-interface	Imaging and sound technology	Information communication device	Electronic measurement
Manufacturing services for ICT equipment														
88741	2610	Electronic component and board manufacturing services	*				*						*	
88742	2620	Computer and peripheral equipment manufacturing services					*						*	
88743	2630	Communication equipment manufacturing services	*										*	
88744	2640	Consumer electronics manufacturing services					*				*		*	
88749	2680	Magnetic and optical media manufacturing services						*					*	
Business and productivity software and licensing services														
47811	5820	Operating systems, packaged					**							
47812	5820	Network software, packaged	**		*									
47813	5820	Database management software, packaged						*	**					
47814	5820	Development tools and programming languages software, packaged					*		*	*	*			
47821	5820	General business productivity and home use applications, packaged								*	*			
47829	5820	Other application software, packaged												
73311	5820	Licensing services for the right to use computer software			*									
83143	5820	Software originals			*									
84341	5820	System software downloads	**		*									
84342	5820	Application software downloads	**		*									
84392	5820	On-line software	**		*			*						
Information technology consultancy and services														
83117	7020	Business process management services			*	*		*	**					
83131	6202	IT consulting services			*	*		*	**					
83132	6202	IT support services			*	*		*	**					
83141	6201	IT design and development services for applications			*	*	*	*	**	*	*			
83142	6202	IT design and development services for networks and systems	*		*	*		*	**					
83151	6311	Website hosting services						*	**		*	*		

CPC Ver.2 subclass	ISIC Rev.4 class	Product Description	High speed network	Mobile communication	Security	Sensor and device network	High speed computing	Large-capacity and high speed storage	Large-capacity information analysis	Cognition and meaning understanding	Human-interface	Imaging and sound technology	Information communication device	Electronic measurement
83152	6311	Application service provisioning	*					*	**	*	*			
83159	6311	Other hosting and IT infrastructure provisioning services	*		*	*		*	**					
83161	6202	Network management services	*		*	*			**					
83162	6202	Computer systems management services					*		**					
Telecommunications services														
84110	6110, 6120	Carrier services	**		*								*	
84121	6110	Fixed telephony services – access and use	**		*								*	
84122	6110	Fixed telephony services – calling features	**		*								*	
84131	6120, 6130	Mobile telecommunications services – access and use	*	**	*								*	
84132	6120, 6130	Mobile telecommunications services – calling features	*	**	*								*	
84140	6110, 6120, 6130, 6190	Private network services	*		**									
84150	6110, 6120, 6130, 6190	Data transmission services	**										*	
84190	6110, 6120, 6130, 6190	Other telecommunications services	**										*	
84210	6110	Internet backbone services	**		*								*	
84221	6110, 6120, 6130, 6190	Narrowband Internet access services	**		*								*	

CPC Ver.2 subclass	ISIC Rev.4 class	Product Description	High speed network	Mobile communication	Security	Sensor and device network	High speed computing	Large-capacity and high speed storage	Large-capacity information analysis	Cognition and meaning understanding	Human-interface	Imaging and sound technology	Information communication device	Electronic measurement
84222	6110, 6120, 6130, 6190	Broadband Internet access services	**		*								*	
84290	6110, 6120, 6130, 6190	Other Internet telecommunications services	**		*								*	
Leasing or rental services for ICT equipment														
73124	7730	Leasing or rental services concerning computers without operator					*	*					*	
73125	7730	Leasing or rental services concerning telecommunications equipment without operator	**		*						*		*	
73210	7729	Leasing or rental services concerning televisions, radios, video cassette recorders and related equipment and accessories									*	**		
Other ICT services														
83325	7110	Engineering services for telecommunications and broadcasting projects	**		*								*	
87130	9511	Maintenance and repair services of computers and peripheral equipment					*	*			*			
87153	9512	Maintenance and repair services of telecommunication equipment and apparatus	**		*						*		*	
87331	3320	Installation services of mainframe computers					**	*	*				*	
87332	6209	Installation services of personal computers and peripheral equipment	*	*	*		*	*			*		*	
87340	3320	Installation services of radio, television and communications equipment and apparatus	*	*	*						*	*	*	

ANNEX 2. DOUBTFUL IPC CLASSES AND THEIR DEFINITIONS

Doubtful IPC class	Class definition
H01B5	Non-insulated conductors or conductive bodies characterised by their form
H01B7	Insulated conductors or cables characterised by their form
H01B12	Superconductive or hyperconductive conductors, cables or transmission lines
H01B13	Apparatus or processes specially adapted for manufacturing conductors or cables
H01L21	Processes or apparatus specially adapted for the manufacture or treatment of semiconductor or solid state devices or of parts thereof
H01L23	Details of semiconductor or other solid state devices
H01L25	Assemblies consisting of a plurality of individual semiconductor or other solid state devices
H01L27	Devices consisting of a plurality of semiconductor or other solid-state components formed in or on a common substrate
H01L35	Thermoelectric devices comprising a junction of dissimilar materials,
H01L37	Thermoelectric devices without a junction of dissimilar materials; Thermomagnetic devices
H01L39	Devices using superconductivity or hyperconductivity; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof
H01L41	Piezo-electric devices in general; Electrostrictive devices in general; Magnetostrictive devices in general; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof; Details thereof
H01L43	Devices using galvano-magnetic or similar magnetic effects; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof
H01L45	Solid state devices specially adapted for rectifying, amplifying, oscillating, or switching without a potential-jump barrier or surface barrier
H01L47	Bulk negative resistance effect devices
H01L49	Solid state devices not provided for in groups H01L 27/00-H01L 47/00 and H01L 51/00 and not provided for in any other subclass; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof
H01L51	Solid state devices using organic materials as the active part, or using a combination of organic materials with other materials as the active part; Processes or apparatus specially adapted for the manufacture or treatment of such devices, or of parts thereof

ANNEX 3. IPCS CODES INCLUDED IN AND EXCLUDED FROM THE NEW AND THE EXISTING ICT TAXONOMY

IPC			New taxonomy	Existing taxonomy at the OECD	Remarks
A			-		
B			B81B7/02: Information communication device B82Y10: Information communication device	B07C, B41J, B41K: Computers, office machinery	B07C (postal sorting) cannot be regarded as ICT, since it is not necessarily relevant to information processing and communication by electronic means. (e.g. B07C5: Sorting according to a characteristic or feature of the articles or material being sorted, B07C7: Sorting by hand only). B41J, B41K: Target of these IPCs are technologies related to structural or mechanical components of printer device. They are not technologies having prominent features in information processing or data communication. For example, B41J1/00 is about mounting of the types, and subgroups of B41J1/00 include technology about mechanical component such as levers, rods, the axis of rotation. B41J2/00 is about printing process, which includes ink jet technology. B41J9/00 is about hammer impression mechanisms, B41J13/00,15/00 are about supporting or handling of copy material. B41K is about stamps. (Though printers are ICT products, technologies used in printers includes both ICT and non-ICT technologies.) B81B7/02 is about microstructure system containing distinct electrical or optical devices, such as MEMS. MEMS is an important technology used for sensors and high-frequency switches. B82Y10 is about nano-technology for information processing, storage or transmission. This is ICT technology which enables new type of computing.

C			-	-	
D			-	-	
E			-	-	
F			-	-	
G01	B-R		-	B-P,R: Other ICT	There are various types in measurement technology, and not everything is said to be within ICT. For example, G01B5/24 is about measuring arrangements by mechanical means for testing the alignment of axes, which is far from ICT. Only measurement technology which is particularly utilising information processing and communication can be regarded as ICT technology. G01S, G01V3, G01V8, and G01V15 can be regarded as ICT technology, since they have a close relationship with communication technology. G01S is about radio direction finding, etc.. G01V3 is about target detection by electric or magnetic means. G01V8 is about target detection by optical means. G01V15 is about target detection using tags. G01S, G01V3,8,15 should be categorised as 'Electronic measurement', since they are measurement techniques. On the other hand, G01S13/74-13/84, G01V3,15 can include techniques to detect objects or measure object's position using electronic tags in sensor system. Therefore these classes should be categorised as secondary importance classes of 'Sensor and device network'.
	S	1-11	Electronic measurement	Telecommunications	
		13/00-13/72	Electronic measurement		
		13/74-13/84	Electronic measurement *Sensor and device network		
		13/86-13/95	Electronic measurement		
		15-19	Electronic measurement		
	T		-	-	
	V	1	-	Other ICT	
		3	Electronic measurement *Sensor and device network		
		5, 7	-		
		8	Electronic measurement		
		9-13	-		
		15	Electronic measurement *Sensor and device network		
		99	-		
	W		-		
G02	B	1-5	-	-	
		6	Information communication device	Other ICT	
		7-27	-	-	
	C		-	-	
	F	1	Information communication device	Computers, office machinery	
		2	Information communication device		
		3,7	Information communication device		

G03-G05			-	G03G, G05F: Computers, office machinery	G03G (electrography) technology is not a prominent feature in information processing and communication, though it applies electronic engineering. For example, it includes G03G5 (Recording-members for original recording by exposure e.g. to light, to heat, to electrons) and G03G9 (Developers). These are not relevant to information processing or communication. G05F (systems for regulating electric or magnetic variables) is technology for control of electric machinery. This class should be excluded from ICT, because, firstly, using electronic processing to control a physical process was removed from definition of ICT sector, in the revision in 2006. Furthermore, systems in this class are not particularly relevant to information processing or communication. (e.g. G05F1/02:Regulating electric characteristics of arcs, G05F1/10:Regulating voltage or current, G05F1/66:Regulating electric power)
G06	C		-	Computers, office machinery	G06C is about digital computers in which all the computation is effected mechanically, such as abacuses. Since they do not process data by electronic means, they cannot be regarded as ICT.
	D		-		G06D is about digital fluid-pressure computing devices. They do not process data by electronic means.
	E		Others		
	F	1	Others		
		3/00	Others		
		3/01- 3/0489	Human-interface		
		3/05	Others		
		3/06-3/08	Large-capacity and high speed storage		
		3/09-3/13	Others		
		3/14-3/16	Human-interface		These are about digital output to display device, or sound input-output. They can be regarded as human interface technology.
		3/18	Others		

		5-11	High speed computing		
		12	Large-capacity and high speed storage G06F12/14:Security *Large-capacity and high speed storage		G06F12/14 is security techniques in memory system. Since its main feature is security, and memory system is background technology, 'Security' should be the main area, and 'Large-capacity and high speed storage' should be the second.
		13	High speed computing		
		15/00	High speed computing		
		15/02	Others		
		15/04	Others		
		15/16-177	High speed computing		
		15/18	High speed computing、 *Cognition and meaning understanding		G06F15/18 should be mainly categorised as 'High speed computing', since it is computer programing techniques. On the other hand, it can include learning machines, which are relative to cognitive computing.
		15/76-82	High speed computing		
		17/00	Large-capacity information analysis		
		17/10-18	Large-capacity information analysis		
		17/20-28	Cognition and meaning understanding		
		17/30	Large-capacity information analysis		
		17/40	Large-capacity information analysis *Sensor and device network		G06F17/40 is techniques to build databases. It can also include techniques of gathering data in sensor network.
		17/50	Large-capacity information analysis *Human-interface		G06F17/50 (Computer-aided design) is computer aided engineering. Therefore it should be categorised as 'Large-capacity information analysis'. At the same time, it can include techniques related to human-interface such as ways to display objects to facilitate design.
		19	Large-capacity information analysis		
		21	Security		
	G		7/00: Others		G06G7/00 is devices in which the computing operation is performed by varying electric or magnetic. They realise information processing by electronic means. Others (G06G1/00: hand-manipulated computing, G06G3/00: devices computing operation is performed

					mechanically, etc.) do not use electronic means.
	J		Others		
	K	1-7	Large-capacity and high speed storage		
		9	Cognition and meaning understanding, *Human-interface		G06K9 is methods to recognise characters or patterns. Therefore it should be categorised as 'Cognition and meaning understanding'. At the same time, it can include techniques for human interaction.
		11	Human-interface		G06K11/00 includes G06K11/02: automatic curve followers, G06K11/06: converting the position of a manually-operated writing, etc., which can be regarded as human interface technology.
		13	Large-capacity and high speed storage		
		15,17	Others		
		19	Security		
		21	-		G06K21/00 is about information retrieval from punched cards designed for manual use or handling by machine. They do not utilise electronic means.
	M		-		G06M (counting mechanisms) does not particularly utilise data processing or communication. (e.g. G06M7: counting of objects carried by a conveyor, G06M9: counting of objects in a stack)
	N		Others		
	Q		Security, Large-capacity information analysis		G06Q20 should be categorised as 'Security', since it is about payment architecture (e.g. G06Q20/02: involving a neutral third party, e.g. certification authority, notary or trusted third party, G06Q20/04: Payment circuits).
	T	1-9	Imaging and sound technology 7/00: Cognition and meaning understanding, *Imaging and sound technology		G06T7 (analysis of motion, analysis of geometric attributes, etc. in image analysis) is relevant to understanding the meaning from image data. As background technology, 'Imaging and sound technology' should be the second relevant area.

		11	Imaging and sound technology, *Human-interface 11/80: Human-interface, *Imaging and sound technology		G06T11(2D image generation) is imaging techniques. It can also include display techniques to facilitate operation by human. G06T11/80 (creating image using a manual input device) is closely relevant to operation by humans. Therefore, 'Human-interface' should be the main category for this class.
		13-19	Imaging and sound technology, *Human-interface		G06T13-19 (animation, 3D image rendering, computer graphics) are imaging techniques. They can also include display techniques to enhance operability by human.
G07	B,C		-	Computers, office machinery	G07B,C is about details component of service devices, and cannot be regarded as ICT. For example, G07B1 is about ticket issuing machines, a sub-group of which has components for printing.
	D		-		G07D is about technology to handle coins and paper currency. (e.g. G07D1: Coin dispensers, G07D3: Sorting a mixed bulk of coins into denominations, G07D5,7: Testing identity of coins and paper currency.) They do not particularly utilise information processing and communication.
	F		7/08-12: Security		G07F7/08-12 are about technology to use coded identity cards or credit cards in coin-freed apparatus, etc.. G07F7/10 (coded signal), and G07F7/12 (card verification), are included. They are information processing technology for security. Others are G07F1/02: coin slots, G07F5/02: mechanism actuated mechanically by coins etc. They are not relevant to ICT.
	G		1/12,14: Security		G07G1/12,14 are about electronically operated cash registers. They are information processing technology for security. Others are G07G3/00: alarm indicators, etc.. They are not relevant to ICT.

G08	B		G08B1/08, 3/10, 5/22-38, 7/06, 13/18-13/196, G08B25-27: Sensor and device network	-	G08B (signalling or calling systems, order telegraphs, alarm systems) includes sensor network technology as follows. G08B1/08,3/10,5/22-38,7/06 are about technology to transmit various signals by electric means. G08B13/18-13/196 is about alarm using radiation of shorter wavelength, etc. They are closely related to communication technology. G08B25: Alarm systems in which the location of the alarm condition is signalled to a central station, G08B26: Alarm systems in which substations are interrogated in succession by a central station, G08B27: Alarm systems in which the alarm condition is signalled from a central station to a plurality of substations, are based on communication technology between central station and substations.
	C		Sensor and device network	Telecommunications	
	G		Large-capacity information analysis G08G1/01-065: Sensor and device network, *Large-capacity information analysis G08G1/0962-0969: Human-interface *Large-capacity information analysis	Other ICT	Traffic control involves large capacity data analysis and communication, and so it can be regarded as ICT technology.
G09	B	1-3	-	Other ICT	G09B1-3 are non ICT features of teaching materials (e.g. G09B1/02: manually- or mechanically-operated educational appliances having a support to carry the elements)
		5-9	Human-interface		
		11-29	-		G09B11-29 are apparatus for various type of teaching, not regarded as ICT. (e.g. G09B11/02: Finger, hand, or arm supporting devices, G09B13/02:Dummy practice keyboard)
	C		Security	Telecommunications	
	D		-	-	
	F		-	-	
	G		Imaging and sound technology	Computers, office machinery	

G10	B-K		-	-	
	L	13	Imaging and sound technology, 13/027: Cognition and meaning understanding * Imaging and sound technology	Computers, office machinery	G10L13 (speech synthesis) is sound techniques. G13/027 (concept to speech synthesisers) involves concept understanding. Therefore, 'Cognition and meaning understanding' should be the main area for this class. G10L15 (feature extraction for speech recognition, etc.), G10L17 (speaker identification or verification) involve high level understanding of speech signal. G10L25/63,66 (estimating an emotional state, extracting parameters related to health condition) involve understanding of meaning and information.
		15	Cognition and meaning understanding *Imaging and sound technology,		
		17	Cognition and meaning understanding *Imaging and sound technology,		
		19-99	Imaging and sound technology, 25/63, 25/66: Cognition and meaning understanding * Imaging and sound technology		
G11	B		Large-capacity and high speed storage	Consumer electronics	
	C		Large-capacity and high speed storage, Security	Computers, office machinery	
G12			-	-	
H01	B	1,3	-	-	
		5	- (excluded doubtful class)	-	
		7	- (excluded doubtful class)	-	
		9	-	-	
		11	Information communication device	Other ICT	
		12	- (excluded doubtful class)	-	
		13	- (excluded doubtful class)	-	
		15	-	-	
		17,19	-	-	
	C-K		-	J:Other ICT	H01J (Electric discharge tubes or discharge lamps) should be excluded. Though electric tubes used to play important roles in electronic circuits for modulation, amplification, etc., they were mostly replaced by semiconductor devices. They can no longer be regarded as devices which make significant contribution to data processing or communication

	L		H01L21, 25, 27: Information communication device (included doubtful class) H01L29-33: Information communication device H01L43-51/: Information communication device (included doubtful class)	Other ICT	
	M		-	-	
	P, Q		Information communication device	Telecommunications	
	R		-	-	
	S	1/00-4/00	-	-	
		5/00	Information communication device	Telecommunications	
	T		-	-	
H02			-	-	
H03	B-J		Information communication device	B-D: Telecommunications F,G: Consumer electronics H: Telecommunications J: Consumer electronics	
	K-M		High speed network	K,L: Computers, office machinery M: Telecommunications	
H04	B		High speed network, Mobile communication, Sensor and device network	Telecommunications	
	H		High speed network	Consumer electronics	
	J		High speed network	Telecommunications	
	K		Security	Telecommunications	
	L		High speed network, Security	Telecommunications	
	M	1	Human-interface, Security	Telecommunications	H04M1 is relevant to means to facilitate use of sub-station. For example, H04M1/02-23 are about constructional features of telephone sets. They can be considered as means to make use easy and convenient, contributing to enhance operability by users. H04M1/247 (user guidance, feature selection means), H04M1/26-658 (devices for calling a subscriber, arrangements for indicating or recording the called number, automatic arrangements for answering calls, etc.) are about means making use easy

					and convenient. H04M1/66-665,H04M1/667-675,H04M1/68-70 have relevance to authentification, since they are means to prevent unauthorised calls.
		3-13	High speed network		
		15,17	Others		
		19, 99	High speed network		
	N		Imaging and sound technology 7/167-7/171: Security, * Imaging and sound technology 5/78-5/907: Large-capacity and high speed storage * Imaging and sound technology	Consumer electronics	H04N7/167-7/171 are secret coding techniques of television signal. H04N5/78-5/907 are storage techniques of television signal.
	Q		High speed network	Telecommunications	
	R, S		Imaging and sound technology	Consumer electronics	
	W		Mobile communication 4/24:Security, *Mobile communication 12: Security, *Mobile communication 84/10, 84/18: Mobile communication, *Sensor and device network	-	H04W4/24 is billing techniques in mobile communication system. H04W12 is authentication, encryption key management, etc. in mobile communication system. H04W84/10(small scale networks, flat hierarchical networks) can include small network among devices. Therefore, this class was categorised as secondary relevant class in 'Sensor and device network'. H04W84/18(self-organising networks, e.g. Ad hoc networks or sensor networks) can include sensor network technologies as indicated in the definition. Therefore, this class was categorised as secondary relevant class in 'Sensor and device network'.
H05			-	-	
H99			-	-	

ANNEX 4. DESCRIPTION OF THE IPC CODES INCLUDED IN THE J CLASSIFICATION

IPC	Details
1. High speed network	
<Digital communication technique>	
H03K	Pulse technique
H03L	Automatic control, starting, synchronisation, or stabilisation of generators of electronic oscillations or pulses
H03M	Coding, decoding or code conversion, in general
H04B1/69-1/719	Spread spectrum techniques
H04J	Multiplex communication
H04L (exclude H04L9, H04L12/14)	Transmission of digital information
*H04L9, H04L12/14	
<Exchange, selecting>	
H04M3-13,19,99	Exchanges in telephonic communication
H04Q	Selecting
<Others>	
H04B1/00-1/68, H04B1/72-1/76, H04B3-17 (exclude H04B1/59, H04B5, H04B7)	Transmission
*H04B1/59, H04B5, H04B7	
H04H	Broadcast communication
2. Mobile communication	
H04B7	Radio transmission systems
H04W (exclude H04W4/24, H04W12)	Wireless communication networks
*H04W4/24, H04W12	
3. Security	
<Cyphering, authentication>	
G06F12/14	Protection against unauthorised use of memory
G06F21	Security arrangements for protecting computers, components thereof, programs or data against unauthorised activity
G06K19	Record carriers for use with machines and with at least a part designed to carry digital markings
G09C	Ciphering or deciphering apparatus for cryptographic or other purposes involving the need for secrecy
G11C8/20	Address safety or protection circuits, i.e. Arrangements for preventing unauthorised or accidental access
H04K	Secret communication; jamming of communication
H04L9	Arrangements for secret or secure communication

IPC	Details
H04M1/66-665	With means for preventing unauthorised or fraudulent calling
H04M1/667-675	Preventing unauthorised calls from a telephone set
H04M1/68-70	Circuit arrangements for preventing eavesdropping
H04M1/727	Identification code transfer arrangements
H04N7/167-7/171	Systems rendering the television signal unintelligible and subsequently intelligible
H04W12	Security arrangements in mobile communication networks
<Electronic payment>	
G06Q20	Payment architectures, schemes or protocols
G07F7/08-12	By coded identity card or credit card
G07G1/12-1/14	Electronically operated cash registers
H04L12/14	Charging arrangements
H04W4/24	Accounting or billing in mobile communication networks
4. Sensor and device network	
<Sensor network>	
G08B1/08	Using electric transmission (Systems for signalling characterised solely by the form of transmission of the signal)
G08B3/10	Using electric transmission; using electromagnetic transmission (Audible signalling systems; Audible personal calling systems)
G08B5/22-38	Using electric transmission; using electromagnetic transmission (Visible signalling systems)
G08B7/06	Using electric transmission (Signalling systems)
G08B13/18-13/196	Actuation by interference with heat, light, or radiation of shorter wavelength; Actuation by intruding sources of heat, light, or radiation of shorter wavelength
G08B13/22-26	Electrical actuation (Burglar, theft or intruder alarms)
G08B25	Alarm systems in which the location of the alarm condition is signalled to a central station
G08B26	Alarm systems in which substations are interrogated in succession by a central station
G08B27	Alarm systems in which the alarm condition is signalled from a central station to a plurality of substations
G08C	Transmission systems for measured values, control or similar signals
G08G1/01-065	Detecting movement of traffic to be counted or controlled
*G06F17/40	Data acquisition and logging
*H04W84/18	Self-organising networks, e.g. Ad hoc networks or sensor networks
<Electronic tag>	
H04B1/59	Responders; transponders
H04B5	Near-field transmission systems
*G01S13/74-84	Systems using reradiation of radio waves
*G01V3	Electric or magnetic prospecting or detecting; Measuring magnetic field characteristics of the earth
*G01V15	Tags attached to, or associated with, an object, in order to enable detection of the object
<Others>	
*H04W84/10	Small scale networks; Flat hierarchical networks
5. High speed computing	
G06F5	Methods or arrangements for data conversion without changing the order or content of the data handled
G06F7	Methods or arrangements for processing data by operating upon the order or content

IPC	Details
	of the data handled
G06F9	Arrangements for programme control
G06F11	Error detection; Error correction; Monitoring
G06F13	Interconnection of, or transfer of information or other signals between, memories, input/output devices or central processing units
G06F15/00	Digital computers in general
G06F 15/16-15/177	Combinations of two or more digital computers each having at least an arithmetic unit, a programme unit and a register
G06F15/18	In which a programme is changed according to experience gained by the computer itself during a complete run; Learning machines
G06F 15/76-15/82	Architectures of general purpose stored programme computers
6. Large-capacity and high speed storage	
G06F3/06–3/08	Digital input from, or digital output to, record carriers
G06F12 (exclude G06F12/14)	Accessing, addressing or allocating within memory systems or architectures
*G06F12/14	
G06K1-7	Marking the record carrier
G06K13	Conveying record carriers from one station to another
G11B	Information storage based on relative movement between record carrier and transducer
G11C (exclude G11C8/20)	Static stores
*G11C8/20, G11C16/22	
H04N5/78-5/907	Television signal recording
7. Large-capacity information analysis	
<Database>	
G06F17/30	Information retrieval; Database structures therefor
G06F17/40	Data acquisition and logging
<Data analysis, simulation, management>	
G06F17/00	Digital computing or data processing equipment or methods, specially adapted for specific functions
G06F17/10-17/18	Complex mathematical operations
G06F17/50	Computer-aided design
G06F19	Digital computing or data processing equipment or methods, specially adapted for specific applications
G06Q10	Administration; Management (Forecasting, optimisation and resource management, etc）
G06Q30	Commerce, e.g. Shopping or e-commerce
G06Q40	Finance; Insurance; Tax strategies; Processing of corporate or income taxes
G06Q50	Systems or methods specially adapted for a specific business sector
G06Q90	Systems or methods specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes, not involving significant data processing
G06Q99	Subject matter not provided for in other groups of this subclass
G08G (exclude G08G1/01-065, G08G1/0962-0969)	Traffic control systems
*G08G1/01-065, G08G1/0962-0969	

IPC	Details
8. Cognition and meaning understanding	
G06F17/20-17/28	Handling natural language data (Processing or translating of natural language, etc
G06K9	Methods or arrangements for reading or recognising printed or written characters or for recognising patterns
G06T7	Image analysis (Analysis of motion, analysis of geometric attributes, etc.)
G10L13/027	Concept to speech synthesisers; Generation of natural phrases from machine-based concepts
G10L15	Speech recognition (Feature extraction for speech recognition, etc.)
G10L17	Speaker identification or verification
G10L25/63,66	For estimating an emotional state, for extracting parameters related to health condition
*G06F15/18	In which a programme is changed according to experience gained by the computer itself during a complete run; Learning machines
9. Human-interface	
H04M1 (exclude H04M1/66-665, H04M1/667-675, H04M1/68-70, H04M1/727)	Substation equipment
*H04M1/66-665, H04M1/667-675, H04M1/68-70, H04M1/727	
G06F3/01-3/0489	Input arrangements or combined input and output arrangements for interaction between user and computer（Arrangements for converting the position or the displacement of a member into a coded form, Interaction techniques based on graphical user interfaces [GUIs], etc.）
G06F3/14-3/153	Digital output to display device
G06F3/16	Sound input; Sound output
G06K11	Methods or arrangements for graph-reading or for converting the pattern of mechanical parameters
G06T11/80	Creating or modifying a manually drawn or painted image using a manual input device
G08G1/0962-0969	Having an indicator mounted inside the vehicle
G09B5	Electrically-operated educational appliances
G09B7	Electrically-operated teaching apparatus or devices working with questions and answers
G09B9	Simulators for teaching or training purposes
*G06F17/50	Computer-aided design
*G06K9	Methods or arrangements for reading or recognising printed or written characters or for recognising patterns
*G06T11	2D [Two Dimensional] image generation
*G06T13	Animation
*G06T15	3D [Three Dimensional] image rendering
*G06T17-19	3D modelling for computer graphics

IPC	Details
10. Imaging and sound technology	
<Imaging technique>	
H04N (exclude H04N5/78-5/907, H04N7/167-7/171)	Pictorial communication
*H04N5/78-5/907, H04N7/167-7/171	
G06T1-9 (exclude G06T7)	Image data processing
*G06T7	
G06T11 (exclude G06T11/80)	2D [Two Dimensional] image generation
*G06T11/80	
G06T13	Animation
G06T15	3D [Three Dimensional] image rendering
G06T17-19	Computer graphics
G09G	Arrangements or circuits for control of indicating devices using static means to present variable information
<Sound technique>	
H04R	Loudspeakers, microphones, gramophone pick-ups or like acoustic electromechanical transducers; deaf-aid sets; public address systems
H04S	Stereophonic systems
G10L (exclude G10L13/027, G10L15, G10L17, G10L25/63,66)	Speech analysis or synthesis; speech recognition; speech or voice processing; speech or audio coding or decoding
*G10L13/027, G10L15, G10L17, G10L25/63,66	
11. Information communication device	
<Electronic circuit>	
H03B	Generation of oscillations, directly or by frequency-changing, by circuits employing active elements which operate in a non-switching manner; generation of noise by such circuits
H03C	Modulation
H03D	Demodulation or transference of modulation from one carrier to another
H03F	Amplifiers
H03G	Control of amplification
H03H	Impedance networks
H03J	Tuning resonant circuits; selecting resonant circuits
<Cable and conductor>	
H01B11	Communication cables or conductors
<Semiconductor>	
H01L29-33	Semiconductor devices
H01L21, 25, 27, 43-51	Semiconductor or solid state devices
<Optic device>	
G02B6	Light guides; Structural details of arrangements comprising light guides and other optical elements
G02F	Devices or arrangements, the optical operation of which is modified by changing the optical properties of the medium of the devices or arrangements for the control of the intensity, colour, phase, polarisation or direction of light
H01S5	Semiconductor lasers

IPC	Details
<Others>	
B81B7/02	Containing distinct electrical or optical devices of particular relevance for their function, e.g. Micro-electro-mechanical systems (MEMS) (micro-structural systems)
B82Y10	Nano-technology for information processing, storage or transmission
H01P	Waveguides; resonators, lines or other devices of the waveguide type
H01Q	Aerials
12. Electronic measurement	
G01S	Radio direction-finding; radio navigation; determining distance or velocity by use of radio waves; locating or presence-detecting by use of the reflection or reradiation of radio waves; analogous arrangements using other waves
G01V3	Electric or magnetic prospecting or detecting; Measuring magnetic field characteristics of the earth
G01V8	Prospecting or detecting by optical means
G01V15	Tags attached to, or associated with, an object, in order to enable detection of the object
13. Others	
<Computer input-output>	
G06F3/00	Input arrangements for transferring data to be processed into a form capable of being handled by the computer; Output arrangements for transferring data from processing unit to output unit
G06F3/05	Digital input using the sampling of an analogue quantity at regular intervals of time
G06F3/09	Digital output to typewriters
G06F3/12	Digital output to print unit
G06F3/13	Digital output to plotter
G06F3/18	Digital input from automatic curve follower
<Other related technique>	
G06E	Optical computing devices
G06F1	Details of digital data processing (digital function generators, clock, etc.)
G06F15/02	Manually operated with input through keyboard and computation using a built-in programme, e.g. Pocket calculators
G06F15/04	Programmed simultaneously with the introduction of data to be processed
G06F15/08-15/14	Using a plugboard for programming
G06G7	Devices in which the computing operation is performed by varying electric or magnetic quantities
G06J	Hybrid computing arrangements
G06K15	Arrangements for producing a permanent visual presentation of the output data
G06K17	Methods or arrangements for effecting co-operative working between equipments for marking the record carrier, printing data, etc.
G06N	Computer systems based on specific computational models
H04M15	Arrangements for metering, time-control or time-indication
H04M17	Prepayment telephone systems

ANNEX 5. IPC-TECHNOLOGY CONCORDANCE, SCHMOCH (2008)

IPC-Technology concordance, Schmoch (2008)

Electrical engineering

1 Electrical machinery, apparatus, energy
2 Audio-visual technology
3 Telecommunications
4 Digital communication
5 Basic communication processes
6 Computer technology
7 IT methods for management
8 Semiconductors

Instruments

9 Optics
10 Measurement
11 Analysis of biological materials
12 Control
13 Medical technology

Chemistry

14 Organic fine chemistry
15 Biotechnology
16 Pharmaceuticals
17 Macromolecular chemistry, polymers
18 Food chemistry
19 Basic materials chemistry
20 Materials, metallurgy
21 Surface technology, coating
22 Micro-structural and nano-technology
23 Chemical engineering
24 Environmental technology

Mechanical engineering

25 Handling
26 Machine tools
27 Engines, pumps, turbines
28 Textile and paper machines
29 Other special machines
30 Thermal processes and apparatus
31 Mechanical elements
32 Transport

Other fields

33 Furniture, games
34 Other consumer goods
35 Civil engineering

ANNEX 6. TECHNOLOGY CLASSIFICATION OF ISI-OST-INPI (FEBRUARY 2005)

Technology classification of ISI-OST-INPI (February 2005)

I. Electrical engineering

1. Electrical machinery and apparatus, electrical energy
2. Audio-visual technology
3. Telecommunications
4. Information technology
5. Semiconductors

II. Instruments

6. Optics
7. Analysis, measurement, control technology
8. Medical technology
9. Nuclear engineering

III. Chemistry, pharmaceuticals

10. Organic fine chemistry
11. Macromolecular chemistry, polymers
12. Pharmaceuticals, cosmetics
13. Biotechnology
14. Agriculture, food chemistry
15. Chemical and petrol industry, basic materials chemistry
16. Surface technology, coating
17. Materials, metallurgy

IV. Process engineering, special equipment

18. Chemical engineering
19. Materials processing, textiles, paper
20. Handling, printing
21. Agricultural and food processing, machinery and apparatus
22. Environmental technology

V. Mechanical engineering, machinery

23. Machine tools
24. Engines, pumps, turbines
25. Thermal processes and apparatus
26. Mechanical elements
27. Transport
28. Space technology, weapons

VI. Consumption

29. Consumer goods and equipment
30. Civil engineering, building, mining

NOTES

1. Examples include the electronic components of cars and of medical instruments.

2. For more detail about the development of ICT-related patent-based definitions at the OECD, see Chapter 4 of OECD (2011).

3. The IPC classification is periodically revised in order to improve the system and to take into account the technical development that occur over time. For more information see http://www.wipo.int/classifications/ipc/en/

4. See e.g. Atzori et al. (2010) for a survey about the internet of things, and Dosi (1982) for a discussion about technological paradigms and trajectories.

5. Alternatively, the taxonomy could rely on the Cooperative Patent Classification (CPC) codes. The CPC is the result of a partnership between the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO) aiming to develop a common, internationally compatible classification system for technical documents, in particular patent publications, to be used by both offices in the patent granting process. Relying on the CPC might help refine the taxonomy, since the CPC containes more than three times the number of entries contained in the IPC and IPC codes can be easily converted into CPC ones. However, the present limited use of the CPC classification by countries would hinder the use of the taxonomy as well as the comparability of the indicators thus produced.

6. While its IPC-based ICT taxonomy is not available to the public, JPO has since 2004 been including ICT-related statistics on this taxonomy in its reports.

7. www.jpo.go.jp/shiryou/toukei/pdf/1402-027/02.pdf

8. Software patents can be considered to be relevant mostly to 'Computers and office machinery' in the OECD 2003 taxonomy, and to 'High speed computing' and 'Large-capacity information analysis' in the new taxonomy, since software is a program related to the operation of computers. However nowadays software is used for various purposes and is relevant to other technology areas as well. Moreover the definition of software patents differs across countries, and this makes it even more challenging to assign software patents to specific technology areas. While challenging, this issue may well deserve attention in future work.

9. Patents featuring only one IPC class were excluded from the count as they could not provide any useful information about the co-occurrences.

10. Additional info about these statistics and the decision criteria can be obtained from the authors upon request.

11. In the same way as ICT technologies can be used in non-ICT products, non-ICT technologies are used in ICT products.

12. See Dernis and Kahn (2004) for more details.

13. As patent families may take some time to emerge, given the lag that may exist between one filing and the next one, figures refer to patents with priority date in 2008-2010, so that truncation is minimised.

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