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Europe lagging behind in ICT evolution: Patenting trends of leading ICT companies

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Europe Lagging Behind in ICT Evolution

Patenting Trends of Leading ICT Companies

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Abstract

In this paper, we examine new Internet ecosystem strategies through comprehensive OECD PATSTAT patent data analyses focusing on mobile operating system software firms. We also describe current patent disputes between mobile hardware firms and mobile operating system software firms in the US and their relevant intellectual property in order to highlight the changes and decisions made within current mobile value chains, which may then enable the further examination of strategic decisions of individual firms. Based on OECD PATSTAT and our descriptive analyses, we find that the latest strategic decisions made by the mobile hardware and operating system firms target industry-level competition on intellectual property and control over new industry convergence, whereas the value of hardware-based intellectual property is measured and evaluated against software and heuristics related intellectual property. This industry convergence includes the evolution of new ecosystems based on Apple, Google and Microsoft technologies that will change the role of several firms in the mobile value chain.

Key words: Apple, Microsoft, Google, Nokia, ICT, ecosystems, intellectual property, patenting

JEL: L86, L8, L25

Tiivistelmä

Tässä raportissa tutkimme uuden Internet-ekosysteemin strategioita tarkastelemalla OECD PATSTAT -aineistoja matkapuhelinten käyttöjärjestelmäohjelmistoja kehittävien yritysten näkökulmasta. Aineiston tukena hyödynnämme myös uusimpia pohjoisamerikkalaisia patenttioikeudenkäyntimateriaaleja matkapuhelinohjelmisto- ja laitteistoyritysten välillä. Näiden aineistojen perusteella pyrimme ymmärtämään arvoketjumuutoksia ja viimeaikaisia yritysten tekemiä strategisia päätöksiä. OECD PATSTAT -aineistoihin ja havaintoihimme perustuvan analyysin pohjalta voidaan päätellä, miten matkapuhelinlaitteisto- ja ohjelmistoyritykset kilpailevat teollisista oikeuksista ja toimialan uuden konvergenssin hallinnasta sekä, miten laitteistopohjaisia teollisia oikeuksia arvotetaan ohjelmisto- ja heuristiikkapohjaisten teollisten oikeuksien suhteen. Tämä teollinen konvergenssi sisältää osanaan Applen, Googlen ja Microsoftin teknologiaan perustuvat uudet ekosysteemit, jotka muuttavat monien yritysten rooleja nykyisessä mobiiliarvoketjussa.

Asiasanat: Apple, Microsoft, Google, Nokia, ICT, ekosysteemi, immateriaalioikeudet, patentointi

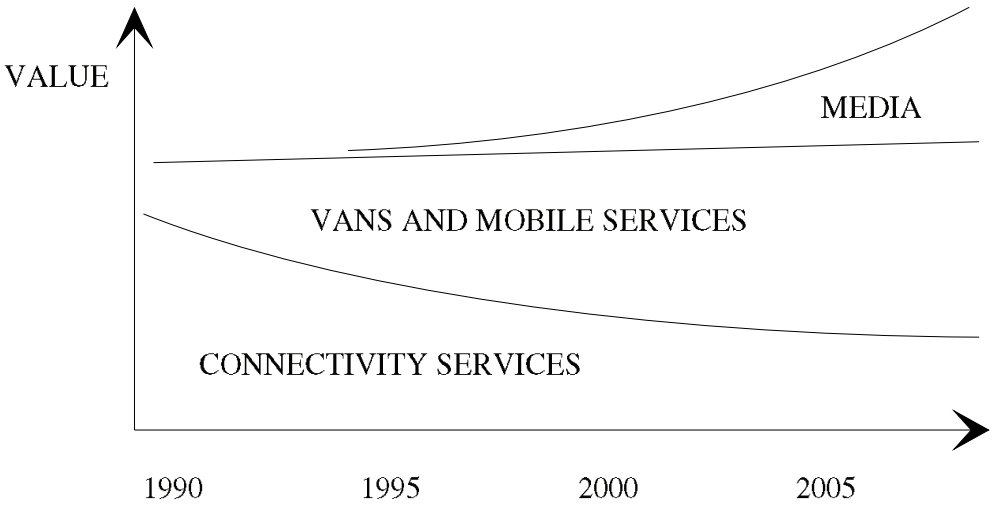
1 Background: the evolution of mobile telephony – technology approach

1.1 From connectivity to value-added services and content provision

The development of telecom technology in the first half of the 20th century concentrated on building global telephony and data connectivity and solving the systemic problems of such automated networks. The largest technological disruptions in telecom technology and telecom services business in the 1990s were created by cellular mobile telephony standards, especially the Global System of Mobile Standards (GSM), or second generation (2G) mobile, and the Internet with its global network of content. These disruptions were results of the convergence of information and communications technologies (ICT). The networks and mobile terminals became computer controlled, and the functional features of the systems were programmed as software in the system components. In fact, mobile cellular networks became possible to implement only when network functionalities such as roaming and handovers became controlled by digitally programmable switching centres. Similarly, high-speed or broadband communication only became possible with new digital transmission systems equipped with high-speed signal processors.

The ability to add new features and services in telecom systems by programming them into the system components started a new era in the business: the era of value-added and mobile services. At the same time, the Internet and the World Wide Web made it possible for users to download applications and media contents from the network. This content distribution opportunity was seen as a new distribution channel for media industries such as TV and video, music, publishing and news. It was also expected that the new network technologies would become cost-effective and that the cost of a transferred bit would decrease considerably. As a result, it was expected that the value of the communications business would transfer gradually from the connectivity services of the network to the value-added and mobile services on top of the network and finally to the media content distribution (Figure 1, Martikainen et al., 1994).

Figure 1 Telecom services business value



In Europe, GSM development was based on European Telecommunications Standards Institute (ETSI) standards (Palmberg and Martikainen, 2005), which were partially covered by so-called essential patents. This systemic patenting enabled the original GSM manufacturers to keep a major share of the GSM system and terminal businesses. A similar focus on network and system patenting continued through the Universal Mobile Telecommunications System (UMTS) and third-generation (3G) development. This patenting focus corresponded to the areas where the value in telecom services was created at that time: the network and the services. There was a lot of discussion in the mid and late 1990s about how to enter the digital media content area. There were acquisitions and mergers between media and telecom service providers, telecom players wanted to enter into TV and cable TV (CATV) businesses, and expensive 3G operator licence auctions were held.

Device manufacturer and telecom service providers have a problem with content and application businesses: how should they obtain revenue from content and application distribution? For example, with CATV, the revenues for the distributor network are quite thin. However, the content and applications are developed and owned by third parties, and thus, direct ownership or patenting is not possible. Obtaining shares of media companies is one possible solution, but there seems to be another solution: to own and patent essential features that are required to display and manage the contents and applications on user devices.

1.2 The foggy future

Disruptive and competence-destroying technologies have been the reason for many firms' successes (Schumpeter, 1942; Tushman and Anderson, 1986). Typically, firms that enter the existing markets with disruptive and/or competence-destroying technologies and tools have been capable of changing the market behaviour of the final customers, i.e., consumers and enterprises. However, the timing must be right when introducing these new technologies. In the mobile phone era, Nokia implemented the Nokia user experience of the late 1990s. Motorola also followed this pattern when introducing the thin clamshell mobile phone and Research in Motion by introducing a mobile phone which included mobile email. Apple has also followed this pattern with its touch-and-feel user interface. In the future, there will always be similar disruptions. Unfortunately, forecasting such disruptions remains nearly impossible.

Today, we are facing a situation with high asymmetries: consumers, enterprises and device and operating system providers do not share the same view about where the market will move next. Presumably, the next market movements will be based on the ability to successfully combine technological, content, application and user experience competencies. Because each enterprise can master only a limited set of competencies, the current situation creates a need for complementary resources (Teece, 1988). These complementarities force firms to form new types of alliances, which may sometimes be unexpected. Recently, the Open Handset Alliance was formed in the mobile phone industry. Typically, such alliances have been created to replace and/or compete against existing dominant designs, such as those of Apple.

Typically, the firms that are members of such alliances also complement each other from their intellectual property rights perspectives, i.e., GSM, UTMS and 3G. In the Open Handset Alliance, however, this seems not to be the case: firms do not complement each other from an intellectual property rights perspective because the core asset of the alliance, operating system

software, is offered free of charge. We claim that this is actually the case with the Google operating system because Google is not offering its alliance members a risk-free pathway to the market.

However, the earlier GSM and the later UTMS and 3G alliances have become the first pieces of a complete puzzle. Now, a new piece to the puzzle is added: the operating system software with a rich user experience. Today, the operating system and rich user experience are considered to be dominant designs that shift the control in mobile telephony value chain from hardware towards software and eventually heuristics. This resembles the earlier patterns of convergence from personal computers in the 1980s towards the Internet in the 1990s. As with personal computers, the application business is more of a value creator than a control mechanism.

We base our analyses of new ecosystems on the patent portfolios of Apple, Google, Microsoft and Nokia by focusing on the number of patents, the number of telecom patents, the number of computing patents, the number of software patents, the number of touch-screen patents, and the number of casings and the constructional details of the electronic apparatuses. Based on our descriptive analyses, we conclude that each of these firms tries to secure their existence as a part of the new convergence value chains and ecosystems with their current and joint patent portfolios. In parallel with intellectual property rights discussions, these new alliances are targeted on an economic scale from hardware, operating system and services perspectives. However, the actual content cannot be considered economically scalable and patentable because of its short lifecycle; therefore, the internationalisation of such content is not possible, as it is with hardware and software. There are two main types of content: media-created and consumer-created.

2 Defining an ecosystem

Because of recent changes in firm strategies in the mobile telephony domain, we have good reason to believe that by understanding trends in the hardware and software patent portfolios of Apple, Google, Microsoft and Nokia, we can identify some emerging trends in relation to technology and the new global mobile value chain. There are four fundamental questions that we must answer to expand our understanding:

- How do we define an ecosystem?
- How many patents does each firm have? (e.g., the number of patents, the number of computing patents, the number of software patents and the number of telecom patents)
- What are the key software patent portfolio categories that vertically control the new global mobile value chain by increasing the dominance of operating systems and the user experience? (e.g., the number of touch-screen patents and the number of casings or constructional details of electronic apparatuses)
- How do we define heuristics, heuristics methods and heuristics patenting?

The primary focus of this paper is to address the first and second questions empirically. The fourth question, in particular, addresses the question of where the new competition of the control mechanism of a global value chain will take place. All four questions are also related to the same fundamental question: who will control the new ecosystems?

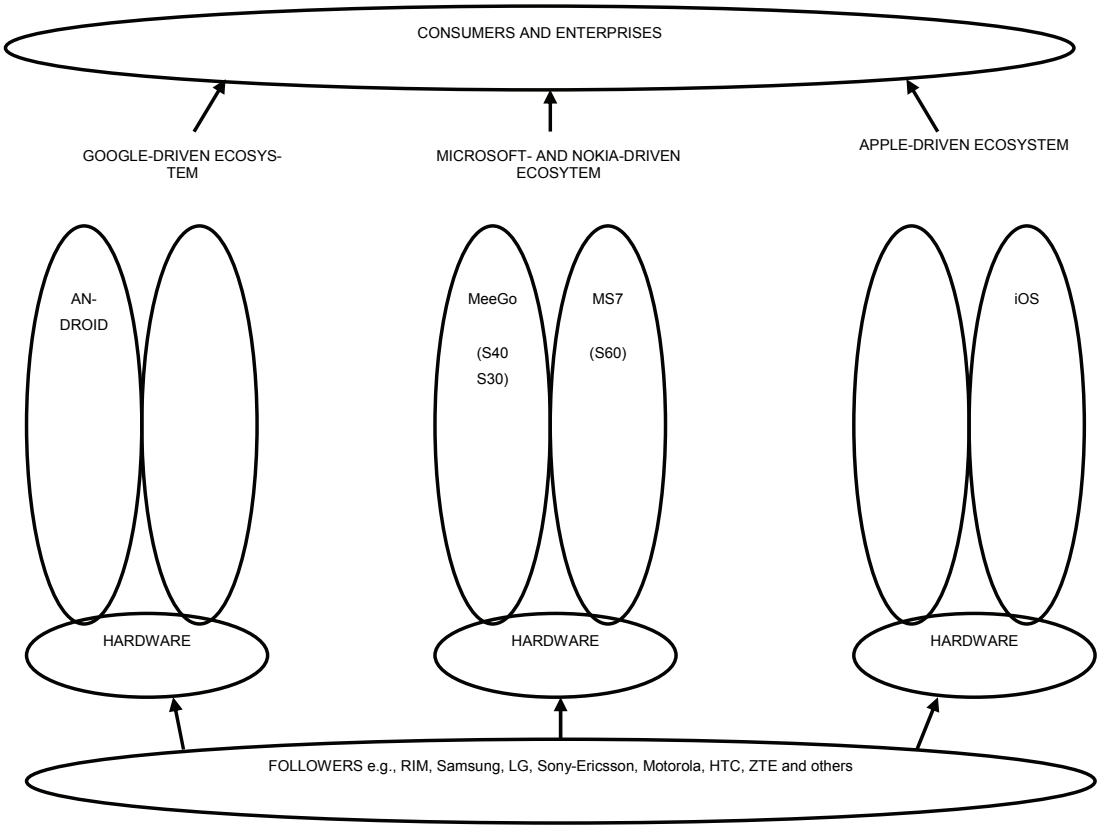
The quantitative analysis is based on OECD PATSTAT data from 2001-2008 (edition dated April, 2011). We have also emphasised on-going court cases and disputes in order to understand the developments of the different ecosystems. The quantitative analysis is supported by interviews and discussions with current mobile industry and value-chain experts.

The paper continues as follows. The next section introduces a background of the current market situation and a definition of an ecosystem in relation to mobile telephony. The third section introduces our methodology and descriptive analyses of patenting trends at Apple, Google, Microsoft and Nokia. Section four includes a definition of heuristics patenting. The final section concludes and discusses the next possible identified convergence.

Using OECD PATSTAT patent data and the current patent disputes in the US, we try to see into the foggy future. We base our ecosystem thinking on three core cellular technology platforms, UNIX (Apple), Linux (Google) and Microsoft (Microsoft and Nokia), and describe how these technologies translate into new cellular technology environments.

Typically, an ecosystem is understood as a firm's collaboration imperative between hardware, software, application and content developers and the distribution channels (Figure 2). Some firms use the intellectual property rights to build co-operation with other firms in a new landscape of business competition (Phelps & Kline, 2009). Often, an ecosystem can be referred to as an alliance managing standardisation (Palmberg & Martikainen, 2005, 2006). Standards can

Figure 2 The new ecosystems



also be defined by the market, and as such, they are called dominant designs (Abernathy and Utterback, 1978). In an ecosystem, intellectual property and alliance strategies complement each other (Teece, 1986; Palmberg and Martikainen, 2006). Here, an ecosystem refers to all firms working together for a new standardisation in the area of operating systems and user experiences that support rich content and applications. An ecosystem includes all key firms from the hardware and software perspectives, such as Intel, Microsoft, Nokia and Samsung. These firms could form the core of a new operating system and user experience ecosystem, similar to Apple, Qualcomm and Samsung or Google, Motorola, Qualcomm and Samsung, supported by the extended role of intellectual property and the access to intellectual property with jointly agreed licensing terms and conditions[1].

3 Methodology and descriptive analysis

3.1 Methodology

In selecting firms for our analyses, we sought to narrow the list to firms that offer operating system software for smartphones and are actively participating in current patent disputes in the US. The result was the four firms listed in Table 1, all of which hold patents related to touch-screen technology.

The logic behind defining the sample through operating system software and on-going patent disputes related to operating systems was to bridge the discussion between today's ecosystems and future ecosystems. We recognise that there are several other firms involved in new ecosystem discussions, such as Intel, Qualcomm and Samsung, but we have excluded these firms.

As mentioned in the introduction, we use OECD patent data from 2001-2008 to capture the patenting trends. We include the number of patents by firm, the number of computing patents by firm, the number of all telecom patents by firm, the number of touch-screen patents by firm and the number of casings and constructional details of electronics apparatus patents

Table 1 Description of firm sample

Name	*Employees in 2010*	*Research and development costs in 2010*
Apple[a]	46.600	1.800 million USD
Google[b]	24.400	3.762 million USD
Microsoft[c]	89.000	8.714 million USD
Nokia[d]	132.427	5.863 million EUR

[a] Apple Inc, Form 10-K (filed 27 October 2010 for the period ending 25 September, 2010).
[b] Google Inc, Form 10-K (filed 11 February 2011 for the period ending 31 December 2010).
[c] Microsoft Inc, Form 10-K (filed 30 July 2010 for the period ending 30 June 2010).
[d] Nokia Oyj, Form 20-F (filed 11 March 2011 for the period ending 31 December 2010).

[1] We largely omit Samsung, Motorola, Intel, Qualcomm, Samsung and others in this paper because they are, at this time, confined to being original hardware manufacturers. All are influential and could successfully compete in the operating system sector, but it is perhaps equally possible that operating system firms will enter the hardware sector or other technology sectors.

Table 2 Concordance table of technology categories, technology classes and other search algorithms[a]

Technology categories	*ICP-classes*	*Other search algorithms*
Computing	G06	
Computing, arrangements for executing subprograms	G06f 9/40	
Telecom	H04	
Touch screen	G09G	Touch
Casings and constructional details	H05K	

[a] Search algorithms were defined based on the Apple patent portfolio.

by firm. Our subjective basis of the technology categories, technology classes and other search algorithms is presented in Table 2. In the table, the traditional computing category is included in IPC class G06, the software category in ICP class G06f 9/40 and the telecom category in IPC class H04. The touch- screen category includes IPC class G09G with the search word "touch" and casings and constructional details of the electronics apparatus category IPC class H05K.

The final step in our methodology was to study the selected key patents based on US patent disputes in the new ecosystem context, because we believe that these patents foster our knowledge related to software and heuristic patenting that the US enables. According to Rivette & Kline (2000), patentable software was legitimised in 1981 (US Supreme Court decision Diamind vs. Diehr[2]). What will happen to heuristic patenting remains to be seen. The US Supreme Court is today substantially narrowing patent rights in comparison to their earlier rulings (Lee, 2010). In parallel with this change, it seems that the US Supreme Court is systematically favouring holistic standards over formalistic, bright-line rulings (Lee, 2010).

3.2 Descriptive analyses: Patenting trends of Apple, Google, Microsoft and Nokia

We approach our analyses of an ecosystem through six different trend indicators in order to describe the changes in intellectual property right strategies of each firm and to point out their areas of concentration: 1) the number of patents by firm, 2) the number of computing patents by firm, 3) the number of software patents of the firm, 4) the number of all telecom patents by firm, 5) the number of touch-screen patents by firm and 6) the number of casings and constructional details of electronics apparatus. Furthermore, based on these five indicators, we are able to quantify the emergence of new ecosystems not only between computing and telecom but also between computing, software, telecom and a rich user experience.

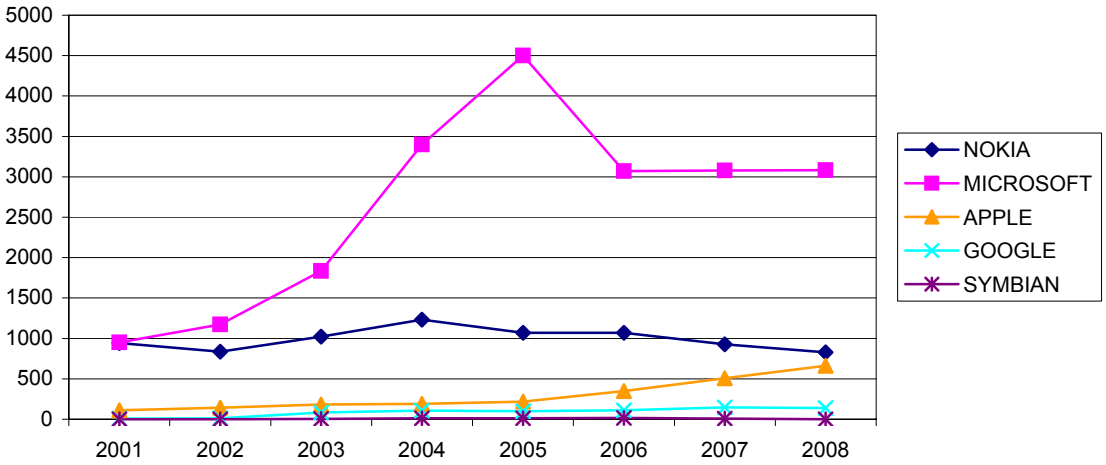
The number of a firm's patents is used as an indicator expressing the changes in the patenting strategies of the firm (see Figure 3). In 2003, former IBM veteran Marshall Phelps joined Microsoft to run its new strategic initiative and related transformations of intellectual property[3]. Today, Microsoft intellectual property is used as a tool to facilitate collaborations among

[2] http://caselaw.lp.findlaw.com/cgia-bin/getcase.pl?court=US&vol=450&invol=175 (information retrieved 5.4.2011).

[3] http://www.microsoft.com/presspass/press/2003/jun03/06-05dgcpr.mspx (information retrieved 6.4.2011).

the different players in the computing and telecom industries. There is a notable change in the number of patents in the case of Apple as well. The changes in other firms' intellectual property strategies are marginal compared to the changes at Apple and Microsoft.

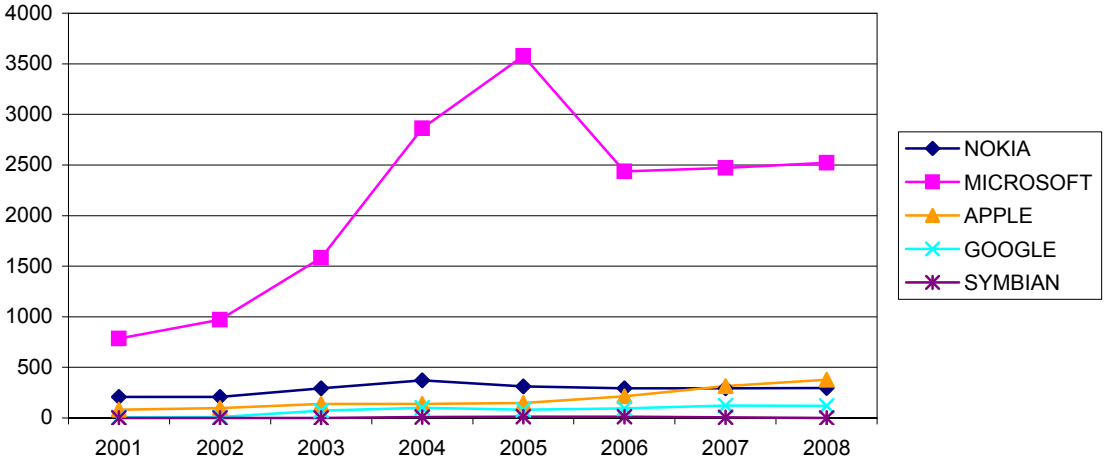
Figure 3 Number of all patents by firm



Source: OECD PATSTAT/ETLA database.

The computing patent portfolios follow the same trend as all patents expressing the dominance of Microsoft (see Figure 4).

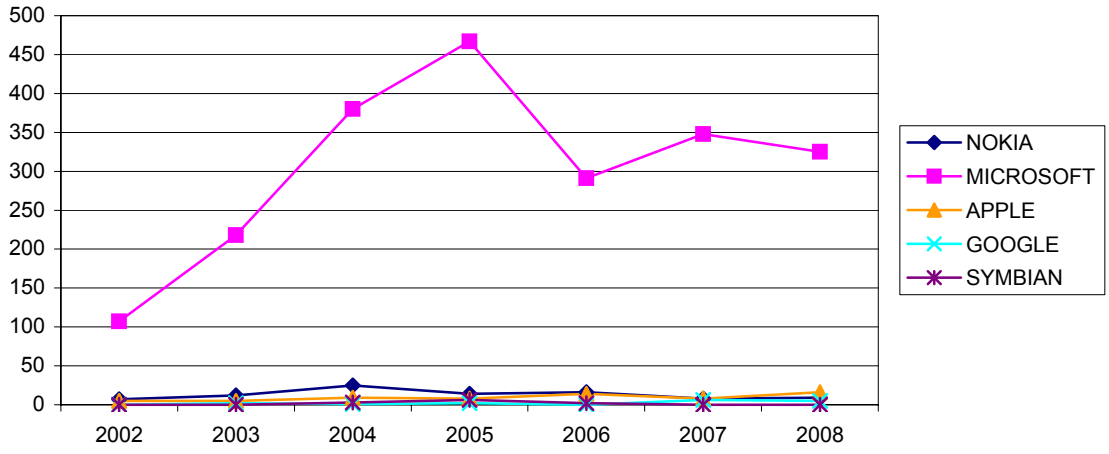
Figure 4 Number of patents by firm / all computing patents



Source: OECD PATSTAT/ETLA database.

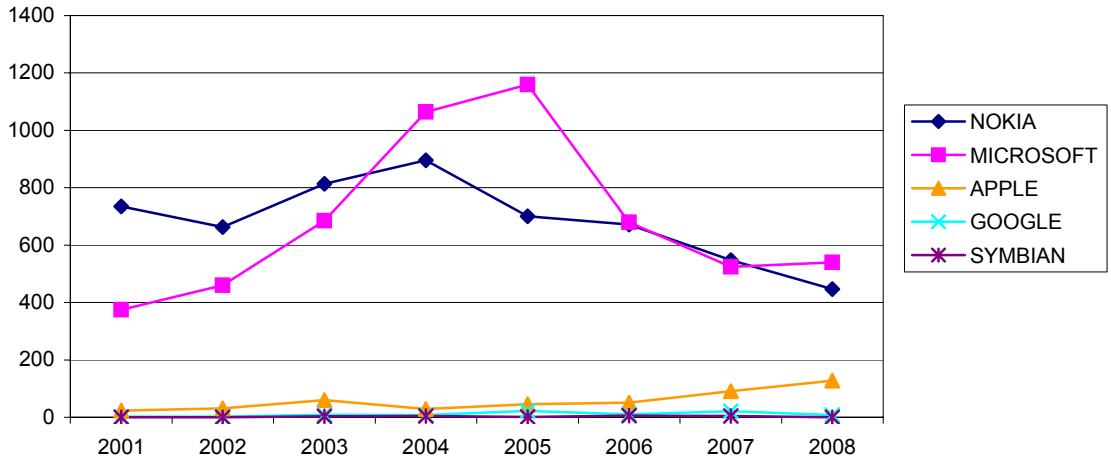
According to Closa et al. (2010), the ability to probe the general patenting behaviour for applications relating mainly to software G06F 9/90 classification should be used as a basis for software patenting analyses. Figure 5 concretises the trends in the patenting of software.

Figure 5 Number of patents by firms/arrangements for executing subprograms



Microsoft intellectual property not only includes computing and software but also telecommunications. Microsoft reached Nokia in telecom patenting in numbers 2004 (see Figure 6). Apple's telecom patent portfolio started increasing in numbers just before and especially after the launch and introduction of the iPhone in 2007[4].

Figure 6 Number of patents by firm/all telecom patents

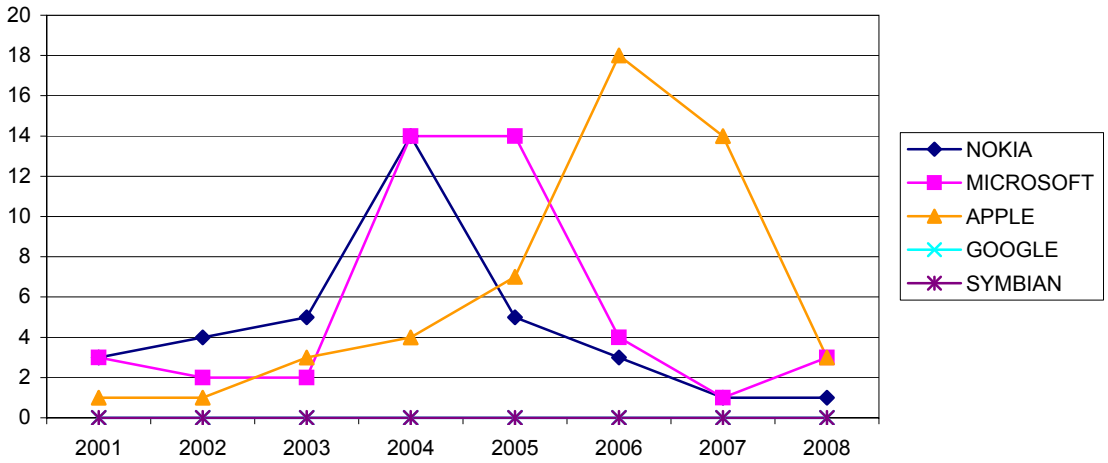


Source: OECD PATSTAT/ETLA database.

The most interesting area in relation to the formation of new ecosystems is the area of touch screens and especially the heuristics patenting related to touch screens and their functionality. In relation to touch screens, we can identify two increasing trends (Apple and Microsoft) and one downsizing trend (Nokia) (see Figure 7).

[4] http://www.apple.com/pr/library/2007/01/09iphone.html (information retrieved 6.4.2011).

Figure 7 Number of patents by firm / touch screen

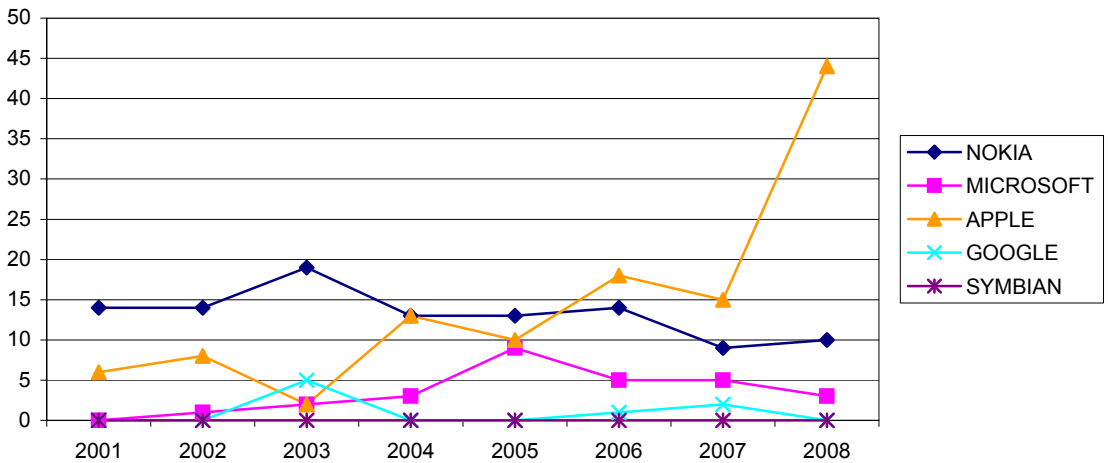


Source: OECD PATSTAT/ETLA database.

Based on current patent disputes in the US (Nokia vs. Apple, Apple vs. Nokia; Apple vs. HTC, HTC vs. Apple, Apple vs. Motorola, Motorola vs. Apple and Microsoft vs. Motorola), we can identify two different types of disputes. Microsoft vs. Motorola is clearly about software. The other disputes are about hardware and heuristics and about hardware and software. It remains to be seen if heuristics patenting will be sustainable in the long run. The first resolution is yet to be seen.

We finalise our analyses by providing the data related to either the casings or constructional details of electronics apparatus patenting information (see Figure 8).

Figure 8 Number of patents by firm / casings or constructional details of electronics apparatus



Source: OECD PATSTAT/ETLA database.

3.3 Patent disputes in the US

To improve our understanding of the latest changes in firms' strategies and new industry alliances in the creation of new ecosystems, we had to consider the latest patent disputes in the US related to mobile operating system software. Relevant starting points are the Nokia vs. Apple and Apple vs. Nokia disputes, in which Apple argues that Nokia violates ETSI licensing terms and conditions. In their response, Apple also states that Nokia does not offer them fair licensing terms and conditions. This is because in return for Apple having the right to use Nokia's intellectual property, Nokia would like to have a licence to use Apple's intellectual property in Nokia's products. Apple does not agree to this idea because Apple would then become vulnerable and lose their competitive advantage by granting Nokia access to their heuristics patent portfolio. This might also be one reason why Nokia has not distributed many touch-and-feel-based technology products in the US market. Outside of the US, the distribution of rich user experience technologies has no similar patent portfolio-based obstacles; unlike the US, Europe does not enable such software-based patenting. Nokia has now merged forces with Microsoft. Moreover, all of these patent disputes help us to identify not only the key patent groups and patents Apple is using as a base for their defence but also the basis for Apple's disputes against the Android operating system. There are also several other on-going disputes[5]. Based on the latest information Nokia and Apple have settled their patent disputes and agreed on partial exchange of intellectual property rights[6].

3.4 Defining heuristics, heuristics methods and heuristics patenting

Heuristics refer to strategies using readily accessible information to control problem-solving processes in humans and machines (Pearl, 1984). Furthermore, heuristic methods are typically used to speed up the process of finding an adequate solution in a man-to-machine interaction, e.g., finding and calculating an optimal middle point on your finger tip while pressing a letter key on your touch-screen keyboard; this includes other similar movements of your fingers, hands and other body parts[7]. In computer science, a heuristics algorithm is the key. Here is one definition:

> *"A heuristic algorithm, or simply a heuristic, is an algorithm that is able to produce an acceptable solution to a problem in many practical scenarios, in the fashion of a general heuristic, but for which there is no formal proof of its correctness. Alternatively, it may be correct, but may not be proven to produce an optimal solution, or to use reasonable resources (Kendre et. al., 2010)."*

Patenting heuristics, in the context of this paper, relates to patenting methods in response to human behaviour. A good example of heuristics patenting is United States patent no. 7,479,949[8], which describes the heuristics content of such patents in general.

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5 http://www.reuters.com/article/2011/04/18/us-apple-samsung-lawsuit-idUSTRE73H6FV20110418 (information retrieved 19.4.2011).

6 http://press.nokia.com/2011/06/14/nokia-enters-into-patent-license-agreement-with-apple/ (information retrieved 17.6.2011).

7 Fingerworks, Unites States patent application: http://appft1.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PG01&s1=Fingerworks.AS.&OS=AN/Fingerworks&RS=AN/Fingerwork (retrieved 6.4.2011).

8 http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PALL&p=1&u=%2Fnetahtml%2FPTO%2Fsrchnum.htm&r=1&f=G&l=50&s1=7,479,949.PN.&OS=PN/7,479,949&RS=PN/7,479,949 (information retrieved 6.4.2011).

In the case of United States patent no. 7,479,949, Apple is not patenting any algorithms. However, Apple is patenting heuristics that include all possible combinations of such algorithms without specifying the internal technical contents of such algorithms. Today, Apple owns several similar types of patents, which have enabled Apple to change the control mechanism in current global value-chain structures.

4 Policy implications for the European patenting mechanism

Leading ICT companies typically start their patenting in the US. This is because the European patenting mechanism is lagging behind, and it is not attractive for multinational enterprises to start their patenting in Europe. That said, it can be seen that the European patenting mechanism does not offer a competitive advantage for European-based multinational firms operating in global value chains opposite to the US patenting mechanism.

Europe needs to react to the current situation soon. If not, Europe faces a situation where most firm patenting activities will move to the US or possibly to Asia. The current competitive advantage that the US patenting mechanism enables, especially in ICT, needs to be narrowed. Furthermore, new enablers who create a competitive advantage, such as heuristics patenting earlier in the US or the patenting of services that is possible in the US, need to be integrated into the new European patenting mechanism. This new European patenting mechanism should enable new innovation and growth instead of stability. If Europe does not act now, it will be too late.

Furthermore, our analysis of the patenting trends of the leading ICT companies indicates that the knowledge of how firms enrol and formulate their patent applications will become increasingly important. Such knowledge can be considered crucial for the future of ICT in Europe. By creating such knowledge in relation to new enablers, a competitive advantage could be regained.

5 Conclusions and discussion

The recent changes in firm strategies and the increasing number of patent disputes between mobile hardware and software firms indicate that the explanation of the controls of new ecosystems must be revised in the near future. The race for the control of new ecosystems has started. In parallel with this race, more firms are learning to exploit hardware, software and heuristics patent portfolios, especially software and heuristics available in the firm or its alliances.

The significance of hardware, software and heuristics patent portfolios in the firm and its alliances will have new meaning not only in the race towards ecosystem control but also in firms' newly written strategies. Due to these changes in market behaviour, the role of hardware-driven firms and their alliance patent portfolios may be diluted, as opposed to those firms and alliances with software and heuristics patent portfolios.

However, one question remains: why does Apple not sue Google as the distributor of the Android operating system? Our conclusion is that Google does not provide legal backup to An-

droid customers from the perspectives of intellectual property and indemnity claims due to its nature as an open-source software business. Furthermore, using an open-source operating system in the US, where software and heuristics patenting is enabled, is risky. This is also true in a situation where a firm sells and distributes products that contain open-source software.

There are two operating system options based on the following two situations 1) Apple not agreeing to trade their patent portfolio with any firm and 2) the risk of getting sued by Apple, Microsoft or any other firm in the US. Either a firm has its own operating system and can back the operating system with intellectual property rights, or the firm licenses an operating system with similar characteristics from someone who is holding an extensive intellectual property right portfolio. Both options apply to the current situation. The current court cases and disputes in the US are expected to be the centrepiece of this action defining the value of each firm patent portfolios, hardware, software and heuristics. Often, these court cases and disputes are used as negotiation tactics. However, in the case of Apple, everything might be different. Earlier, as part of the personal computer convergence, Apple stubbornly kept all of its intellectual property rights to itself, and they were left only with a niche market. Most probably, Apple has learned a lesson from history.

5.1 Change in patenting focus

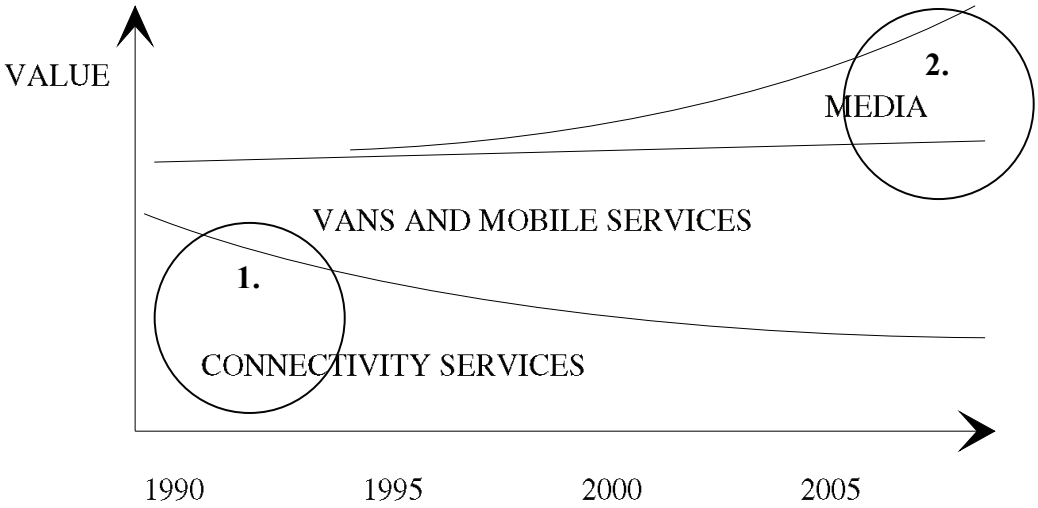
Software and heuristics patenting offers a new and interesting area of investigation. Heuristics patenting, combined with 3D user experience, hardware and other software functionality, offers a field for new battles. These battles may be won by the ecosystem with the most valuable patent portfolio that controls the key features between competing ecosystems.

Earlier, the development of GSM, UTMS and 3G networks was based on common ETSI standards, and patents related to these technology standards were called essential patents. When the GSM mobile networks were adopted, the development proceeded from network and radio technologies toward system and management solutions. The transfer of business value from networks towards services and user-oriented media contents (Figure 1) was already seen quite early (Martikainen et. al., 1984). However, the enabling technologies in mobile devices, such as operating systems and high-performance processors that were powerful enough to run applications and services with rich graphical user interfaces were developed much later.

The patenting in the technological phase of network development was concentrated in the essential patents. Currently, the patenting in the service, application and content phase concentrates more on the features related to the dominant designs that provide the user experience and the ease of use for the application and content users. Such dominant designs include, for instance, touch-screen finger position recognition, finger-movement recognition, multiple finger-movement pattern recognition and the corresponding commands, such as screen scrolling, screen translations and displaying the next items on the screen.

This change in patenting focus has a quite natural explanation. The value in mobile services has moved from basic network and terminal technologies to services, applications and contents. The technologies (Area 1 in Figure 9) were originally standardised, developed and patented by the network and mobile device manufacturers. On the other side, the services are provided by mobile network operators, and the applications and contents by application and

Figure 9 Development of value (1994)



content providers. The applications and contents are sold through mobile devices and operators as distribution channels, and the device manufacturers can control only the user interface and user experience features related to the applications and contents in the device (Area 2 in Figure 9).

Due to these changes in patenting focus, ETSI standards and the patenting systems related to ETSI standards are now lagging behind. To be able to gain back the competitive advantage that ETSI standards offered earlier, new patenting instruments are required to enable the competitive positions of European firms, especially in their home markets. These new instruments should include but not be limited to, rich features, i.e., heuristic and industrial- type patenting, such as the US patenting system allows. These rich features have a strong interdependence with major market failures related to the core features of Internet economies that enable shorter development cycles.

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Appendix: Definitions

Innovation-intensive Schumpeterian competition

Technology development takes place in technological cycles, where new and more productive technological solutions are used after the previous ones (Anderson and Tushman 1990, Shapiro 2000). In information-intensive products and services, the technology cycles are shorter than usual. Schumpeterian competition refers to competition where firms with new innovations win market share from incumbent firms with traditional products.

Technology paths based on IPR and alliance policies

Intellectual property rights (IPR) can broadly be classified into the following two types: R&D subsidies and patents (copyrights) and standards (Stenbacka, 2002). R&D subsidies are an ex ante commitment by the government to share part of the risks associated with investments in innovation. Patents represent an ex post reward directed towards successful innovations. The developer of an innovation faces spill-over risks: the development cost is high but the innovation can later be easily copied. The subsidies and patents lower the risks of the innovator, both in terms of cost and reward.

Standardisation can be from a standardisation organisation. The purpose of developing standards is to create compatibility, interchangeability and common development and testing measures to lower the cost of development and testing and to enlarge the market size. Standards defined by the market are called industry standards, and if a particular product type has a market share over 50%, it is called a dominant design.

Alliances can be formed either to exchange complementary technological knowledge and IPR or to develop common standards.

Technological scale economies: Dominant designs

Technological cycles have two phases: the innovation phase and the imitation phase (Anderson and Tushman 1990). Firms that acquire dominant market positions, such as from a dominant design, enjoy extraordinary rents from the market during the innovation phase. The profit margins are protected by imperfect competition due to inherent technological entry barriers and possible strong appropriability regimes based on IPR. In the imitation phase, the technological and IPR entry barriers break down, and imitating firms can enter the market, which reduces the profit margins.

Switching costs

Switching costs refer to the costs associated with switching the supplier (see Stenbacka 2002). For instance, the user interface of the mobile phone can create substantial switching costs for the user. Types of switching costs include exit fees, search costs, learning costs, equipment and installation costs and financial and other risks.

Network externalities

Externalities in economics refer to costs (negative) or benefits (positive) that are not transmitted through the process (see Shapiro 2000). Network externalities are externalities that are related to products or services whose value increases as more people use them. A typical example of an externality is a telephone or a mobile phone.

Complementarities

Complementary assets are assets that are different from the assets originally associated with the innovation but that are needed to successfully support either the commercialisation or marketing of the innovation (Teece 1988). Complementarities may be complementary assets, infrastructure or capabilities. For example, a mobile network is complementary to a mobile phone.

Asymmetric information

In economics, the term information asymmetry refers to the decisions in transactions where one party has more or better information than the other party (see Stenbacka 2002). This creates an imbalance of power in transactions. On the Internet, it is typical to create businesses based on information asymmetries. For instance, Google is creating value with a search engine that collects information on web pages using an advanced search algorithm.

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