THE STRATEGIC TRADE-OFFS FOR BENEFICIAL OPEN INNOVATION: THE CASE OF “OPEN SOURCE” CONSORTIA IN MOBILE OS DEVELOPMENT

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Abstract:
The trivialization of smartphones has given rise to an architectural reconfiguration of the mobile operating system innovation process. We have also seen the recent emergence of three “open source” consortia: the Symbian and LiMo Foundations, and the Open Handset Alliance. In this exploratory paper, we analyse the coherence of these consortia using an open source framework to perform the necessary reconfiguration at both the technological and organizational level. In order to evaluate the coherence of this strategy, we analyse the ability of these consortia to produce standards. Bearing in mind the exploratory nature of this research, this allows us to demonstrate that, although these consortia exhibit original forms of “open innovation”, they find it difficult to produce consortia standards by means of vertical coordination. Equally, we consider various scenarios dealing with the construction of standards, examining in particular horizontal collaboration between these consortia.

Keywords: platform architecture, standards, mobile operating system, mobile industry, open innovation, open source

JEL codes: L15, L17, L86, L96, O33, O34
Introduction

Three consortia dedicated to the provision of “open source” mobile Operating System (OS) for smartphones emerged in 2007 and 2008: the Symbian Foundation, the Open Handset Alliance and the LiMo Foundation, representing respectively the 1st, 3rd and 6th mobile OS in market shares in 2010\(^1\). These consortia are particularly interesting when addressing the issue of ongoing architectural innovation (Henderson and Clark, 1990) in the mobile industry: the reconfiguration of the system linking existing digital services to fixed and mobile devices, thanks to the trivialisation of smartphones. Consequently, we analyse the coherence for these consortia of using an open source framework, in order to perform the necessary reconfiguration at both the technological and organizational level. This question involves three corpora of the existing literature.

First, at the technological level, the mobile OS is a complex system: a set of components with strong interdependencies, which “constrains the adaptative potential of systems, and, thereby, the possible paths of evolution” (Frenken, 2006, p. 3). In line with Simon (1962), one means of reducing complexity is to hierarchically decompose complex systems into subsystems. This approach is to be found in the transversal definition of platform made by Baldwin and Woodard (2009), which stems from a decomposition in terms of modularity (Baldwin and Clark, 2000), with an emphasis on technological hierarchy. It should be recalled that although platform architecture is still a modular system, it is itself split into a platform as core, together with its complements, interoperability being managed by interface specifications. At the organizational level, collaboration matters for the mobile industry, because such a complex system requires the coordination of innovations from heterogeneous technological fields (Kelly, 2006; Maula et al., 2006). According to Funk (2004, p. 202), “the conventional view is that the design of the architecture and the alliances that firms make with others are the critical issues in platform management.” So, in line with Le Masson et al. (2009, p. 290), we consider a general framework where “a collaborative process of platform design can actually be itself a specific platform; we shall call it a ‘platform for platform design’”. Hence, there is a real interest in analysing these processes at the systemic level, from the very earliest stage, all the more so as the literature has only just started to address this question (Le Masson et al., 2009; Maula et al., 2006; West and Wood, 2008). In other

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\(^1\)Regarding the smartphone sales to end users in second quarter 2010; Source: Gartner, Press releases, August 12, 2010.
words, for Henderson and Clark (1990), architectural innovation requires reorganization and the acquisition of knowledge by firms. This approach presupposes, however, that the available elements are readily divisible, which requires a greater formalisation of activities (Gallouj and Weinsten, 1997, p. 552), the more so as the degree of product decomposability depends on the existing state of knowledge (Buenstorff, 2005).

Second, the characteristics of consortia lead us to operate a selection in the literature dealing with the effect of open source communities on industries. The consortia – as sponsor-based, profit-motivated and involving firms – give echo to the idea of open innovation (e.g. Chesbrough, 2006), because of their open source strategy (West and Gallagher, 2006; West and Lakhani, 2008). Equally, we have to take into account the fact that sponsor-based communities differ from autonomous ones (West and O’Mahony, 2008). We need, thus, a clarification of all these concepts: for Pénin (2008), the definition of open innovation does not take into account knowledge accessibility, which is critical here. However, the consortia emerged as a transition from proprietary to open source models. For Bonaccorsi et al (2006, p. 1094), firms tend to hybridize open and proprietary strategy rather than follow a pure model. This idea is consistent with West (2003, p. 1279): proprietary platform vendors’ strategy evolves from fully proprietary to open standards and, then, to open source, but the strategy is always hybrid (“opening parts”, “partly open”). A certain number of reasons encourage these sponsors to operate this transition: e.g., the market environment (West, 2003), developers’ preference (Sen et al., 2008), users’ involvement in innovation (von Hippel and von Krogh, 2003). Conversely, a transition to open source supposes an effort to redesign the product’s architecture (Baldwin and Clark, 2006; MacCormack et al., 2006).

Third, to judge the coherence of this organizational strategy, we analyse the ability of these consortia to produce standards, because they encourage the provision of complements (Gawer and Henderson, 2007) and, more generally, facilitate coordination (Simcoe, 2006). In line with Coris (2006), the consortia could encourage a hybrid form of standardization in which firms work collectively, rather than relying on the market to produce a de facto standardization subsequent to standards wars or, imposing a de jure standardization (upstream or downstream of the innovation diffusion) (Steinmüller, 2003) on the political and committee-based authorities. This form of standardization supposes a serious involvement of the stakeholders in the interest of the consortium. But while Bonaccorsi et al. (2006) show that free riding is not rational (even in “hybrid” source projects), Shah (2006, p. 1011) shows that, in these projects, “activities that permit value appropriation by the firm are sometimes
detrimental to value creation within the community”. So, it seems that organizational coherence – via the provision of standards – has equally to be adjusted via profit motivation.

Clearly, our work is mainly of an exploratory nature, since the organizational and technological platforms have not reached maturity. In the first part, we situate the consortia against a background of mobile OS platform competition. Then, we present an index of this openness, oriented on knowledge accessibility. To complete this conceptual framework, we analyse the standard creation issue as regards profit motivation coherence. In the second part, when we apply this framework to situating the three consortia in terms of an open innovation context, we note a relative difference among the consortia. We then show that the emergence of collective standards within the platform tends to remain uncertain, due to a divergence of concerns for knowledge sharing and a potential fragmentation for end-users. We conclude by discussing different speculative roadmaps for the emergence of collective standards among consortia.

A Conceptual Framework

The Mobile OS Market Competition

At the end of summer 2005, the New York Times mentioned the acquisition by Google of a Silicon Valley start-up specialized in mobile phone applications: Android Inc. The journalist wondered whether Google was interesting in developing new products for mobile phones. This proved to be the case since, two years later, on 5th November 2007, thirty-four companies (including Google) announced their involvement in the development of an “open platform for mobile devices” (Android) within a new inter-firm organization, the Open Handset Alliance (OHA). However, in January, a similar event happened: the creation of the LiMo Foundation by NEC, NTT DoCoMo Orange, Panasonic and Vodafone (LiMo stands for Linux Mobile). As for the Symbian Foundation, its creation was announced on 24th June 2008, by Nokia, together with AT&T, LG Electronics, Motorola, NTT DoCoMo, Samsung, Sony Ericsson, ST-NXP Wireless, Texas Instruments and Vodafone. But the Foundation had, in fact, to wait until 2nd December 2008, when Nokia obtained full ownership of Symbian Ltd, and contributed the Symbian platform for free to the Symbian Foundation. Symbian Ltd was founded in 1998 by Ericsson, Motorola, Nokia and Psion. It aimed to promote and improve

Symbian, an OS that stemmed from a former PDA OS: EPOC, the OS of Psion’s handheld devices.

The consortia are not, however, the only providers of mobile OS. According to Gartner (Table 1), there are six mobile OS for smartphones active today. The BlackBerry OS is provided by Research In Motion (RIM), a firm which provides both the BlackBerry smartphone and its OS. RIM has a long experience in connected mobile devices, since it provided in 1995 the Inter@ctive Pager, capable of sending and receiving text messages through a specific wireless network, Mobitex. This trajectory is very different from that of Apple or Microsoft. Apple launched its PDA, the Newton, in 1993, but exited the market in 1998, without any real commercial success. At the same time, Microsoft has been active on the PDA via the Pocket PC and its OS (Windows CE), since 1996. Microsoft never left the mobile OS market, continuously improving its Windows CE, known as Window Mobile, since 2003. Apple returned to this market only in 2007, launching the iPhone and its OS (iOS).

<table>
<thead>
<tr>
<th>Operating System</th>
<th>2nd Quarter 2010</th>
<th>2nd Quarter 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>units</td>
<td>market shares (%)</td>
</tr>
<tr>
<td>Symbian</td>
<td>25,386.8</td>
<td>41.2</td>
</tr>
<tr>
<td>BlackBerry OS</td>
<td>11,228.8</td>
<td>18.2</td>
</tr>
<tr>
<td>Android</td>
<td>10,606.1</td>
<td>17.2</td>
</tr>
<tr>
<td>iOS</td>
<td>8,743.0</td>
<td>14.2</td>
</tr>
<tr>
<td>Windows Mobile</td>
<td>3,096.4</td>
<td>5.0</td>
</tr>
<tr>
<td>Linux⁴</td>
<td>1,503.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Other OSs</td>
<td>1,084.8</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61,649.1</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Table 1: Worldwide Smartphone Sales to End Users by Operating System in 2Q10 (Thousands of Units)⁵

Any evaluation of the former trajectories and actors of the mobile OS reveals a relative diversity which requires smartphones - and consequently, their OS - to be situated within the digital technology system. Put concretely, the mobile service (as seen by end-users) “has to match with a quintuple layer of specifications” (Feijoo et al., 2009, p. 287): (i) the handset;

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⁴ There are many mobile OS based on Linux, including LiMo.
⁵ Source: Gartner, Press releases, August 12, 2010.
(ii) the mobile OS; (iii) the application which runs the service; (iv) the wireless technology; and, (v) the operator’s mobile system (portals, billing system …). It is all this which constitutes the specificity of mobile OS for smartphones: the OS operates the technological coordination between the hardware and software layers (as it does for computers), but it also requires competences peculiar to the mobile handset and mobile network. The sheer range of the relevant knowledge explains why one single firm is unable to manage everything, while the different types of collaboration help to juggle with the growth of specialized knowledge, the diversity of complementary knowledge and the variations in technological opportunities (Powell and Giannella, 2010, p. 580).

**How to Pin Down Open Innovation?**

For software firms, open source projects now have a major interest in ensuring such collaborations, but this is not the only concept if we choose to delve into the *open versus closed* debate. Pénin (2008, p. 8) retains three dimensions, based on the definition of *collective invention*, to establish whether a project corresponds to *open innovation context*. His definition is particularly appealing for our project, because of its focus on knowledge provision and sharing, critical for *architectural innovation*. We, therefore, use it to construct an index to schematize the multi-dimensional trade-offs between open and closed innovations, in terms of mobile industry specificities.

The first dimension – “*voluntary knowledge disclosure*” – echoes the global tendency towards knowledge sharing displayed by the computer industry, particularly for digital platforms like the OS. Microsoft, for instance, “*released considerable information on the interfaces to help other firms build software applications and compatible computers and networking systems*” for Windows (Gawer and Cusumano, 2002, p. 13). However, not all knowledge is transferable, *qua* information (Nelson and Winter, 1982, chapter 4); it requires a certain amount of translation via a shared codebook, as well as the skills needed to understand it. Grimaldi and Torrisi (2001, p. 1427) apply this idea to the software industry: knowledge is “*articulated codified*” and “*unarticulated codified*” when, the codebook is, respectively, transparent among epistemic communities or inside one epistemic community; and knowledge is “*unarticulated uncodified*” when located in individuals (leaders), organizational routines or processes. However, Brusoni *et al.* (2001, p. 600) encourage us to discuss the boundaries of epistemic communities, in the case of industries devoted to multitechnology

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and multicomponents products, because of the “gap between what they make and what they know”. Taking all this into account, openness depends on the means designed to perform knowledge disclosure.

The second dimension – “openness of knowledge” – raises the question of the legal ownership of knowledge: does every claimant have access to knowledge? The proprietary versus open source strategies define the scope for digital platforms. To some extent, using legal tools to appropriate knowledge (like patent and copyright) supposes a relatively public disclosure of knowledge. For Shapiro (2000), however, this strategy encourages the emergence of a “patent thicket”, increasing the probability for a new product (particularly, its complements) to infringe on multiple patents. For this researcher, the problem may be solved by collaboration, such as patent pools and cross licences. This form of collaboration, which reposes on “partial” licensing of modules from platform architecture, has major effects on competition (Bourreau et al., 2007, p. 183). Open architecture, on the contrary, supposes that all the knowledge produced is accessible to everybody. Hence, the domain of intellectual property is a major index for judging openness (Powell and Giannella, 2010). At the same time, its influence varies with its position in the platform architecture. For instance, openness at the platform (core) level provides a good picture of co-opetition (Nalebuff and Brandenburger, 1997): cooperation on platform standards, competition on complements.

Thirdly, knowledge has to be continuously extended by “ongoing interactions among stakeholders”, via “frequent interactions and collaborations among as diverse participants as possible”. In an industrial world of de-integrated firms, due to the rise of modularity in technology and in organization (Baldwin and Clark, 2000), the concrete form of these interactions, outside the boundaries of the firm, is a central issue. For open source communities, Raymond (1999) puts forward two organizational structures: hierarchical, the Cathedral, which involves few or more stakeholders according to the stage of software development; and, non-hierarchical, the Bazaar, when participation is open to everybody, all the time. O’Mahony and Ferraro (2007) show that hierarchies – based on meritocracy – emerge and evolve inside the open source communities. However, in the presence of sponsors, the interaction quality changes (Shah, 2006; West and O’Mahony, 2008). In this way, the leader’s reputation is a major issue, because its unfair action may deprive the community of the collective innovation, especially if it attempts to compete commercially with the other stakeholders. Consequently, while the non-sponsored open source communities benefit from the participation of hobbyist developers, in sponsored ones, the developers are more incentive-oriented. Hence, in a “platform for platform design” perspective (Le Masson
et al., 2009), because of the volatility and heterogeneity of the interactions, we have also to examine whether the interactions are between individuals or firms; being surrounded by incentive-based employees reduces hobbyist involvement even more.

**The Standards Settings as a Proxy of Organizational Coherence**

At the organizational level, a first source for weakening the platform coherence is the opposing visions of its stakeholders about revenue origin: network, or services (Maitland, 2006). For telecommunications incumbents, the whole stack of layers must be coordinated (vertical standardization) in order to provide services “Here, now”: i.e., services which derive their functionalities from the network (e.g., location-based services, videophony, etc.). This vertical standardization gives the best results in terms of security, mobility and service efficiency, since the network is the source of revenue. However, for firms coming from software, Internet and media, the mobile phone is only a new box for their products. Because of the services already adopted on desktop and laptop computers, these firms favour horizontal standardization inside a technological layer, to provide their services “Anytime, anywhere”.

However, the mobile OS, compared to desktop computers, is particular, because it needs better integration with both the device and the end-user service (Funk, 2001) to enjoy the easiest access to the embedded mobile services (Kelly, 2006). But neither the position of the mobile services within the digital technology system, nor the users’ preferences are established. In order to manage these oppositions and uncertainties, mobile OS need the support of systems integrators, i.e. “companies that rely on wide and dispersed networks of suppliers of specialised components and capabilities, yet maintain broad and deep in-house capabilities” (Brusoni et al., 2004, p. 5). In concrete terms, the system integrator has to manage the standards setting and selection process to provide the technical compatibility enabling interorganizational coordination (Steinmuller, 2003).

These system integrators follow various strategies in the mobile OS competition. A major distinction may be made “between giving up control over the platform and simply granting access to the platform in order to open up complementary development” (Boudreau, forthcoming). For Apple and RIM, the system integration is performed in-house: there is no licensing of their mobile OS to competing handset manufacturers; only the interfaces are
opened up to complement developers for relatively cheap fees to obtain the SDK\textsuperscript{7} and have access to their online application stores. This is the same for Microsoft, which licenses its mobile OS to handset manufacturers: in 2005, Microsoft mainly worked in partnership with original design manufacturers (oriented to low-cost handsets), but it also managed to make profitable collaborations with Mobile Network Operators (MNO), which have the necessary skills and exercise power all over the vertical partners (Evans et al., 2006, p. 195). Hence, the standards architecture (for accessing the platform) is managed by a single system integrator, according to its vision in terms of horizontality, verticality and platform evolution. For open platforms, because of their organizational architecture, standardized interfaces within the platform help coordination without hierarchical authority, as integration increases transaction costs when the community grows. Meanwhile, by rallying open multitechnological knowledge, the consortia can produce collective standards and, thereby, provide system integration consistent horizontally, vertically and evolutionarily.

But, in a consortium made of potential competitors, this strategy is at the expense of differentiation. Furthermore, in firm networks, for Garud and Kumaraswamy (1995) the distinction between horizontal or vertical interactions become blurred because of knowledge sharing, since former vertical complementors may become horizontal competitors. Hence, beyond the network or service as a source of revenue, the standardization process depends also on stakeholder trade-offs: either end-users are encouraged to adopt the collective platform or else one particular company’s own components. For instance, Tee (2010) reminds us that during the 1998-2008 period, cooperation on the Symbian OS and competition on the user interface induced a fragmentation of the system for end-users. Consequently, technical compatibility standards and system integration matter also at the mobile OS competition level. For Schilling (2009, p. 208), three primary factors explain why end-users acclaim one particular platform (characterized by network externality effects) rather than another: “(i) stand-alone functionality and performance; (ii) size of the installed base; (iii) availability of complementary goods”. The average technical performances of handsets (i) are enhanced, thanks to the trivialization of smartphones. So, new opportunities appear for firms able to encourage synergy / interoperability between the different platforms they own, particularly, between desktop and mobile devices. This means that, thanks to interoperability (Besen and Farrell, 1994), there is a better portability of end-user contents and its ensuing bandwagon effect (resulting from the direct network externality with “desktop-installed” base), thereby

\textsuperscript{7} The Software Development Kit gives the main tools and information for producing applications, services and contents complementary with the platforms.
attracting a vast community of developers and media/software providers. The point is to “mobilize” the installed base of end-users (ii). This idea is reinforced by the economic models underlying the provision of complementary goods (iii). For Evans et al., (2006), platforms follow an original pricing strategy, via the concept of *multisided platforms*. For instance, in mobile handset history, this strategy was followed by Palm: in 1996, it released the Palm OS SDK under a royalty-free license, disclosing the source code of certain applications (to guide developers in software writing). This encouraged the registration of 400,000 developers providing 26,000 applications, under Palm’s standards. Hence, the platform (Palm OS) took advantage of a virtuous circle in which the provision of applications was subsidized by Palm PDA sales, themselves accelerated by the provision of applications, and so on. For smartphones, the handset manufacturers follow the example of Palm: they subsidize online application stores to sell devices (phones, tablets, computers, and so on). The mobile network operators subsidize handsets to increase the use of networks. Equally, Google has a strong market share in Internet services. By transposing these services onto mobile devices, it secures its on-line advertising model. Consequently, fragmentation may occur when many firms have control of platform evolution and implementation, because the stakeholders have opposing visions of which side subsidizes the other side.

**The Consortia: Open Innovation in Progress?**

In order to further explore the issues shown in the first part, we need now to focus on the consortia. That is why we have collected data portraying the consortia’s membership on 15th June 2010, as well as information available from consortia’s websites about their strategies.

**The Consortia: from Philosophy to Practice**

Each consortium respects the open source philosophy: from the outset, LiMo was a Linux offshoot under Foundation Public License (FPL); the OHA announced its code source availability on 21st October 2008, under Apache Software License (ASL) 2.0; and the Symbian platform code was released in open source, royalty-free, under the Eclipse Public License (EPL) 1.0, on 4th February 2010. In addition, from a purely technological perspective, mobile OS is software. Therefore, most of the knowledge is incorporated in the code and its documentation. To extend the disclosure of knowledge, the consortia made extensive use of knowledge diffusion tools, providing substantial information via their respective websites, meetings, developer forums and blogs.
Nonetheless, the fact remains that “open source philosophy” can be interpreted in several ways\(^8\): hence, the use of “hybrid” licensing strategies. For Lerner and Tirole (2005), the choice of a particular license refers to specific project characteristics, because the license architecture marks the boundaries of platform use and evolution. We can simplify this question via the concept of *copyleft*, referring to commercially-based contributions. By definition, “*copyleft is a general method for making a program (or other work) free, and requiring all modified and extended versions of the program to be free as well*”\(^9\). Under this definition, Android’s ASL 2.0 is non-copyleft. In line with Pénin (2008, p. 3), there is both “*strong and weak openness*”, depending on whether the stakeholders have to ask permission, or not, to access a resource. In this sense, Symbian’s EPL 1.0 is weak copyleft since “*only the owner of software can decide whether and how to license it to others*”\(^10\), and LiMo’s FPL is copyleft, but for Foundation members only. Hence, even if the knowledge is available via open source, there are various conditions concerning its use.

These conditions refer to the organizational construction of the consortia. Table 2 gives statistics on the consortium members for two characteristics: membership level and sector. Our initial focus is on the membership level, which echoes the points put forward to analyse the open innovation context of stakeholder interactions in the first section. As regards membership, we notice, first, the contrasted attractive power of consortia, consistent with the respective market share of each platform. But it is membership hierarchy which constitutes the most significant factor. For Symbian, only Board members have an automatic seat in each council. The idea is that “*the Foundation will operate as a meritocracy, with board and council membership allotted based on contribution to the platform*”\(^11\). There are four councils which guide the evolution of the platform in different aspects. LiMo operates hierarchically too, since the Core and Founder members hold almost all the seats in the Board of Directors and the three Councils. There is no such distinction in the OHA. In fact, while the Alliance also supports the diffusion and enhancement of Android, the technical directions are given directly by the Android Open Source Project (AOSP), managed by Google employees.

This can be explained by the organizational profile of these consortia as *systems integrators* which aim to develop and give the direction of a core platform, as well as to give the roadmap and support for the provision of complements. These concerns correspond to the

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proposition of West and O’Mahony (2008, p. 151) to distinguish two types of openness, in the case of sponsor-based organizational architectures: transparency, which “allow[s] to understand what is happening” and “allow[s] use of the final product, the source code” and; accessibility, which “allow[s] to influence the direction of the community”. In the three consortia, every member benefits from transparency, but only those members who have Board and Council seats may influence the direction of the LiMo and Symbian platforms, or Google in the case of Android. Meanwhile, in the three consortia, the contributions follow different hierarchical steps according to their “size” and to their location within the platform architecture. Put simply, the more the contribution introduces a radical evolution, and the closer it is to the platform core, the more the contribution’s adoption involves hierarchical levels.

<table>
<thead>
<tr>
<th>Consortium</th>
<th>Mobile Network Operator</th>
<th>Handset Manufacturer</th>
<th>Semiconductor Company</th>
<th>Software or Content Editor</th>
<th>Software Solutions Provider</th>
<th>Research Institute</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total</td>
<td>including core and founder members</td>
<td>total</td>
<td>including founders</td>
<td>total</td>
<td>including core and founder members</td>
<td></td>
</tr>
<tr>
<td>Symbian</td>
<td>12 (6.42%)</td>
<td>7 (30.43%)</td>
<td>12 (16.44%)</td>
<td>7 (21.21%)</td>
<td>12 (25.53%)</td>
<td>6 (42.86%)</td>
<td>187</td>
</tr>
<tr>
<td>OHA</td>
<td>16 (8.56%)</td>
<td>6 (26.09%)</td>
<td>17 (23.29%)</td>
<td>3 (9.09%)</td>
<td>9 (19.15%)</td>
<td>4 (28.57%)</td>
<td>69</td>
</tr>
<tr>
<td>LiMo</td>
<td>11 (5.88%)</td>
<td>4 (17.39%)</td>
<td>21 (28.77%)</td>
<td>9 (27.27%)</td>
<td>4 (8.51%)</td>
<td>0</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>40 (21.39%)</td>
<td>1 (4.35%)</td>
<td>7 (9.59%)</td>
<td>7 (21.21%)</td>
<td>8 (17.02%)</td>
<td>2 (14.29%)</td>
<td>145</td>
</tr>
</tbody>
</table>

Table 2: Consortium members by main activity

These concerns correspond also to the location of interactions: the three consortia combine the joint work of independent firms, but interactions appear at the individual level, too. The Symbian Foundation, which is owned by its members, is not a company, since its objective is not to produce innovation; only the members (firms or individuals, according to the “size” of the contribution) are the real innovative contributors\(^ {12} \). The philosophy is similar

\(^ {12} \) See http://blog.symbian.org/2010/02/08/package-owners-committees-contributors/
for LiMo, except that most of the platform modules and complements are direct implementations from “desktop” open source projects (e.g. Linux for its kernel, Eclipse for its SDK), thus following their own innovation trajectory. In this perspective, the OHA seems merely a hollow shell: only five firms joined the OHA during the 2009-mid 2010 period, and the AOSP structure favours individual developer registration rather than third-party company support. Equally, at the management level, Symbian and LiMo have a dedicated staff made up, respectively, of former and present employees of the consortium members. For the OHA, as well as the AOSP, only Google employees are concerned. Last, but not least, the right to distribute the platform commercially varies with each consortium. This is important, since it is this right which dictates the particular handset devices shipped by the platform. This right is restricted to Foundation members for Symbian, and to core and founder members for LiMo. Meanwhile, the AOSP philosophy is to “welcome all uses of the Android source code, but only Android compatible devices - as defined and tested by the Android Compatibility Program - may participate in the Android ecosystem”\(^{13}\).

### An Undecided Involvement on Vertical Cooperation within Platforms

Table 5 (in Annex), which summarizes the explicit characteristics of the consortia, shows some major differences between the projects. But, in our analysis, these aspects should not minimize the importance of profit motivation. First, it seems that the (evolving) difference in openness among the projects refers to the “tension between control and openness” (West and O’Mahony, 2008, p. 155): thanks to control, the platform sponsors “assure ongoing alignment between their investment in the community and related product goals”, while with openness, they “win greater external participation and technological adoption”. In fact, some components of the platforms are open source but, in every consortium, the trade-off between open and proprietary licensing is largely at the discretion of the components’ contributor. For instance, the AOSP explains its license choice by the compliance with the handset manufacturers’ issues: ASL 2.0 (non-copyleft) is more adopted for the commercial diffusion of the platform, particularly since the handset manufacturers do not have to ship the source code on handsets (only via Internet), nor to allow the modification and reverse engineering of their contributions. This example emphasizes the distinction between the openness of the innovation process and the openness of the end product of innovation (Simcoe, 2006). In fact, our dataset (Table 2) shows that the OHA lacks handset manufacturer involvement at the

\(^{13}\) [http://source.android.com/faqs.html](http://source.android.com/faqs.html)
foundation stage. Licensing flexibility demonstrates OHA’s will to attract handset manufacturers, thanks to upstream knowledge disclosure and the relative freedom to share or not downstream innovation. This corresponds to the fragmentation scenario shown in the theoretical part: there is no move towards collective standardization (Coris, 2006). This strategy is also at the expense of echoing an open source community, since such a strategy frustrates developers motivated by social benefit (Sen et al., 2008).

Thanks to his industry overview, Yamakami (2009) gives us an interesting (sector-based) economic explanation of firms’ commitment to openness: (i) for semiconductor manufacturers, the mobile OS is a non-core part of their competence; (ii) for network operators, this enables a “discount war”, a smart strategy when a market reaches maturity; and (iii) for handset manufacturers, this helps to transfer the growing production cost of software platforms, as well as giving a greater readability of platform evolution. Concretely, besides the leading role played by Nokia, in the early days of the Symbian Foundation, its operating expenses were covered by the three device manufacturers (Nokia, Samsung and Sony Ericsson) of the Board. Similarly, as regards the sectoral distribution of the core and founder members, we can see a clear leadership of the mobile phone incumbents (i.e. handset manufacturers and mobile network operators), while the Foundation attracts mainly software sector firms. Likewise, the LiMo Foundation exhibits an overrepresentation of mobile phone incumbents, particularly that of Mobile Network Operators (MNO). This bias is due to its involvement with the Wholesale Application Community (WAC), a community made up of the main mobile network operators.

In a nutshell: the consortia leaders overtly want platform integrity by means of vertical cooperation. However: (i) the only tool to prevent fragmentation is the hierarchical selection for contribution; (ii) the legal structure authorizes free riding; (iii) sectoral concerns exhibit a preference for openness in term of “free beer” rather than “free speech”. Consequently, the “platform for platform design” does not guarantee the emergence of collective standards within the platform.

Discussion: Towards Horizontal Cooperation between Platforms?

Such a standardization dynamic may appear horizontally, via compatibility standards shared between platforms for specific layers. For instance, Nokia sponsored the Open Mobile Architecture Initiative (OAI), which gave birth to the OMA in 2002, by merging with the
WAP Forum. This organization is in charge of the definition of mobile standards at every layer: it is a standard committee (Farell and Saloner, 1988). For Steinbock (2003), since Nokia had no strong horizontal advantage, it encouraged collaboration on standards, in order to weaken competitors who staked everything on horizontal technology. Equally, since March 2010, the WAC and LiMo have united their efforts, merging various mobile platform projects within an open architecture. This helps us understand the platform involvement of MNO. In fact, via the WAC and the technical support of LiMo, they aim to produce an open platform as open standard in order to remove fragmentation, which is detrimental for their revenue. That could also explain why LiMo has no mobile application store: rather, it promotes the transposition of “desktop” open source applications. Thus the WAC, associated with the W3C\textsuperscript{14}, aims at becoming a standard committee of the mobile Internet, with the ability to impose standards on other platforms. We hypothesize two reasons for such standardization involvement. First, the MNO have accumulated a stock of technological competence by developing their own platforms (i-mode, Vodafone Live!...), as well as having spent money and energy designing them. So they probably do not accept their investment going to waste. Second, in line with Odlyzko’s (2001) hypothesis, we can assume that “content is not king”. In fact, the MNO are the main gates for reaching end-users and they have a market power far greater than any other mobile industry actor.

<table>
<thead>
<tr>
<th></th>
<th>Symbian</th>
<th>OHA</th>
<th>LiMo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total</td>
<td>including core and founder members</td>
<td>total</td>
</tr>
<tr>
<td>Three Memberships</td>
<td>14 (7.49%)</td>
<td>8 (34.78%)</td>
<td>14 (19.18%)</td>
</tr>
<tr>
<td>Two Memberships</td>
<td>25 (13.37%)</td>
<td>10 (43.48%)</td>
<td>23 (31.51%)</td>
</tr>
<tr>
<td>Total</td>
<td>39 (20.86%)</td>
<td>18 (78.26%)</td>
<td>37 (50.69%)</td>
</tr>
<tr>
<td>Foundation Member</td>
<td>187 (100%)</td>
<td>23 (100%)</td>
<td>73 (100%)</td>
</tr>
</tbody>
</table>

Table 3: Multiple Platform Memberships

Beyond purely theoretical suppositions, we assume that this issue gains clarity by an analysis of multiple platform membership as a horizontal diffusion channel for the open knowledge produced within the consortia. In our first analysis, we studied the 307 members of the three consortia but, when all of these are combined, we find only 248 firms. In fact, 31

\textsuperscript{14} A standard-setting consortium of the World Wide Web.
firms are members of two consortia, and 14 firms belong to all three. In a standard-setting approach, we have to outline the profile of these potential bridges. First, Table 3 and Table 4 give some statistics about this issue, and Figure 1 gives an overview via a network graph.

<table>
<thead>
<tr>
<th>Mobile Network Operator</th>
<th>Multiple Memberships</th>
<th>Total Membership</th>
<th>Ratio Multiple / Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 (20%)</td>
<td>22 (8.87%)</td>
<td>40.91%</td>
</tr>
<tr>
<td>Handset Manufacturer</td>
<td>8 (17.78%)</td>
<td>30 (12.10%)</td>
<td>26.67%</td>
</tr>
<tr>
<td>Semiconductor Company</td>
<td>9 (20%)</td>
<td>24 (9.68%)</td>
<td>37.5%</td>
</tr>
<tr>
<td>Software or Content Editor</td>
<td>5 (11.11%)</td>
<td>50 (20.16%)</td>
<td>10%</td>
</tr>
<tr>
<td>Software Solutions Provider</td>
<td>14 (31.11%)</td>
<td>119 (47.98%)</td>
<td>11.76%</td>
</tr>
<tr>
<td>Research Institute</td>
<td>0</td>
<td>3 (1.21%)</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45 (100%)</strong></td>
<td><strong>248 (100%)</strong></td>
<td><strong>18.15%</strong></td>
</tr>
</tbody>
</table>

Table 4: Multiple Memberships and Membership Distribution by Sector

From the consortium perspective, we see clearly that multiple memberships are frequent, particularly for core and founder members. For standard settings, this could be understood in four very different ways: (i) multiple memberships increase convergence among the mobile OS consortia, thanks to inter-consortium knowledge diffusion and imitation; (ii) members assume that the platform variety will last and, consequently, multiple membership will open multiple markets; (iii) members expect that one platform will become a leader but, as they do not know which this will be, they are involved in all consortia; and (iv) a quest for complementarities among consortia, i.e. the members operate a labour division among the consortia, each consortium developing its competences on particular technological layers. Furthermore, we can also explain a part of the multiple membership strategy by introducing the factor of switching costs. The transition from closed to open – carried out by Symbian and promoted by Android and LiMo – leads the actor to invest in new technological and organizational competences: without horizontal standards shared between consortia, it would be too expensive to be involved in every platform. This, therefore, makes it easier to participate in competing projects, which all exhibit the same characteristics of openness.
From the sector perspective, if we look at the centre of Figure 1 we can see the dominance of network, handset and semiconductor sector firms. In fact, they dominate both platform leadership and multiple memberships (see Table 2 and Table 4), while only 30% of consortium members belong to these sectors. This could demonstrate a stronger involvement by the hardware side of the mobile industry, compared with that of content and software providers. For Yamakami (2009, p. 4), “considering this complicated stakeholder relationship, it should be noted that the mobile platform initiatives are still in an early stage and major players are struggling to identify the right standing position.”

Overall, one can question the durability of these consortia. Collaborations on mobile OS may be restricted to initiating the dynamic of co-evolution between platform adoption and the provision of related services, i.e. to solve “the chicken and egg problem”. From a vertical perspective, collaboration is useful to transform the indirect network externality (the provision of valuable services) into scale economies at platform level (Varian, 2004). Klepper (1997) defends collaboration as having a transient stage in the product life cycle: the technological stage of a sector determines its organizational structure (disintegrated or integrated). Gille (2007) shares this idea for the mobile industry: the various complement providers are at different stages, hence their heterogeneous interest for disintegration. One reason to break this

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15 The object size refers to the number of links: small = 2, large = 3. For readability, firms are pooled by sector and membership similarity.
dynamic could be the revenue issue: is there a real economic model underlying consortia? or are firms simply setting aside their profit for the time being? For Greenstein (2010, p. 501): “intertemporal externalities also lead to divergence between private costs and benefits and industry-wide costs and benefits”. However, faced with strong uncertainty about potential success, collaboration helps to protect against potential loss (Powell and Giannella, 2010) and to add unanticipated complements.

Summary, Limitations and Future Research

In this work, we analyse the three main “open source” consortia dedicated to mobile OS. Thanks to this analysis, we find that open innovation is subject to various implementations according to its stakeholder concerns, with consortium leaders overtly trying to ensure platform integrity via vertical cooperation. However: (i) the only tool to prevent fragmentation is the hierarchical selection for contribution; (ii) the legal structure authorizes free riding; (iii) sectoral concerns exhibit a preference for openness in term of “free beer” rather than “free speech”. Consequently, the “platform for platform design” does not guarantee the emergence of collective standards within the platform. Finally, in the discussion, we analyse various scenarios concerning a transfer from vertical standardization (inside consortia) to horizontal standardization (between consortia).

Here, by focusing on the link between innovation and related organizational structure, and using the term “consortia” generically, we leave aside the diversity of interactions between the firms inside and outside the consortia. Likewise, because of the paper’s exploratory nature, some facts refer to the consortia’s philosophy rather than to observable acts. Consequently, there is ample scope for many more future research roadmaps: the profile of individual contributors is not analysed, and nor is that of the firms’ real contribution; what fragmentation of platforms can be observed on the markets?; to what extent, do the relationships between firms outside the consortia impact the evolution of platforms and stakeholders? This allows us to envisage our future research in two directions. First, thanks to the amount of information provided by the consortia, the network and econometrical analysis could be greatly improved, particularly at the technological level. For instance, we are considering an analysis of the concrete technological modules shared between the consortia: what standards are spreading among the consortia, and who are their providers? Similarly, multiple membership could be explored by studying the evolution of the relationship between firms other than mobile OS providers. This evolution is also significant in terms of the entry and exit of firms from the consortia: the consortia membership is evolving, and this evolution
requires further analyses. The second direction for future research concerns the need to develop a model for agent-based simulation, in order to analyse the various strategies involving mobile OS provision. This paper has attempted to bring to light a complex (horizontal, vertical and hierarchical) strategy, one which is rarely investigated as a whole using agent-based modelling.

Acknowledgment

I would like to thank the anonymous referees and the editors for useful criticisms and suggestions. I will also like to thank Marie Coris for her support throughout the elaboration of this paper, via the GREThA publication seminars she organizes, as well as for her knowledge of this particular issue. The general shape of this paper took form at a conference initiated by the Research Program, Les Trajectoires de l’Innovation, in the Maison des Sciences de l’Homme d’Aquitaine, Octobre 22nd, 2009. I am grateful to its organizers and participants.

References


## Annex:

<table>
<thead>
<tr>
<th></th>
<th>Symbian</th>
<th>Android</th>
<th>LiMo</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td>EPL 1.0</td>
<td>APL 2.0</td>
<td>FPL</td>
</tr>
<tr>
<td>Copyleft</td>
<td>Weak (depends on owner decision)</td>
<td>No</td>
<td>Strong (but restricted to members)</td>
</tr>
<tr>
<td>Right to mix open and proprietary licences</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GPL Compatible</td>
<td>No</td>
<td>Yes (Linux Kernel)</td>
<td>Yes (Linux Kernel)</td>
</tr>
<tr>
<td>Right to review platform source code</td>
<td>All Foundation members</td>
<td>All registered developers</td>
<td>All Foundation members</td>
</tr>
<tr>
<td>acceptance</td>
<td>Fix and enhancement: package owners</td>
<td>“Approvers” (Google employees)</td>
<td>Architecture Council</td>
</tr>
<tr>
<td>Consortium management</td>
<td>Former employees of the members</td>
<td>Google employees</td>
<td>Employees of the members</td>
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<tr>
<td>Right to commercially distribute the platform</td>
<td>All members</td>
<td>Devices approved by the Android Compatibility Program</td>
<td>Core &amp; Founder members</td>
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<tr>
<td>Eligible to participate in the Board and Councils</td>
<td>All members</td>
<td>n.a.</td>
<td>Core and Founder members (Requirements Council open to all members)</td>
</tr>
<tr>
<td>Consortium membership</td>
<td>Open</td>
<td>Closed (Invitation)</td>
<td>Open</td>
</tr>
<tr>
<td>fees (2010)</td>
<td>$1.5k/year</td>
<td>n.a.</td>
<td>$20k/year (Associate Member)</td>
</tr>
<tr>
<td></td>
<td>The operating expenses are covered by the handset manufacturers in the Board</td>
<td></td>
<td>$230k/year (Core Member)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$460k/year (id. in the Board)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$550k/year (Founder)</td>
</tr>
</tbody>
</table>

Table 5: Consortium governance and IP management