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The impact of cognitive radio technology on mobile network operators' interorganizational networks and business models

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ABSTRACT

In this paper, we analyze the impact of the introduction of Cognitive Radio (CR) technologies on the interorganizational networks of mobile network operators. We present a comprehensive overview of relationships between its main actors within business ecosystems and value networks. This analysis helps us identifying the positions of the different actors with respect to mobile network operators (MNOs) and constructing the value net of these latter after CR introduction. We finally determine its nature as a disruptive or a sustaining technology. In view of our analysis, we discuss the possibility of the emergence of a platform ecosystem centered on the spectrum database.

1. Introduction

Structural changes in the information and communication technology (ICT) industry, such as convergence, enable current telecommunication players to expand their roles (Li and Whalley, 2002). They also mark the entry of powerful new players from IT and media industries which are altering their value chains and business models. These are key issues for networks' operators. Firms are moving up the value chain to higher margin activities through both vertical integration and horizontal concentration, establishing numerous partnerships and cross investments (Zhang and Liang, 2011). New innovation leads to higher complexity to the telecommunication business with new players entering the game and 'old' ones changing their roles and positions in the value chain (Christensen, 1997; Gronsund, 2013; Medeisis and Minervini, 2013).

This paper deals with potential disruptive technology expected to introduce many changes in the mobile telecommunication business that is "Cognitive Radio" (CR) networking (Nekovee, 2009; Ahokangas, Matinmikko, Myllykoski, and Okkonen, 2012). Radio spectrum, classically allocated to different industries (broadcast, military, mobile communications, etc.) in a licensed manner, can be reused by secondary applications license-free. This removes the most important entry barrier of the mobile telecommunication market, the spectrum licenses, and allows new actors to enter it and 'old' actors to expand their roles to new services. This is expected to bring new relationships. Regarding the fact that CR introduces new ways for building and operating wireless networks that may be radically different from the classical way, many researchers argued that "CR is the potential game changer of the entire wireless industry", leading to a loss-loss situation for incumbent providers that is one of the reasons that stall the introduction of CR technology (Medeisis and Minervini, 2013).

The objective of this paper is to give more insight to the position of network operators with respect to CR technology. This article analyses two research questions. The first question is about the possibility for the emergence of a new platform related to CR, especially with the role of Internet Giants like Microsoft and Google that are expected to create and manage a database

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for spectrum access. The second research question is about the disruptive nature of CR technology. Indeed, many papers made the disruptiveness assumption based on the fact that a rare and expensive resource that is the spectrum may become cheap and available to everybody (Barrie, Delaere, Anker, and Ballon, 2012; Nekovee, 2010). However, defining the nature of the innovation related to CR, i.e. disruptive or sustaining, as defined by Christensen (1997), is a difficult research question. According to Gronsund (2013), "it is often stated that CR is a disruptive technology. However, to the best of the author's knowledge, there does not exist any detailed studies using disruptive innovation theory to analyze the disruptive potential of CR". We address this question based on the analysis of the business environment changes and in the light of the strategies of the main actors.

As of our research methodology, we adopt a qualitative approach that is exploratory and descriptive in nature. This exploratory design gives more objectivity any flexibility to our research (Stebbins, 2001). We triangulate among different methods to provide a comprehensive picture of the potential new business environment of mobile network operators and of their BMs.

The remainder of this paper is organized as follows. Section 2 presents theoretical foundation and analytical framework. We propose to make a comparative analysis of two kinds of networks: business ecosystems and value net model. These two approaches could provide a broader overview of the evolution of strategic roles and business models highlighting the emergence of a potential disruptive technology competitive advantage. Section 3 describes the technology background. Section 4 analyzes relationships between actors within the two different types of networks. Section 5 presents the impact of CR technologies on business models. The final section concludes the paper and responds to the main research questions.

2. Interorganizational networks

At a general level, firms are embedded in different networks of cooperative relationships. The "hypercompetition" context (D'Aveni, 1994) has created a significant incentive for organizations to collaborate. Networks are viewed as structured and articulated contract-governed entities comprising at least two partners engaged in more or less long term exchange relationships. Most of networks are complex and integrate processes that often operate across multiple companies and countries.

Networks are created as the result of specific organizational and regulatory action, based on somewhat formalized and elaborated control modes, as well as on trust.

2.1. Business ecosystems versus value net models

As complex relationships between firms are an increasingly prevalent and important trend in business practice, we propose to place an emphasis on two types of networks that have been adopted to address complex relationships issues: business ecosystems and value nets.

While the 1990s witnessed significant growth in international strategic alliances and cross-border mergers and acquisitions (M&A), the 2000s were characterized by the generalization of a "new form" of network organization: the business ecosystem (BE), defined by Moore (1996) as a business community that brings together various interdependent players who belong to different sectors. This situation is even more noticeable when there is convergence between several industries: IT (Information technology) industry, telecommunications sector, and the media (Gossain and Kandiah, 1998). The resulting structure no longer resembles the traditional definition of what we refer to as an 'industry'.

Iansiti and Levien (2004a and b) have focused their research on BEs, following up on work on the evolution of clusters of networked companies. Within a BE, the interests between the partners could be conflicting and "actors use their knowledge of the network as well as their relationships with other actors in order to increase their control" (Haakansson and Johanson, 1992, p. 30). Iansiti and Richards (2006) consider BEs as complex networks "whose integrated efforts are necessary to deliver value to end customers" (p. 77).

The business ecosystem may become blurred with other forms of networks and comes to resemble an undefined, non-geographic network (of innovations) characterized by cooperative and "open" practices (among suppliers, organizations and customers) in order to co-create value. As suggested by Koenig (2013), BEs come in many flavors: supply systems, platforms, communities of destiny, and expanding communities.

On the other side, the value net concept, developed by Brandenburger and Nalebuff (1996), relies on a strategy view and uses game theoretic modeling (cooperative games) to analyze: the value created by vertical chains of suppliers, firms and buyers; the added-value of a specific player "defined as the value created by all the players in the vertical chain minus the value created by all the players except the one in question." (Brandenburger and Stuart, 1996, p.6); and more generally, the creation of asymmetries between the firms. "Along the vertical dimension of the Value Net, there is a mixture of cooperation and competition (…). Along the horizontal dimension, however, managers tend to see only half the picture. Substitutors are seen only as enemies. Complementors, if viewed at all, are seen only as friends." (Brandenburger and Nalebuff, 1995, pp. 60–61). This ignores the fact that a single player can have more than one role simultaneously and can even be both competitor and complementor at the same time.

In both approaches, (BE and value net), assign to the players and stakeholders critical roles, distinct but complementary. For BEs, Iansiti and Levien (2004a and b) consider four different roles that organizations can take. A few number of firms, called keystones, are considered as enablers having a great impact on the whole system. These companies improve ecosystem health and, in doing so, increase their own performance. Dominators and hub landlords attract and exploit resources and competencies from the other companies. Niche players represent the largest mass of the business ecosystem.

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In the value net model (Brandenburger and Nalebuff, 1996), four main groups influence the business of any firm customers, suppliers, complementors and competitors. The value net analysis is able to capture the dynamics of an environment business for a specific firm in an easiest way.

3. Technology background

Before presenting the methodology and the contributions, we present briefly the main concepts of CR technology that has been proposed as a reaction to the spectrum scarcity. Indeed, as the demand for wireless data connectivity continues to rise, many cellular operators are predicting a shortfall in available radio spectrum, a "spectrum crunch" (FCC, 2011). The reason for this spectrum crunch, according to CR experts, is more regulation constraints than real spectrum usage.

As assigned spectrum is far from being fully utilized, CR can intelligently detect whether any portion of the spectrum is in use, and can temporarily use it without interfering with the transmissions of other users (Ahokangas et al., 2012).

While many publications looked at the regulation and standardization aspects of CR technology, few of them considered economic aspects and fewer discussed interorganizational networks and associated business models. Ahokangas et al. (2012) presented results issued from four research workshops that developed specific scenarios and business models for cognitive radio systems. The research report (Markendahl and Kim, 2012) focused on potential business opportunities of different actors for particular CR technologies (cellular use of TV white space, cognitive machine-to-machine and fixed operator use of CR). This publication argues that there is no single answer for each of these CR technologies; it performed a quantitative analysis for each of them based on a cost structure and a company asset analysis.

The objective of the thesis of Gronsund (2013) was to understand how a mobile operator can benefit from using CR as a potential sustaining or disruptive innovation to opportunistically access white spaces. He concluded that the most promising business case for an operator is that of a joint venture that gets the rights to use the "unused spectrum resources of spectrum owners".

Medeisis and Minervini (2013) stated that "providing the CR innovation community with an open and unrestrained testing ground would represent a plausible solution for effectively removing the identified innovation barriers and turning the current loss–loss formula into a potential win–win situation."

The important works cited in the previous paragraph laid the background for the analysis of the impact of CR on the mobile telecommunications business. However, there is still a need for a complete qualitative analysis that identifies the main actors and their positions in the business environments. The present paper fills this gap following a business ecosystem/value net approach as discussed in the following section.

4. The introduction of CR and implications on inter-organizational networks

4.1. The current wireless telecommunications business ecosystem and value chain

The mobile business ecosystem has been described by several authors. In 2011, Zhang and Liang have represented the business ecosystem including suppliers, mobile network and service operation, distribution channels and customers. They have added regulatory organizations and various stakeholders. They have defined two circles within this ecosystem as "core business" and "extended network". According to the two authors, "it is obvious that a mobile network operator should play the role as a keystone and take the responsibilities to foster a healthy ecosystem." (Zhang and Liang, 2011, p. 159).

A representation of a value chain at the industry level is also interesting as it includes the main market players and helps to understand linkages between the actors in the industry. The wireless telecommunications industry value chain is specialized into segments that include content related services and applications, network infrastructure, integration services, access devices, and a multitude of sub segments and niche applications. Fig. 1 presents the value chain of wireless telecommunications industry. Note

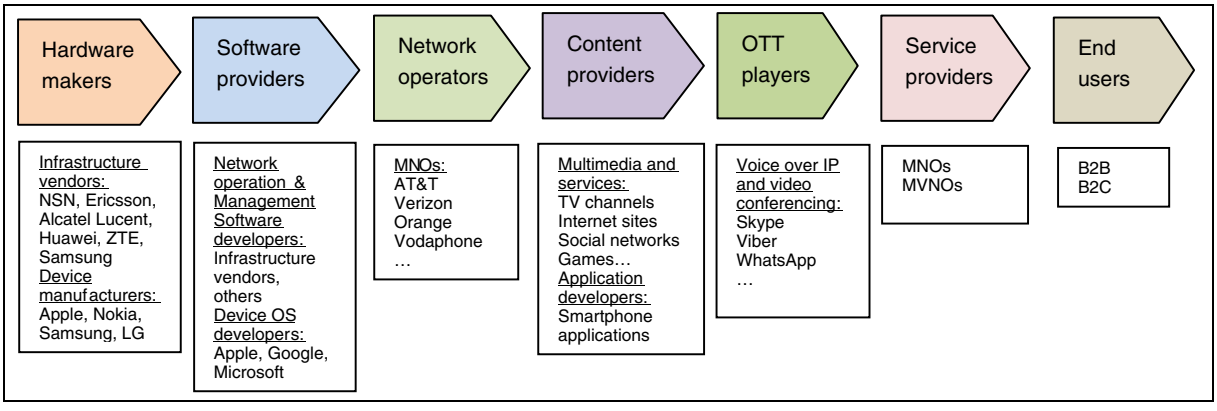

Fig. 1. Value chain of wireless telecommunications industry.

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that the involvement of Over-The-Top (OTT) players is recent as OTTs, if considered, are classically placed in the same category of content providers. However, we believe that OTT players, especially those like viber and skype that provide telecommunication services (voice and video conferencing), are becoming major actors in the wireless telecommunication chain.

4.2. The emergence of new players in the wireless telecommunications industry with CR introduction

With cognitive radio, new players emerge leading to the extension of the business ecosystem. Mwangoka, Marques, and Rodriguez (2013) studied cognitive radio networks operating in TV white spaces. They developed the potential TV white space value chain depending on technological exploitation scenarios, regulatory policies, standardizations efforts and viable business models. They focused on a new actor in the business ecosystem, namely the intermediary spectrum manager, such as the geolocation database managers, brokers, band managers, etc. that facilitate dynamic spectrum access in a free or paid manner depending on their revenue models.

Regarding spectrum managers, they facilitate dynamic spectrum access in a free or paid manner depending on their revenue models. They have the technical expertise to develop and operate a spectrum on a secondary usage. Examples of spectrum managers are:

Spectrum brokers: they operate in the case where primary users sell the access to their spectrum for secondary users. In this case, primary users (e.g. MNOs) decide to allocate the spectrum that they do not use, on a time and space basis, to secondary users on a paid manner. Spectrum brokers act thus as intermediate entities that determine the spectrum access fees based on the demand and the available spectrum.

Database administrators: they operate in the case where spectrum holes are not announced by the primary users, but must be detected in order to allow an interference-free secondary operation. This is for instance the case of TV White space operation, where some database administrators have been designated in order to measure the received signals, detect white spaces and update a white space database that is accessed by secondary users each time they want to use a spectrum band.

These new suppliers will have a strong position in the market as their presence is mandatory and their services are paid. However, the existence of multiple spectrum managers will ensure that the cost to access the databases by CR devices is subject to competition, which will mitigate many of the concerns that are raised, including concerns about the potential for conflicts of interest (between the spectrum managers and the broadband service providers) or monopoly pricing (Figs. 2 and 3).

Another player can be added: regulators, even if they do not create value directly. Regulators have the highest authority over all actors. Their main objectives are to maximize the social value of the spectrum; impose rules that allow unlicensed radio transmitters to operate without harmful interference to primary users; and, designate the spectrum managers. Note that regulators are also present in the classical mobile business ecosystem where they allocate spectrum licenses on a long-term basis, but their role

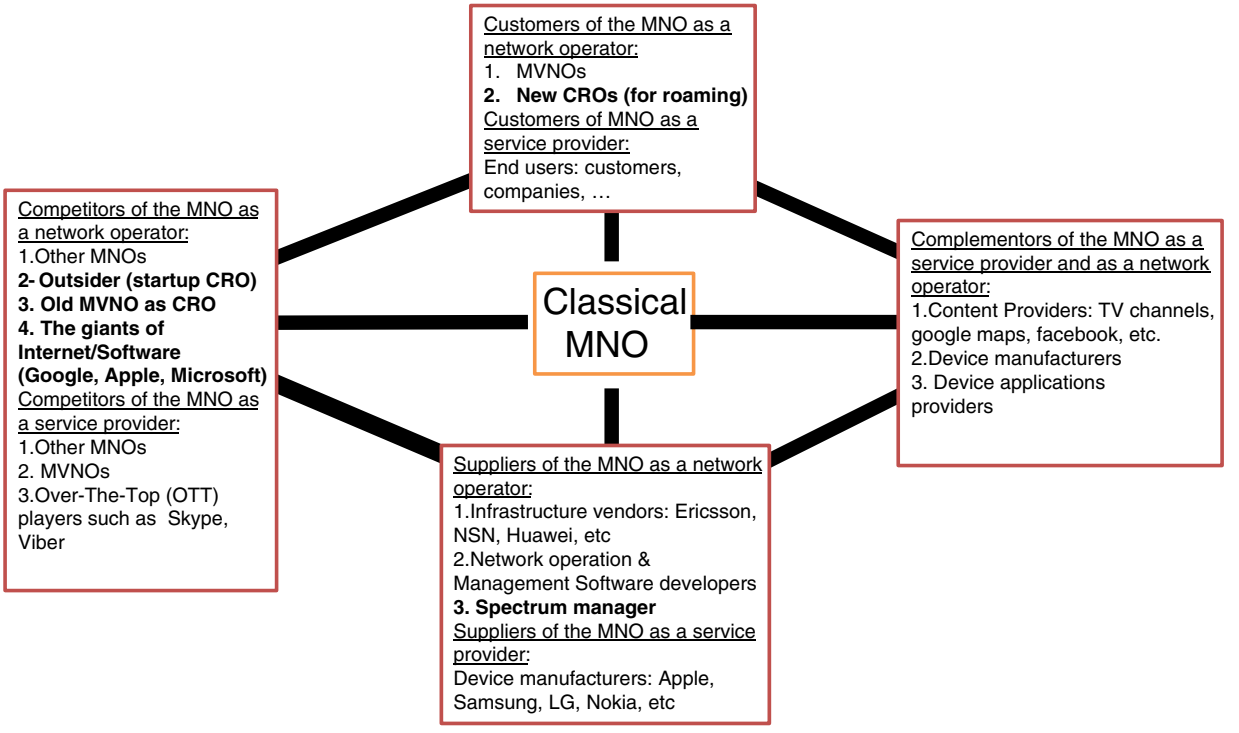

Fig. 2. Value net evolution with cognitive radio. New CR-related actors and players whose roles have changed with CR technology are highlighted in bold.

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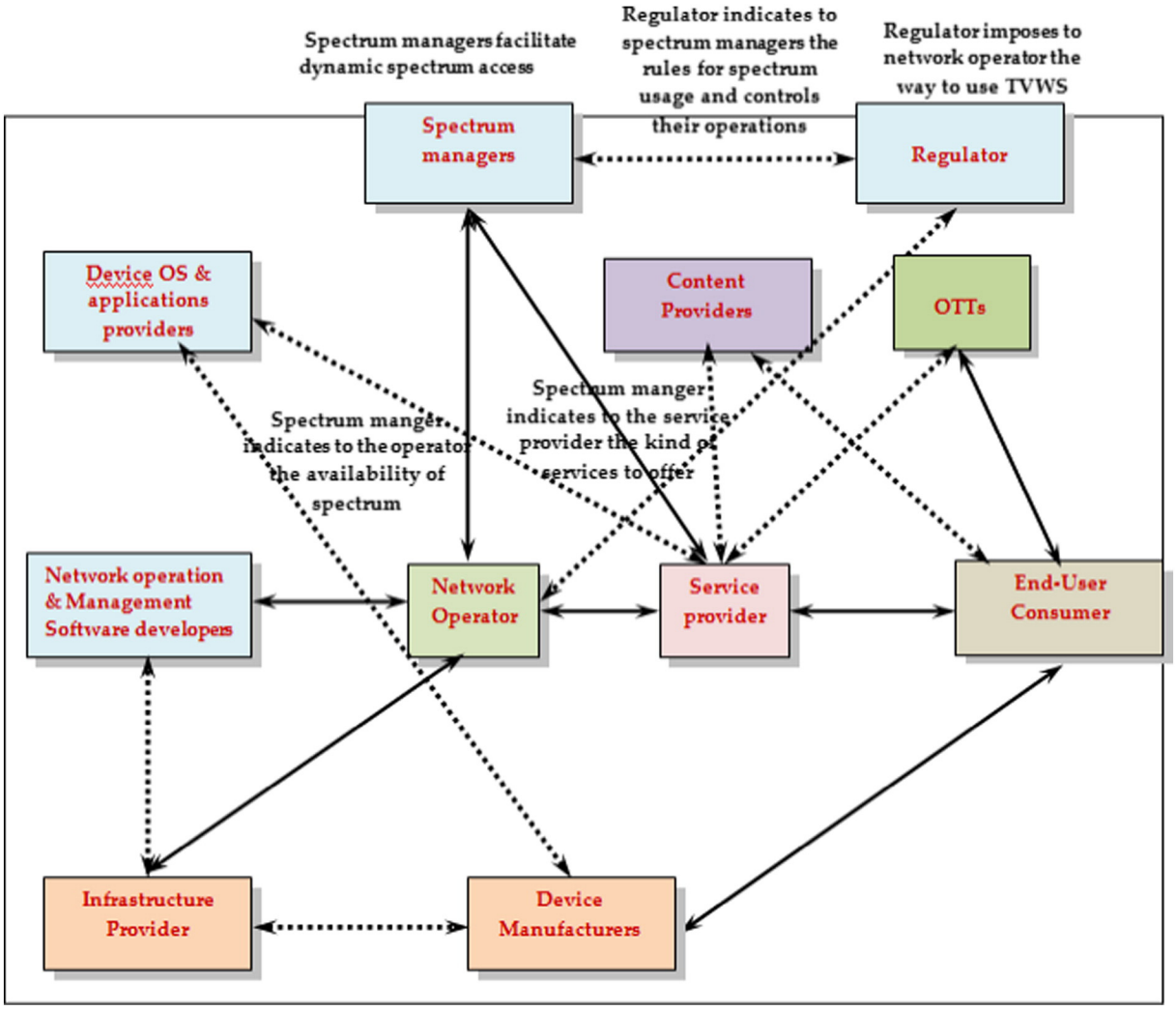

Fig. 3. Detailed relationships between actors after the introduction of CR technologies. Dashed arrows correspond to non-monetary interactions while solid arrows correspond to money exchange. Source: elaborated by the authors and adapted from Constance and Gower (2001).

becomes however more dynamic in the case of CR as they setup rules that may change on a shorter time scale and perform a tight control for the operation of CR operators.

4.3. The value net evolution with CR technologies

Fig. 2 shows the value net evolution with CR technologies. We consider an integrated network operator and service provider, as it is the case for most MNOs. We also consider only the mobile segment in order to make the analysis tractable, even if most MNOs are also fixed network operators.

We first begin by defining customers as this will give us a clear view about the positioning of the MNO. Two kinds of customers are identified: First, end users, be they in the mass market (individuals), or other business customers (private companies or public administrations). Clearly, these customers are contracting with the MNO as a service provider. Second, MVNOs: they are customers of the MNO as they buy the right to use his network in order to serve their customers. When the MNO sells network access rights to MVNOs, he is behaving as a network operator.

Based on this analysis, we can see that customers group can be classified into two groups: customers of the MNO as a service provider and customers of the MNO as a network operator.

With the introduction of CR technology, the following evolutions can be foreseen. First, the role of a classical MNO may be reinforced as they may use non-licensed spectrum in order to increase their coverage and capacity. They may also sell access rights to their spectrum and reinforce their role as a service provider (where service here is spectrum allocation to secondary users). However, the number of competitors will increase with new entrants such as CR operator (CRO), whose role can be played by the following actors:

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- 'traditional' Mobile Virtual Network Operators (MVNO) that have an additional advantage relying on built up organization, customer base and core network, but no licensed spectrum or radio access network. If an MVNO decides to invest in CR technology, its position will be reinforced regarding to classical MNOs, but it will still act as a MVNO in zones that are not well covered by CR spectrum.
- giants of Internet/Software like Google, Apple, Microsoft which may be interested in building their CR based networks. Indeed, even if these companies are classically interested in WiFi-like applications of CR, recent developments show that they are also interested in playing the role of MVNO, as announced by Google during the 2015 Mobile World Congress in Barcelona. A liberalization of the spectrum may lead to a further evolution of the business model of these internet Giants towards the deployment of their own cellular CR technology. They have distinctive resources and core competencies to build networks if they believe in the potential of the technology.

In the value net construction, the most difficult task is to identify complementors whose presence incites customers to buy more services from the MNO. Obviously, content providers (online game developers, Google maps, TV channels) act as complementors are people are willing more to buy mobile data access in order to profit from their favorite contents everywhere. Device manufacturers are also complementors as end users consider smartphones and tablets as valuable devices by themselves, and a smartphone or a tablet will be more useful with a wireless Internet connection. Device application developing industry is also a complementor as the multitude of smartphone applications incites users to buy a smartphone and to subscribe to a mobile data connection. Note that we do not make a distinction between complementors of the MNO as service provider or as network operator as they are generally the same (they stimulate the need of a network access).

4.4. A new platform wireless business ecosystem?

We now focus on a group of players who are now omnipresent in the mobile industry and whose role will be reinforced with the introduction of CR technology. These are the Internet giants like Google, Apple and Microsoft. Indeed, these actors are now present in different positions of the value chain and their interactions with MNOs are very complex:

They are suppliers of MNOs as they are in the same time hardware providers (they provide mobile devices and tablets) and software providers (they provide operating systems like iOS and Android). They are competitors of MNOs as they are OTTs (they offer VoIP ad video conferencing tools like Skype). They are complementors of MNOs as they are content providers (e.g. Google maps, mobile applications, etc).

These Internet companies are nowadays complementors, competitors and suppliers of MNOs regarding their roles as service providers and not regarding their role as network operators. With the introduction of CR, these Internet giants will be more present in the value chain as they will be also spectrum managers. This reinforces their position as competitors and suppliers of MNOs, but in their roles of network operators this time. A spectrum database is not only a collection of geo-localized spectrum availability data, it is a powerful tool that allows its manager controlling the access rights to the spectrum resources and building a set of interfaces and tools allowing: (1) equipment manufacturers to provide CR-capable base stations, (2) device manufacturers to develop smartphones and dongles that can access CR spectrum, (3) CR-only MNOs to provide mobile services to customers, (4) classical MNOs to extend their coverage and capacity and (5) brokers to develop a spectrum Market where classical MNOs sell secondary access rights to their licensed spectrum.

However, does this mean that a platform ecosystem may emerge, centered on the spectrum databases? This is highly improbable due to stringent constraints that are imposed by regulators regarding access interfaces to databases. Indeed, all CR devices and equipment has to be supported by each of the databases through standard interfaces, preventing thus the emergence of platform-based ecosystems are those described in (Tiwana, Konsynski, and Bush, 2010). However, databases managed by Internet Giants that have already established platform ecosystems (e.g. the Google Android ecosystem) may expand their actual ecosystem by adding the spectrum database as a module that connects to the platform to add CR functionality to it, allowing for example a native support of CR technology by devices.

5. The impact of CR technologies on business models (BM)

5.1. Business models and CR technologies

The notion of BM reflects the fit between the internal and external level of strategic analysis, in other words, between environments (economical, technological and legal) and companies' business strategies (Ballon and Arbanowski, 2002). "If the firm's value chain allows the internal value creation processes to be explained, the value network allows the external value creation processes to be explained, making the BM a link between these two areas, internal and external. The BM thus ensures coherence between these areas and enables the company to manage the value creation process for all the parties, including the end-client." (Daidj and Isckia, 2009, p. 31).

A BM represents the strategic positioning of the firm in a market (Yip, 2004) and defines how a firm creates and captures value for its stakeholders (Chesbrough, 2007; Casadesus-Masanell and Ricart, 2010). Timmers (1998) was the first author to propose a comprehensive definition of a BM considered as "an architecture for the product, service and information flows, including a description of the various business actors and their role; and a description of the potential benefits for the various business actors; and a description of the sources in revenues." (pp. 3–8). Other authors focus their attention on the role of all the stakeholders concerned

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defining the BM as "a description of the roles and relationship among a firm's consumers, allies and suppliers that identifies the major flows of products, information and money and the major benefits to participants." (Weill and Vitale, 2001, p. 34).

Lillehagen, Armyr, Hauger, Masdal, and Skow (2001) applied the value net framework for different Mobile Virtual Network Operator (MVNO) business models in order to establish their viabilities and highlighted models that stimulate a high total value of the whole value net (a win-win situation with the MNO and other partners).

Fig. 3 shows the detailed interactions between the two new actors mentioned in the previous section (i.e. regulators and spectrum managers) and the other actors. It includes non-monetary and money exchanges. Spectrum manager indicates to the network operator the availability and price of the spectrum at each location in order for the operator to be able to provide wireless connections. He also indicates to the service provider the kind of services that can be offered based on its knowledge of the continuity of coverage area (for instance, if mobility of users can be supported). The regulator, from its side, indicates to the database administrator the rules to follow when detecting and pricing a spectrum band, and controls him to verify that these rules are followed. He also indicates to the network operator how to use the spectrum without interfering on primary users, and controls regularly the presence of such interference.

5.2. Business models, CR and disruptive innovation

Understanding BMs also involves defining the nature of innovations, as Christensen (1997) has done with the concepts of disruptive versus sustaining innovation. Sustaining technology relies on incremental improvements to an already established technology. In his book, "The Innovator's Dilemma", Christensen has described a new technology that unexpectedly overturns the dominant technology in the market sector. Disruptive technologies are those that force changes in industry frontiers, business processes and business models. "Business units and their business models just mature and die. By using the lens of the disruptive model, strategic leaders can learn how to cause their organizations to evolve successfully." (Knight, 2001, p. 15). Christensen has affirmed his position as being situated within the study of theories of industrial innovation (Christensen and Bower, 1996; Foster, 1986; Teece, 1986; Utterback, 1996; von Hippel, 2005). He has shown how the dominant positions of large firms can prove to be an obstacle to their adaptation in phases of radical change and disruptive innovation where such firms need to adopt innovative BMs to compete with aggressive new entrants. In a more recent work, Johnson, Christensen, and Kagermann (2008) have defined five conditions that justify adopting new BMs: "the opportunity to address through disruptive innovation the needs of large groups of potential customers who are shut out of a market entirely because existing solutions are too expensive or complicated for them (…), to capitalize on a brand new technology by wrapping a new business model around it (…), and to bring a job-to-be-done focus where one does not yet exist (…) and the need to fend off low-end disrupters (…) and, to respond to a shifting basis of competition" (pp. 64–65).

Even if reference to this notion of disruptive technology is shared by several authors, it has been questioned by other scholars such as Latzer (2009): "the disruption concept can be judged as helpful and inspiring but also as easily misleading (…); there is a very limited range of validity of research results, so generalizations of individual or company assessments are hardly valid. Moreover, the concept is not equally well suited to different markets with different institutional characteristics. For telecommunications and electronic media markets its applicability is comparatively low, which calls for even more cautious application and interpretation of results." (p. 616). The term 'disruptive technology' has been widely used as a synonym of 'disruptive innovation'.

Habtay (2012) makes a distinction between a technology-driven disruptive business model innovation and a market-driven disruptive business model innovation. "We define an innovation where R&D experimentation precedes market opportunities and a business model development that will over time affect the incumbent firm's established market, as a technology-driven disruptive business model innovation. In contrast, a less sophisticated technological business model innovation that results from radical changes in the established value propositions to the existing customer (Govindarajan and Gupta, 2001), or altering the firm's role in the existing value chain or both (Moore, 2004), that will over time affect the established market, can be referred to as a market-driven disruptive business model innovation. Frequently, business model innovation emerges at a later stage when a once radical or disruptive technological innovation matures and competition through a new business model becomes critical (Moore, 2004)." (Habtay, 2012, p. 291).

Disruption is rarely the result of a single innovation but occurs when two or more technologies converge. Disruptive innovation studies often analyze the issue of adaptation from the perspective of incumbents but research must take into consideration how new entrants introduce and develop disruptive innovation and therefore how they develop new business models. These are several disruptive technologies and innovations that will shape enterprises in the very near future in the field of ICT. We will try, based on the above analysis, to explore the disruptiveness of CR.

We claim that the response to the question: "is CR a disruptive technology?" depends on the strategies of the different actors and on the regulator decisions. Indeed, if regulators prevent CR access to spectrum or impose stringent restrictions on it, CR would definitely be a sustaining innovation that "improves the performance of established products, along the dimensions of performance that mainstream customers in major markets have historically valued." (Christensen, 1997).

Examples of scenarios corresponding to this case are the following:

1. intra-operator scenarios like agile allocation of spectrum to systems (e.g. dynamic refarming of a 2G sperctrum for 4G usage). This corresponds to the basic ITU-R scenarios defined in (De Nardis and Holland, 2014).
2. inter-operator scenarios where only MNOs with licensed spectrum are allowed to access spectrum of other MNOs in a secondary way. This leads to dynamic spectrum sharing between operators allowing them reducing their network deployment and

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upgrading costs by an inter-operator traffic offload. Example of this is the Dynamic Spectrum Allocation (DSA) scenario described in (De Nardis and Holland, 2014).

3. CR scenarios with restrictive coverage and Quality of Service (QoS) constraints imposed by regulators on CR-only operators, increasing thus the CR network deployment and operation costs (including roaming costs to classical MNOs).

However, as the global tendency is for spectrum liberalization (as can be observed from the FCC and OFCOM decisions), we have to investigate the situation where regulators open white space spectrum for secondary usage without significant restrictions, or even force MNOs to open their licensed spectrum to secondary access. In this case, if MNOs fail to elaborate coopetition strategies (with equipment vendors and with Internet Giants) that prevent new forms of competitors from entering the system, CR would introduce new actors in the value chain and reinforce the position of other actors with respect to MNOs, as discussed in the previous sections. The way networks are built and operated will thus drastically change and new forms of operators would appear that offer connectivity services for a very low fee, or even for free (e.g. included in the smartphone costs). CR will be in this case a disruptive technology that "brings to a market a very different value proposition than had been available previously" (Christensen, 1997), here in the sense of a completely different pricing model.

6. Conclusion

The evolutions in the ICT industry, typically fast-paced changes and disruptive innovations, significantly affect the positioning of groups and Internet giants. These leading firms try to achieve better performances by creating multi-stakeholder partnership and entering different types of networks and in particular business ecosystems and value net models.

This paper focused on the impact of cognitive radio technologies on the on mobile operators' interorganizational networks. We began by performing an up-to-date analysis of the mobile telecommunications value chain. We then extrapolated this analysis to the case of CR technology deployment and show the new actors and their interactions with the actual actors. With the introduction of CR technology, we can conclude that the main organizational environment forces that introduce large uncertainties on the organizational environment of mobile operator is the regulation and the competitors forces specially: Internet Giants that are expected to be omnipresent in the value chain and the value net of mobile operator. Our findings confirmed that this new technology may change radically the game by bringing new actors and new rules.

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