Platform for Open Innovation and Integrated Solutions: the case of BT and its Next Generation Network (NGN)

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Abstract

This paper analyzes how innovation in services is being organised in the telecommunication industry after the bubble burst in the beginning of the 2000's and how BT is applying the concept of 'open innovation' in order to sustain its competitiveness. After the bubble burst in the beginning of the 2000's, the telecommunications industry is trying to find its way to growth. Internet services and broadband have changed the way customers perceive communication services. Traditional telecommunication companies, like BT, Deutsche Telekom and France Telecom have been urging to change in order to survive and sustain its competitiveness. One outcome of the industry was that the traditional PSTN (Public Switched Telecommunications Network) technology was not suitable anymore to deliver the multimedia services demanded by customers. The IP (Internet Protocol) has become an unprecedented agreement in the telecommunications industry and the traditional telecommunications companies started to transform its infrastructure based on this Internet-based technology. While this infrastructure transformation is under way, another huge challenge is to change the way these traditional telecommunications companies create, integrate and deliver new services. Service innovation on top of the IP platform is the ultimate challenge. The research was conducted through interviews and analysis of documents such as reports, newspaper articles and official Internet websites. The reports included annual reports of suppliers and incumbent service providers, and documents of regulators. The interviews were conducted with senior managers, managers and other practitioners of incumbent telecommunications service providers and suppliers, regulators, consultants and market research analysts. Initial findings suggest that incumbent telecommunications firms will be increasingly extracting value from platform and software sharing, exposing its 'capabilities' to third parties and developing business models to interoperate with other companies, co-creating new services. Thus, the ability to expose their capabilities in services, not to hide them, will be determinant of its success. Also important is the ability to offer integrated solutions to large firms as part of the service portfolio. And, in this context, the concept of open innovation and value innovation also find a fertile ground to be applied in services in the communication industry. Important dynamic capabilities identified in this context are strategic planning, project management, new product/service development (especially software development), supported by systems integration.

Keywords: Service innovation, platform innovation, open innovation, value innovation, integrated solutions, Telecommunications Next Generation Networks (NGN).

1. Introduction

Since the bubble burst in the beginning of the 2000's (some people say 2002), the telecommunications industry is trying to find its way to growth and profitability again.

The "Internet way of doing business" brought new challenges and business models in the communications market, and the traditional structure of the telecommunications industry was not prepared to respond adequately and timely to it. The convergence of markets, where the firms providing fixed and mobile phone, cable TV, satellite, and Internet services started to compete for the same customer, established different dynamics of providing communication services, redefining their value.

With the emergence of the IP (Internet Protocol) technology as the 'de facto' standard for providing voice, video and data services, the traditional telecommunications firms started to rethink their infrastructure and deploy IP-enabled systems and equipment. The advent of digitalization can be compared to choosing the alphabet, and the advent of IP to choosing the language. Now that the language is common, open and known, more people and firms are brought into the innovation landscape.

The emergence and adoption of IP has a direct impact on how traditional telecommunications firms innovate. The IP infrastructure, the IP platform, enables the development and delivery of a whole set of new services and create a space full of uncertainty where innovation can flourish. This creates a situation of both threat and opportunity. This paper analyzes how innovation in services is being organised in the telecommunication industry from the operator/service provider perspective, after the bubble burst in the beginning of the 2000's. It uses the concepts of open innovation and value innovation as a starting point in order to achieve service innovation on top of a platform using IP as the common technology for voice, video and data services. And it also analyzes the specific case of how BT is applying the concept of 'open innovation' in order to sustain its competitiveness. Ultimately, the paper deals with the issue of innovating the process of innovation, especially in traditional telecom operators, for their own survival.

One of the main outcomes of the process of convergence allowed by IP technologies is the capability of BT to offer integrated solutions to interconnect multi-site operations of large multinational firms. This allows BT to grow in the business of

convergence in the B2B market, while investing in the construction of an IP platform (through a large technical project called BT 21st Century Network), preparing to offer new converged services both for the business and consumer markets.

2. Research Method

This paper is part of a wider research where the following research method was applied. The data collection involved major trade conferences which occurred during the years 2005, 2006 and 2007. The attendance to trade conferences was important to interview executives, attend their presentations and get insights which would not be possible (or would take much more time) only analyzing documents. The interaction between the information obtained through interviews and presentations (as primary sources) and through documentation (as secondary sources) helped to speed up the process and deepen the understanding of the phenomenon.

Being a recent phenomenon, I adopted an exploratory approach in three stages. The research was conducted through interviews and analysis of documents such as reports, newspaper articles and official Internet websites. The reports included annual reports of suppliers and incumbent service providers, and documents of regulators. The interviews were conducted with senior managers, managers and other practitioners of incumbent telecommunications service providers and suppliers, regulators, consultants and market research analysts. An overview of the documentary and interview data used is shown in appendix 1.

The interviews were conducted during the trade conferences and lasted typically less than half an hour. I organised a questionnaire with several questions related to my research and during the trade conferences I adopted the strategy to make few questions very focused on the expertise of the interviewee and wherever possible, made the same question to many interviewees until I was satisfied. I tried though to cover all the questions in one trade conference. Then, whenever possible, I compared with the documentary data, trying to confirm or not the information obtained in the following trade conference. Dubious or ambiguous information I have either discarded or considered for a discussion topic. When necessary and possible, I contacted again some previous interviewees (by telephone and/or e-mail) for clarification or to obtain more information.

3. Literature Review

In order to address the issue of how the traditional telecommunications operators like BT are changing their innovation processes, I review the literature on innovation models, including the concepts of open and value innovation in order to relate to the empirical findings. These empirical findings could be separated into infrastructure transformation and service innovation. As the infrastructure transformation is the construction of a platform based on the Internet Protocol (IP), I review the literature about platform innovation. The ability to develop new services faster, cheaper and better is addressed under the theory of service innovation. New services can be developed on top of the platform (i.e. not necessarily owning the infrastructure, like the services provided by Internet firms such as Google and Yahoo) or through the platform (such as the integrated solutions offered by BT to large multinational firms, which are services linked to the provision of infrastructure).

3.1. Innovation Models

There are some innovation models in the literature which are relevant for the context of this research. Afuah (2003, p.18) divides the innovation models into static and dynamic ones. Among the static innovation models, he cites: Schumpeter, incremental-radical dichotomy, Abernathy-Clark, Henderson-Clark, disruptive technological change, innovation value-added chain, strategic leadership and familiarity matrix. Among the dynamic models: Utterback-Abernathy, Tushman-Rosenkopf and Foster´s S-Curve. Based on the innovation models, some initial comments about them taking into account the context of transition to NGN can be made, considering the telecommunications network as a LTS composed by CoPS.

Schumpeter (1934, , 1950) first suggested that the small entrepreneurs were the sources of most innovations and later he suggested that the large firms with some degree of monopoly power are most likely to innovate. Certainly, he was talking about suppliers, not service providers. In large telecommunications networks, the established network has some characteristics like long sales cycle, necessity of huge amounts of capital that makes the innovation coming from smaller entrepreneurs less likely. However, smaller companies may partner with large companies in order to sell to a large incumbent fixed telecommunication operator, so the issue of small entrepreneurs and large firms as sources of most innovations becomes blurred.

About the incremental-radical dichotomy:

- The strategic decision to invest focus on the product: the innovation is radical if it makes the existing products noncompetitive, and if it is incremental the existing products remain competitive (Henderson, 1993). In this context, voice-only services would be the 'product' to be analyzed.
- Considering organizational capabilities, the innovation is radical if it is competence destroying, and the existing capabilities do not fit anymore, and innovation is incremental if it builds on existing capabilities (Tushman and Anderson, 1986). It seems that a new knowledge base needs to be built, however existing capabilities can help or be a 'core-rigidity' (Leonard-Barton, 1992, , 1995). The time of transition to NGN is long and existing and new capabilities influence each other. Also, considerations of interoperability and interconnectivity do not allow the old capabilities to fade quickly.
- The Abernathy-Clark model unbundles two types of knowledge, the technological and the market, and they suggest that incumbents may outperform new entrants in 'radical' innovations when technological capabilities are destroyed but market ones remain intact (Abernathy and Clark, 1985). In the context of this research, technological capabilities are destroyed, but not overnight and not totally. More discussion about market capabilities needs to be done, as it does not seem a question of being destroyed or not, but how existing and new capabilities interact and emerge.

The Henderson-Clark model tries to explain why incumbent firms may fail in incremental innovations. They unbundle technological knowledge into component and architectural, and call incremental innovation when both are enhanced, and radical when both are destroyed. They claim that architectural innovation (when component knowledge is maintained and architectural is destroyed) may be wrongly assumed as incremental one, so that incumbents fail because they are not able to change the routines and procedures which deals with the architectural knowledge (Henderson and Clark, 1990). Initial evidences indicate that in the transition to NGN, both component and architectural knowledge are destroyed, compared to PSTN. As Henderson and Clark (1990) define component and architecture knowledge in the discrete product

level, it is necessary to redefine them in the context of telecommunications networks as LTS.

In the disruptive technological change model, Christensen (1997) distinguishes sustaining from disruptive technology, claiming that for disruptive technologies: the initial product performance is worse, although there are other features that some few customers value; products are typically cheaper, simpler, smaller and, frequently, more convenient to use; there is no clear market for its products; profits are lower than in mainstream markets/current business. One example is the packet-switching communications networks as a disruptive technology compared to the circuit-switched telecommunications networks (Christensen, 1997, p. xxv).

The case studies presented in the research of disruptive technologies are hard disk drives, mechanical excavators, electric power vehicles (Bower and Christensen, 1995, Christensen, 1997); minicomputers/PCs, ink-jet printers (Christensen and Overdorf, 2000). Rarely the case studies address the context of complex products and systems (CoPS), as mentioned by Miller et al. (1995) and defined by Hobday (1998). In this context, the customer is more sophisticated and the innovation faces more inertia (Davies, 1996). Voice over IP (VoIP) is usually called as a disruptive innovation in the telecommunications industry. As the word 'disruptive' is being overused, better analysis needs to be done in order to verify if it is not being misused.

The innovation value-added chain model considers not only the capabilities and competitiveness of the innovative firm, but also the capabilities and competitiveness of the firm´s suppliers, customers and complementary innovators. The firm´s ecosystem may explain the failure of incumbents in incremental innovations and their success in radical ones (Afuah and Bahram, 1995). During the transition, and the incumbent fixed telecommunications operator being a user or adopter of the technology, not the supplier, its innovation value-added chain and the suppliers and partners chosen to compose the ecosystem are important for the success of the transition. This innovation cannot be analysed isolated from its suppliers, customers and complementary innovators.

The strategic leadership view highlights the role of top management in recognizing, adopting and supporting the innovation. The top management´s dominant logic may explain the fact that incumbents embrace radical innovations in early stages

(Finkelstein and Hambrick, 1990, Hambrick and Mason, 1984). The fact that BT has taken such a radical approach may be linked with the top management´s dominant logic. This is discussed in section 5.

The familiarity matrix concentrates on how the firm adopts the innovation as the determinant of its success or failure. It argues that the more unfamiliar are the technological and market knowledge, the more the firm needs to look outside its boundaries in order to innovate (Roberts and Berry, 1985). For a service provider, adopting an innovation means buying technology. The whole discussion about familiarity is about selecting suppliers. Selecting more familiar suppliers was an issue during monopolistic times. This may be changing now with the transition to NGN in a more competitive market.

The Utterback-Abernathy dynamic model of innovation describes three phases of innovation: the fluid, transitional and specific phase. The fluid phase is characterized by technological and market uncertainties and by product innovation. The transitional phase begins when uncertainty is reduced by the emergence of a dominant design and the emphasis shifts from product to process innovation. In the specific phase, the rate of product and process innovation declines, it occurs more process innovation, and product innovation is mainly incremental, and the competition is more based on lower cost (Utterback and Abernathy, 1975, Abernathy and Utterback, 1978, Utterback, 1994). Miller et al. (1995) argue that the life cycle of CoPS tend to remain in the fluid phase of product innovation. This happens because their analysis is limited to the supply of CoPS, and does not include the adoption of CoPS by, for example, incumbent fixed telecommunications operators, where process innovation takes place and CoPS are used to provide services to mass market. Dominant design is achieved in this context in industrial level through standardization bodies like ITU-T. It seems that the dichotomy product and process innovation is reasonable, but product innovation is mostly in the supplier and process innovation in the telecom operator.

The Tushman-Rosenkopf model describes four phases for the technology life cycle: a technological discontinuity, an era of ferment, a dominant design and an era of incremental change. It deals with complex innovations, arguing that external, socio-political factors may become more relevant with the increasing complexity of innovations. Different capabilities are needed in each phase and firms try to influence the evolution of the innovation and establish an industry standard (Tushman and

Rosenkopf, 1992). This model seems to represent better the way innovation occurring in the transition to NGN, coupling suppliers and telecom operators.

The S-Curve deals with the prediction of the arrival of a technological discontinuity. At its physical limit, the return on effort of the old technology becomes too little and a new technology emerges to overcome it (Foster, 1986). The case of PSTN, based on circuit-switched technology is the typical one. However, only the technological issue does not explain the whole story, it is necessary to include at least the economic issues.

It is interesting to consider the concept of 'open innovation', developed recently by Chesbrough (2003), pointing out the changing principles surrounding R&D activities, where it is less important to have a central laboratory, as external knowledge is more available, and firms can benefit from them, and even trade the outcomes of its internal R&D activities which were not fruitful inside the firm, but may find another context where it may flourish. The concept of open innovation stresses the availability of technology and different options for telecom operators to deploy it. Chesbrough (2003) shows how Cisco overcame Lucent using a different process of innovation less based on its own R&D and relying more on partnerships and acquisitions. Both Lucent and Cisco are suppliers of equipment. Is open innovation also being practiced by the large users of such equipment, i.e., the telecommunications operators like BT, Deutsche Telekom and France Telecom?

The concept of value innovation stresses that 'market boundaries and industry structure are not given and can be reconstructed by the actions and beliefs of industry players' (Kim and Mauborgne, 2005, p. 17). Value innovation is about creating 'new best-practice rules by breaking the existing value-cost trade-off and thereby creating a blue ocean' (Kim and Mauborgne, 2005, p.18). It redefines value from the customer perspective, changing processes and practices common to mainstream firms and/or taking advantage of practices/values of adjacent markets, reshaping market boundaries.

The telecommunications operators are becoming service providers. All the transformation in their infrastructure, with the adoption of IP, does not make sense if they cannot provide new services or the same service in different ways. Thus, their final objective is service innovation: the creation and delivery of new services that will sustain their competitiveness.

3.2. Platform Innovation

From the infrastructure perspective, the transition to NGN of telecommunications networks may be viewed as what Hughes (1983, , 1987, , 1992) calls Large Technical Systems (LTS), whose main components would be Complex Products and Systems (CoPS), such as defined in Miller et al. (1995), Davies (1997) and Hobday (1998). Davies (1996) has already examined the telecommunications network as a LTS, but the aim here is to extend his analysis, including more recent events of telecommunications industry, especially the transition to NGN. In LTS, the unit of analysis is a complex system, defined as 'coherent structures comprised of interacting, interconnected components [ranging from] relatively simple machines to regional electricity supply networks' (Hughes, 1983, p. ix). Davies (1996) argues that this definition is different from the concept of complex systems offered by Miller et al.(1995), where 'the unit of analysis is the product and the nature of its production: that is the supply of large, complex, customized, engineering-intensive products or systems, in which production is of "one-off" kind, usually on a project basis, to meet the requirements of individual customers' (Davies, 1996, p. 1145-1146). Some related researches (Prencipe, 2000, Hardstone, 2004, Rycroft and Kash, 1999) investigate the context of Complex Products and Systems (CoPS), as categorized by Hobday (1998), from the supplier perspective. Davies and Brady (2000) also approach the organisational capabilities in CoPS from the supplier perspective. Little attention is given to the user perspective. In fact, Prencipe, Davies and Hobday (2003, p.11) affirms that 'currently research barely scratches the surface of systems integration from the user perspective'. In this research, the incumbent telecommunications service providers are users of CoPS, and in the transition process they need to develop new capabilities to adopt CoPS, and at the same time, make old capabilities that are not useful anymore go away. This context leads to the question if systems integration and project management capabilities need to be matched by the user, and, if positive, to what extent.

The framework of analysis, as argued by Davies (1996), should take into account not only the technical, but also the economic and political issues surrounding the transition to NGN, considering the concepts of LTS and CoPS. Economies of scale, scope and system explain the innovation paths found in the evolution of the system. Economies of scale are obtained by cost reduction when using larger networks to

produce a defined product or service (Chandler, 1990). Economies of scope are cost advantages obtained when providing various services with the same infrastructure at a lower cost when providing the services separately using separate infrastructures (Chandler, 1990). Economies of system are 'more specific reductions in cost arising from improvements in control components [whose function] is to manage load and to control traffic flows' (Davies, 1996, p. 1163). Political issues are represented by regulatory ones such as required by the Office of Communications (Ofcom) in the UK, and competitive issues raised by competitors and users. Davies (1996) also highlights some Hughesian concepts of momentum and inertia, typical of LTS. Momentum makes the system evolve and expand, while inertia makes any change on its current status of evolution more difficult, the larger the system.

Complex systems have been studied by several authors (Rycroft and Kash, 1999, Miller et al., 1995, Davies, 1997, Hobday, 1998, Hobday et al., 2000). The category of Complex Products and Systems (CoPS) is used to distinguish from the mass production industries, such as the ones addressed in the studies of disruptive technologies. CoPS are defined as 'high cost, engineering intensive products, systems, networks and constructs' (Hobday, 1998, p. 690). Usually, they require a high variety of distinct knowledge bases, intense user and other supplier involvement, stretching the boundaries of the organisations involved in the production and delivery of CoPS. CoPS have substantial differences from mass produced goods, such as extended life cycles (maybe for decades), long time to decide to invest (meaning long sales cycles for suppliers). They are not mass produced and usually produced in small batches or through one-off projects (Hobday, 1998).

Some CoPS are standalone (e.g. flight simulator, as approached in Miller et al., 1995), but some have to be integrated to existing CoPS, as it is usually the case for telecommunications. If the legacy system is to be replaced, it usually takes some time, maybe years for that to happen. Meanwhile, the legacy and the new system need to interoperate.

Davies and Hobday (2005) show how innovation is managed in the supply of CoPS. The transition to NGN is an opportunity to study the innovation management in the *adoption* of CoPS by incumbent telecommunication fixed-line operators.

One of the difficulties when using the approach of LTS is how to define 'large'. The incumbent fixed-line telecommunications networks are big enough to be considered large, and it has the characteristics of interconnectivity and interoperability, which makes the issue of defining its boundaries a challenging one. Telecommunications operators, like BT, are users of CoPS produced by suppliers such as Ericsson, Alcatel and Siemens. Once such CoPS are deployed, they form the network, a Large Technical System (LTS), to be used by other users: consumers and small, medium and large businesses and organisations. One of the limitations of LTS literature is considering the influence of these last users on inducing innovation and transforming the systems (Summerton, 1994). This influence needs to be addressed in this work, as the services associated with this network/LTS are becoming more and more 'customer-centric'. Also, the LTS approach does not pay much attention to the organisational aspect of the technological systems, focusing more on the interrelation of the various components, where changing one component may impact positively or negatively other components within the system (Constant, 1987). The aim of analyzing BT transition to NGN is to address this issue of organisational change within the LTS.

In the pursuit of establishing the infrastructure and service layers, incumbent telecom operators struggle to establish platforms that will allow the development of new services. These platforms are composed by complex systems (each such component may cost millions of US dollars). These complex systems are interconnected forming a large technical system – LTS (cf. Hughes (1987)). And the LTS would have interfaces for exposure and for interaction with their users (the users can interfere in their design and in the development of new services). For modelling the infrastructure, I will use then the literature that is related to Complex Systems, CoPS (complex products and systems), LTS and platforms. Platform is defined in Oxford Dictionary as 'level surface raised above the surrounding ground or floor, esp one from which public speakers, performers, etc. can be seen by their audience' (Oxford, 1989). This definition highlights an important feature of platforms: visibility to the audience. The visibility corresponds to some kind of exposure to the audience, who can be customers or users in the telecommunications industry context. Thus, platform seems to be better than system, as this last one does not highlight the visibility or exposure of the system to customers and users, such a way that these last ones can influence its

design and the products and services derived from the platform. Interestingly, Gawer and Cusumano (2002, p. 2-3) define high-tech platform as 'an evolving system made of interdependent pieces that can each be innovated upon'. This definition seems to be still highly dependent on system and does not emphasize the visibility or exposure of the system to the 'audience'. It emphasizes though the interdependency of the various systems' parts and the evolution through innovation of each part. These are characteristics already emphasized in systems.

On top of the infrastructure, i.e., the platform, new services will be developed. One major characteristic that makes the NGN different from PSTN is the level of interaction with users and customers that was not possible (or desirable) before. This interaction leads to different forms of collaboration, which depend on the degree of openness of the interfaces provided by the incumbent telecom operator. This notion of platform is being applied by Internet firms like Skype as well. After establishing free and low cost voice communication through the Internet, now Skype is inviting other firms to develop applications on top of their platform.

The concept of platform also tries to give the notion of something in transit, moving or ultimately changing. This is the case of the launching platform for spaceships, the boarding platforms in train stations and airports, and the petroleum platforms.

Both the infrastructure and the service level depend on some degree of openness for the different actors to interact and integrate their efforts into new products and services.

Usually the literature on New Service Development (NSD) and New Product Development (NPD) assume that the 'producer' already knows the end service to be developed and then describes the whole process of development and delivery. This research does not have this focus. It is concerned with the process of building a 'generic' platform where new services can be developed in the future without knowing exactly what this new services will be. One challenge here is the mind set. Some executives in the trade conferences seem not to be very comfort with this idea. A recurrent question was: what are exactly the services that will be developed in this platform that will render the desired revenues and profits in the future? And by the way, when is 'in the future' 'exactly'? After some time trying to find the 'killer application', the industry gave up trying to find it. And many said that there was no

'killer application', but a 'cocktail of applications', i.e., a set of applications that would move in and out of the market, and that the platform should be prepared to this new dynamic. This 'new dynamic' refers mainly to the 'time-to-market' to develop new services, now measured in months and weeks (even days), not years (as it was in the past with the PSTN voice services).

The notion of platforms as noted earlier emphasizes the visibility or exposure of the internal system to the external system. It also lends the idea of flux or flow in the interfaces. There is a literature stream in product innovation, where the concept of product platform is used (see, for example, Meyer and Mugge (2001), Meyer and DeTore (2001), Tatikonda (1999), Meyer and Dalal (2002)).

The concept of platform is a 'common sense way for a firm to leverage technologies into new markets and, at the same time, reduce per-unit costs through more efficient production and procurement (Meyer and Mugge, 2001, p. 26). Here the idea of platforms is applied to products (usually mass produced) and from the supplier perspective (like IBM and SUN). And the issue of product complexity is very generic and not well defined. Usually this literature of product platform is connected to manufacturing, and thus production. This is not the case for incumbent telecom operators that have outsourced their equipment development to specialised equipment providers. Also, the reduction in per-unit cost does not explore the potential of different forms of collaboration, as the Internet culture is making it possible and more popular.

Gawer and Cusumano (2002) put forward the idea of platform leadership, and the examples are firms like Intel, Cisco Systems and Microsoft. Their perspective, as well as of those from the product platform literature, are from the suppliers perspective and usually the literature does not focus on how large users build their platforms in order to deliver new services. Telecom operators now use Cisco Systems and Microsoft platforms to build their own. The leadership (from the suppliers' perspective) consists in establishing market standards and architectures that will be adopted by large users.

The discussions about platform in the literature usually concentrate on the product as the unit of analysis (see, for example, van de Paal and Steinmueller (1998) and Mansell and Steinmueller (2000) for a discussion on multimedia platforms, analysing DVD and CD-ROM; Gawer (2000) about Intel's microprocessor; Gawer and

Cusumano (2002) about Intel, Cisco, Microsoft, Palm, NTT DoCoMo and Linux). The notion of platform does not go to the large ones being implemented by incumbent network operators, like BT, France Telecom and Deutsche Telekom. Gawer and Cusumano (2002) used the example of NTT DoCoMo to illustrate how NTT is using different business models to create an environment where third parties are encouraged to develop applications for their mobile phones. This is part of the scope that this research intends to achieve. The platform being developed is for any device (mobile and fixed phone, PC, laptop, blackberry, IPod, Palm, …).

Some characteristics of platforms are important to take into account in order to understand the platform-centric organisation. And how platform innovation leads and facilitates service innovation in the telecom industry. Firms organise differently in order to develop and implement capabilities to adopt a platform-centric organisation. Platform thinking has significant implications on the way firms organise innovation in services (Meyer and DeTore, 2001). Some pitfalls when transitioning from single-product thinking to platform thinking are (according to Meyer and DeTore (2001):

- The lack of experience of senior executives to build platforms. These senior executives may bring with them the mindset of single and sequential. product or service development. The organisation is focused on the next product or service and does not recognise the value of streams of new products and services.
- The firm is focused on a single market. And focused on the same requirements of customers for a long time, which gives room to disruptive technologies (cf. Christensen (1997)) to take over its market.
- The best people in the firm are too busy paying attention to short-term business, maintaining the existing products and services, not developing or thinking about new ones.
- Reusability is considered a good idea, but some firms think that it will be difficult for different parts of the organisation to work together.
- Platforms are considered only as technical ones, involving only engineers to decide on their architecture.
- The firm has no process to define new platforms. The project control and processes are designed for single product or service approach.

Paoli (2003, p. 157) mentions the various knowledge bases the integrator needs to have in order to:

- put together the parts;
- manage the interfaces;
- organize the architecture;
- invent the 'missing' links (e.g. to integrate).

In order to 'invent the missing links', the systems integrator needs to develop organisational and technological capabilities in order to succeed in a changing environment.

Wise and Baumgartner (1999) stated that "smart manufacturers are moving downstream for a very simple reason: that´s where the money is". Manufactured products are becoming commodities as long as competition becomes fiercer, reducing profitability and the installed base becomes big and the extended product life cycle makes the necessity of substitution or replacement not so demanding. This leads to a strategy of diversification, where the company decides to move to services based on its existing products or on products and systems from others, offering integrated solutions, which, according to Davies (2003) comprise the following four sets of capabilities: systems integration, operational services, business consultancy and financial services (p. 334). The integrated solutions are usually complex products and systems (CoPS), defined as "high cost, engineered-intensive products, systems, networks, constructs" (Hobday, 1998). Thus, the systems integrators have the opportunity not only to provide the integrated solution, but also to operate and maintain the product/system (operational services), provide professional services to upgrade or improve the system performance (also in other areas of the firm, resulting from the deployed integrated solution) and offer financial packages, facilitating the cash flow of the customer, as usually the amount of money and the amortization period are high (Davies, 2003).

Although many manufacturing companies are moving downstream into services, there are service companies moving upstream and acting as systems integrators also (Davies, 2003).

All the infrastructure transformation that the telecommunication industry is undertaking, adopting the IP technology, has the ultimate objective of creating and delivering new services which will sustain their competitiveness. Thus, service

innovation becomes an essential part of the strategy of telecommunication firms. The framework of analysis for service innovation presented by Hull and Tidd (2003, p. 139) highlights performance, SPOTS (Strategy, Process, Organisation, Tools/Technology) model, environmental and national context. An adapted framework for the context of this research is presented in figure 1.

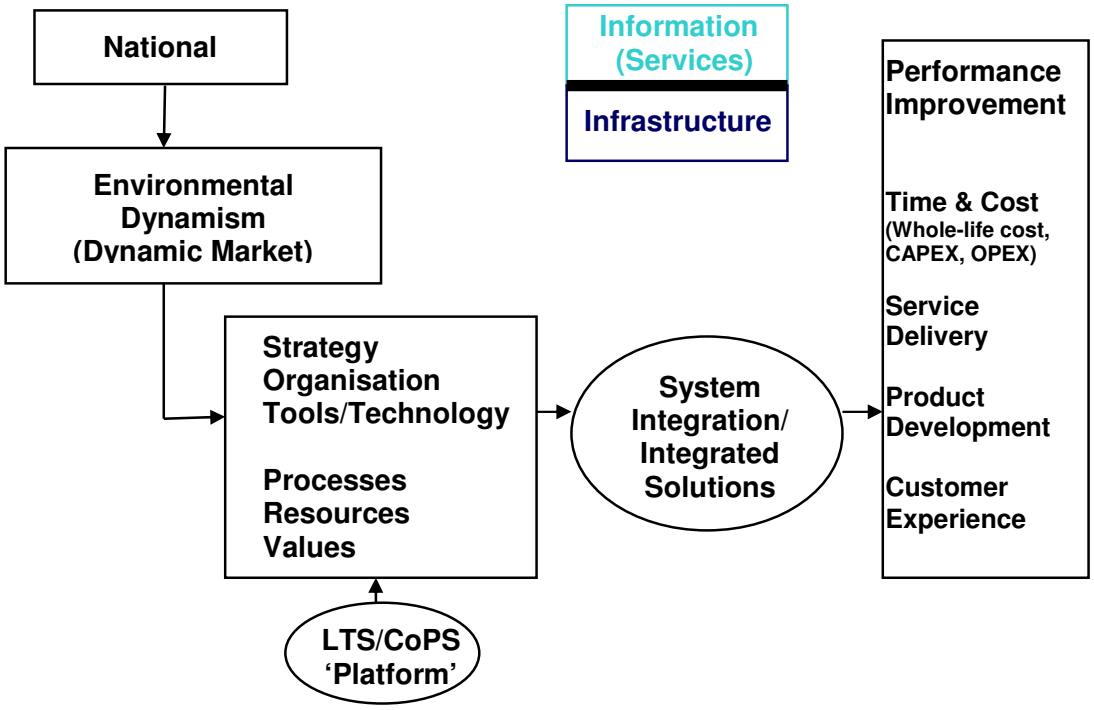

Figure 1- Framework of Analysis for Service Innovation in the context of incumbent fixed-line telecommunications operators in transition to NGN.
Source: Adapted from Hull and Tidd (2003, p. 139))

This framework highlights the system integration in the service/application level, where as Prencipe, Davies and Hobday (2003) focus on system integration in the product or infrastructure level. Performance in this context is measured by the decreasing time to develop new services and the decreasing costs to maintain and upgrade the network/infrastructure.

In order to examine the organization of innovation in services in the telecommunication industry from the telecommunication operator perspective, the following framework of analysis is useful. It combines service innovation with value

and open innovation, and uses the concept of CoPS (Complex Products and Systems) for the infrastructure level, as depicted in figure 2.

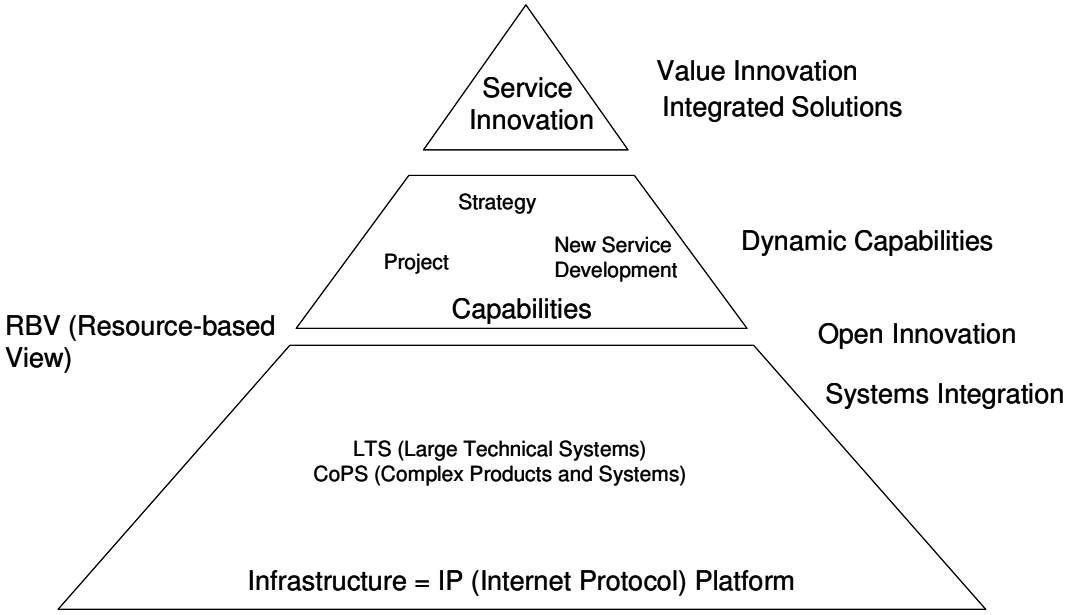

Figure 2 – Framework of analysis combining service, value and open innovation.

4. Telecommunications Evolution to the Transition to NGN

The telecommunications industry comes from a history of monopolistic, and frequently, national supplier and buyer relationship. This was supposed to be a long-term relationship with a reasonable and predictable market share and revenues. With the privatisation and liberalisation of major markets in the world this situation changed and competition became fiercer and a new order emerged. Competition forced a more customer focused approach in order to supply end-to-end solution to satisfy specific needs of the customers, and search for markets beyond the ones the players (suppliers and operators) were used to sell and operate. Capabilities like project management and systems integration became more important.

From time to time, the innovation history experiences short time of radical innovation followed by long time of incremental innovation, during which the new technology diffuses and the institutions adapt to it. After this long time of incremental innovation, another radical innovation shows up and the cycle repeats (Tushman and Anderson,

1986, Utterback and Suarez, 1993). It is interesting to analyze the period when the radical innovation takes place, i.e., when technological and institutional transitions take place. Damanpour (1991) makes a distinction between technical and administrative innovations, where the technical innovation refers to improved or completely new products, services and processes, and administrative innovation refers to organisational structure and administrative processes. It is important to note that when referring to the transition in this context it is also important to address the process of letting go old processes which are not useful anymore. It seems that the bigger the firm and the more people are dedicated to old processes the more difficult is to promote change in the firm, and these old processes may even become a hindrance to change or become what Leonard-Barton (1992) calls 'core rigidity'.

During the evolutionary time of a technology, not only the technology but also the institutions develop and accumulate capabilities which are useful to deal with the current evolving situation. The process of evolution of capabilities implies in solving problems in order to improve the performance of the technology and satisfy the necessities and demands. However, a time may reach, when the accumulation of capabilities lead to the saturation of capabilities and an incremental effort to improve the technology does not solve the changing and critical problems and new demands of customers and market. Then, there is a fertile ground for a radical shift.

Hall and Preston (1988) argue that from 2004 the fifth Kondratieff wave is taking place, calling it the information age of convergent IT (Information Technology). In telecommunications, after mechanical, electronic and digital switching, IP switching is supposed to be the fourth wave, where 'traditional barriers of geography and technology have faded away' (BT, 2005a). The transition and evolution of large technical systems have an inherent degree of uncertainty which varies with time. At the very beginning, the uncertainty is higher, but as the system evolves it decreases to a certain minimum level.

Mansell and Steinmueller (2000) describe the non-executed plan to convergent infrastructure based on the development of ISDN (Integrated Services Digital Network), based on 128 kbps during the late 1980s, at 2.048 kbps at the beginning of the 1990s and broadband ISDN, in the 10 Mbps range, by the mid-1990s. Instead of implementing a higher performance ISDN network, the development of the infrastructure in Europe has continued 'with a combination of circuit-switched

telephony, leased-line, and packet-switch networks based upon heterogeneous technical standards' (p. 100). During that time, the concept of IN (Intelligent Network) was developed, taking advantage of computer technology and software-based functionalities, and incorporating them into the telecommunications networks. The potential of IN in generating new services and increasing economic wealth started to be explored. Mansell (1993) explores the development of the IN in some developed countries and shows the ideas driving it regarding new services. These ideas continue alive in the building of NGN.

By the beginning of the 21st century, IP (Internet Protocol) is becoming the common technology of telecommunications to deliver integrated services combining voice, data and video. It is an unprecedented agreement in the telecommunications industry over a technology.

In 1998, IP was not still recognized as the dominant technology and many engineers believed that ATM (Asynchronous Transfer Mode) would be the preferred packet-switched technology for multimedia applications. At that time, the major experience with IP was through dial-up connections and the quality of experience was such a way that it was even difficult to classify it as 'best effort' (Hersent et al., 2005). This view is reinforced in Mansell and Steinmueller (2000, p. 127), where they provide a discussion about the data communication technologies (X.25, IP, Frame Relay and ATM) and ask if TCP/IP would be the dominant networking technology for the twenty-first century.

Mansell and Steinmueller (2000) use the theory of technology diffusion to illustrate the competition between ISDN and TCP/IP, and show how network externalities influenced the diffusion process, endangering the future of ISDN. Although there were problems with IP technology regarding real-time applications, support for billing and security, nowadays, it is broadly accepted now that IP is winning the race and becoming a consensus in the industry. The main lesson from this contest is 'ignoring the diffusion process because of a belief in the technological superiority of a particular solution is a dangerous strategy' (Mansell and Steinmueller, 2000, p. 113).

In the recent years, broadband connections are increasing and revenues from fixed-line services are declining. This poses a challenge to fixed-line telecommunication operators to create new sources of revenues other than the voice-only services.

Convergence has become a central issue. According to Mansell and Steinmueller (2000), convergence is related to two ideas: one is that all electronic communications can be seen as digital bit streams, so that voice, video and data are seen as bits; the second is the impact on industry and market, where the boundaries of fixed and mobile operators, broadcast, cable TV companies and internet service providers become blurred. From the consumer point of view, there is a whole range of choice for devices, like the various models of mobile phones, the iPod, Microsoft´s Xbox, Sony´s PlayStation and PSP (PlayStation Portable). And when the consumer sees the fixed telephone device it seems too old fashioned. Besides that, Internet-based firms like Skype, Yahoo and Google offer a whole range of new services, free or with low cost, which challenges the business models of the incumbent firms. For example, in 2005, a small company called Skype was bought by E-Bay, which paid US$ 2.5 billion for a company with US$ 60 million of revenues. The commoditization of voice-only services and the convergence of industries, services and networks are driving the transition to NGN by incumbent operators. More powerful consumer devices (e.g. mobile phones, iPods and PSPs) are changing the consumer´s habits and expectations about communications services from service providers. Also, the broadband networks and the high speed Internet are making possible many services unimaginable in a recent past. Internal research conducted in an incumbent fixed wireline operator in Brazil indicated that 75% of the lost traffic was to mobile operators and 25% was due to the migration from dial-up to broadband Internet (AgenciaEstado, 2005).

To address these challenges, incumbent fixed telecommunications operators are building the so-called Next Generation Network (NGN). The concept was extensively discussed in many fora in the period of 2000-2003, like in the ITU-T (International Telecommunications Union – Telecommunications) and ETSI (Ahmad and Kapoor, 2005). The NGN is seen as an all-IP, packet-based integrated network, where application and services are separated from the transport network, so that voice, video and data are transformed into packet data and delivered as integrated services to the customer (OECD, 2005). With NGN, it is expected to reduce the complexity of the network, and its ‘stove pipes’, where for each service it was necessary to deploy a specific network from the backbone to the end customer, increasing overhead costs and posing significant problems in terms of flexibility of the service.

5. Background of BT and of the Telecommunications Industry Transformation

During the Chairman Sir Iain Vallance leadership, until April 2001, BT's vision was 'to be the most successful worldwide communications group'[1]. And this was to be achieved by 'seizing the many opportunities open to us in the global market'[2]. This has led BT to make many acquisitions in the 1990's which resulted in the high amount of debt in 2001. Sir Christopher Bland assumed BT as Chairman on 01 May 2001 with the mission of making a 'structural and financial transformation of BT'[3]. As of 31 March 2001, the net debt reached the unsustainable amount of £27.9 billion after the acquisitions made in that fiscal year[4]. BT was divided by geographical criteria, BT UK and BT Worldwide until April 2000, when a new structure was established, taking into account market sector rather than geography. It was created four main divisions: Ignite, for the broadband IP (Internet Protocol) business; BT Openworld, for the mass market internet business; BT Wireless, for the mobile business; and Yell, for international directories and e-commerce business[5]. In October 2000, two new divisions were created: BT Retail and BT Wholesale. In November 2000, it was announced the intentions to sell BT Wireless and Yell in order to reduce debt[6]. In the BT Annual Report of 2001, the vision of 'to be the most successful worldwide communications group' has disappeared. In February 2002, Ben Verwaayen was hired as the new BT CEO (Chief Executive Officer), replacing Sir Peter Bonfield.

Ben Verwaayen established then a strategy composed of three parts: the first is 'passionate concern for […] customers, and a scrupulous focus on their requirements, now and in the future'; the second is 'the pursuit of profitable growth'; and the third is 'the delivery of Broadband Britain', recognising broadband as 'a critical growth opportunity'[7]. As of May 2002, Ben Verwaayen wrote that 'after a difficult time for the company, we now need to understand our strengths better and play to those strenghs'[8]. In other words, he was re-evaluating BT's core capabilities and business. The former vision of being the most successful worldwide communications group led BT to expand its range of activities to unsustainable levels. And his work was to re-

[1] BT Annual Report 2000, p.1
[2] Idem
[3] BT Annual Report 2001, p.4
[4] Idem
[5] BT Annual Report 2000, p.9
[6] BT Annual Report 2001, p. 6
[7] BT Annual Report 2002, p. 7
[8] Idem

establish BT's focus on the customer and not on itself. About the position of BT in the market, Ben Verwaayen wrote[9]:

> Post-privatisation, BT was the benchmark company in the telecommunications industry, not just in the UK but in Europe and globally. The bad news is that we've currently lost pole position. But the good news is that there's a vacancy. No single company in this industry can confidently lay claim to that position at the moment. That's the opportunity and challenge for us. We can become the benchmark once again. So, that's what we're aiming to do.

It seems that the target is still to be the 'benchmark', but there is a significant cultural shift in terms of achieving that focusing on 'customer requirements now and in the future' rather than focusing on the greatness of itself.

The mobile business was demerged on 19 November 2001, Yell business was disposed and BT Group plc was formed, consisting of four lines of business: BT Retail, BT Wholesale, BT Ignite and BT Openworld. Other business like Japan Telecom, J-Phone and Airtel were also disposed to focus on the core business and reduce debt[10]. A possible floatation of BT Ignite was being studied in 2001[11], but this has not occurred. By May 2002, after assuming as BT CEO, Ben Verwaayen wrote that 'the restructuring is done; stability has been achieved'[12]. In the 2002 financial year (ended 31 March 2002), 89% of the BT revenues were obtained within UK. Internationalisation was restricted to Europe in the strategy set in 2002. Concert, the joint venture with AT&T was also disposed. The seven strategic priorities for the lines of business set in 2002 were[13]:

- to deliver the highest levels of customer satisfaction performance and reduce the number of dissatisfied customers each year;
- to achieve organic profitable revenue growth, while constraining capital expenditure;
- to put broadband at the heart of BT, expand the market for broadband services and create a media-enabled network;
- to provide solutions and other value-added services for multi-site corporate customers in Europe;
- to place all UK networks under a single management structure and to limit investment in legacy voice and data platforms, while migrating operations to new platforms;

[9] BT Annual Report 2002, p. 7
[10] BT Annual Report 2002, p. 9
[11] BT Annual Report 2001, p. 8
[12] BT Annual Report 2002, p. 7
[13] BT Annual Report 2002, p. 8-9

- to use the strength of the BT brand to move into broadband services for consumers; and also into related markets, such as communications solutions and business mobility services for major business customers; and information and communications technology for SMEs; and
- all delivered by diverse, skilled and motivated people.

From these seven strategic priorities, I would like to highlight some points. The fourth priority led BT to rename BT Ignite to BT Global Services and become a leading provider of integrated solutions to major customers in Europe. This move to integrated solutions is going to be explored in more details in chapter 5. The fifth strategic priority led BT to two major initiatives: BT 21CN programme, a mega-project of £10 billion to be done in 5-6 years; and the open innovation model to revitalize the innovation processes within BT. As a result, the Next Generation Network is a network transformation to adopt IP that is needed for incumbents to compete in the world of horizontal broadband applications, where exposure of capabilities, different forms of collaboration with third parties and new business models are important.

The central question of this research is how the incumbent telecom operators are surviving convergence/fierce competition and radical technological change mainly after the bubble burst at the beginning of the 2000's. I examine here the BT case study as it has embraced technological change in an unusual way. Also BT seems to be taking more radical initiatives in order to stay ahead of their competitors. Thus, BT, as a first and faster mover, was chosen to be the main case study from which possible generalisations could be drawn.

BT in particular was suffering from huge debt problems in the beginning of the 2000's. In 2001 when Christopher Bland joined BT as Chairman of the Board, BT had had £ 28 billion in debts. 'We went through a traumatic situation. […] We could do nothing. We could only pay our debts at that point'[14]. 'BT took some big decisions at that time to rapidly address its debt mountain and that created malleability within BT - an understanding that change was needed and that the old BT wasn't right anymore'[15]. It is important to note that the debt problem occurred in the beginning of 2000's was a huge crisis in the history of BT and may have accelerated its change process. As Matt

[14] Interview with BT CEO Ben Verwaayen in Global Telecoms Business, Sept/Oct 2005 n82, p.13
[15] Interview with BT CTO Matt Bross in http://networks.silicon.com/telecoms/0,39024659,39152548,00.htm accessed on 13 Dec 2005

Bross notes, that moment of crisis brought some 'malleability' to BT's culture and open the mind of BT employees to a 'new BT'. The Chairman Christopher Bland prepared the ground to bring new people to BT and in 2002, a new CEO was hired, Ben Verwaayen, and also a new CTO, Matt Bross, this last responsible for the open innovation and technology strategy at BT. Four years later, in 2005, 'the debt problem has been addressed, we've changed from just being a telco to also being a major supplier of ICT services, and we've also revitalised our approach to innovation'[16]. The main areas to work in telecom in this transformation are 'ICT for business, broadband the consumer, and convergence of services where you bring things together. That's how you build innovation'[17]. ICT services seems to be a core competence of BT. The issues that has been addressed more intensely in the last years are the broadband adoption in the UK and the revitalisation of the approach to innovation (due to converged services). This revitalised approach to innovation has been called open innovation.

While analyzing the data, it became clear that the four main issues or challenges for the transition to Next Generation Network and BT survival under the technological change are:

- Reduction of debt (at £27.9 billion in 2001), finding its strengths (core business/capabilities) and consolidating its operations. One of the strategic priorities was to consolidate BT and present it as one BT to the customer. A strength that BT has been exploring during this technological change to IP is to offer networked solutions to multi-site customers, the networked IT services.
- The construction of a new infrastructure based on IP (Internet Protocol) technology. For this BT established a large and complex project: BT 21CN. Here the aim is to build a network that will serve as a platform that will allow the development of new services by BT and with the collaboration of external parties. Main capabilities in focus here are project management and systems integration for large and complex projects in the context of a large user of technology and complex products and systems.

[16] Idem
[17] Interview with BT CEO Ben Verwaayen in Global Telecoms Business, Sept/Oct 2005 n82, p.12

- To revitalise the innovation process within BT. It means to innovate the way BT innovates. A new structure is put in place, where innovation is owned at the chairman level. Also, this shows how BT is reorganised its structure for innovation and establishing mechanisms to take better advantage of external innovations and integrate into BT's internal processes. It also shows how BT is using venture capital and Intellectual Property rights to foster innovation. The theory behind this analysis is the Open Innovation Model.
- Service innovation for 'horizontal broadband applications', where the management of creativity, user innovation and convergence of services play a major role. Internet and broadband have been changing the perception of customers about services and their active participation and collaboration on shaping them. Developing services from the customer perspective, taking into account the total customer experience, forces BT to establish new processes for service development, involving the customer and using multidisciplinary teams. The main capability here is software development and the main challenge is on creating in collaboration with third party firms. The issue of business model becomes of central importance, as the value of the platform will be determined by the appropriate business model for each service or package that will be delivered through the new IP infrastructure.

One recurrent theme in BT transformation and fast implementation of the NGN through their 21CN project is innovation, i.e., changing the way BT innovates: innovating innovation. So, innovation processes at BT are examined and the concept of 'open innovation' is used as a background to analyze the data acquired. Also the capabilities of systems integration, project management and software development, highlighted by the CoPS (Complex Products and Systems) research are examined in the context of the user of the technology.

One answer to the question of how BT is surviving the radical technological change and competitive market provided by the adoption of IP and market convergence is through changing the way BT innovates both in infrastructure and service layers. But how is BT trying to innovate innovation and what are the implications on BT organisation and the whole industry? This chapter focuses on BT and the following chapters address the innovation issue from an industry perspective, searching for generalisation of some of the findings.

6. Innovation in the Transition to the Telecommunications NGN

Several start-up suppliers showed up in the market in the late 1990´s. Some are struggling to become profitable and others were sold to established suppliers. The market for incumbent telecommunications service providers, a typical CoPS context, is characterized by long sales and short delivery cycles. It is a very difficult market for smaller companies. As an example, BT in the UK announced on April 2005 its preferential suppliers for the BT 21st Century Network (BT 21CN), where a massive transformation into IP-based Next Generation Network is going to take place. Eight suppliers were selected: Siemens, Alcatel, Huawei, Fujitsu, Cisco, Lucent, Ericsson, Ciena. They are relatively large firms with strong financial power.

In the beginning of the 2000´s, several incumbent telecommunications operators have been experiencing financial problems. So, the appeal of the IP technology in reducing operating and capital expenditures was very strong and made some incumbent providers to accelerate its adoption. Another driving force for the massive adoption of the IP technology is the announcement of established suppliers in discontinuing the development of systems and equipment based on the traditional circuit-switched technology, making it unsustainable in the long term. Revenues and profits with voice-only services tend to decrease, as competition increases. So, the capability and flexibility of service providers in offering new products and services become crucial. Market liberalisation and privatisation have been changing the competitive scenario for the incumbent service providers. They need to expand to new and foreign markets and face fierce competition in their domestic market.

Innovation may be seen as invention + commercialization (Freeman and Soete, 1997). It is important to verify what happens in the interface between invention and commercialization, as the organisation which makes the invention may not commercialize it, creating various possibilities of purchasing technologies, products and ideas from different firms. This is the basis of the concept of open innovation as conceptualized by Chesbrough (2003). BT, for example, uses the concept of 'innovation continuum' to highlight its end-to-end process (Figure 3).

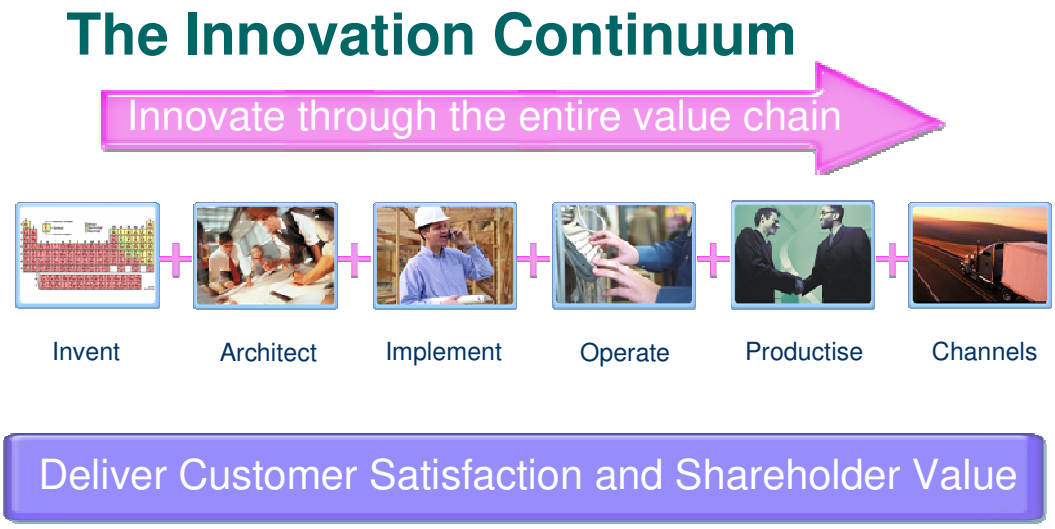

Figure 3 – The Innovation Continuum at BT

Source: Dunbar (2005)

Thus, expanding the concept of innovation and considering it as an end-to-end process, we may see it as invention + integration + commercialization, where invention is predominantly at the suppliers side; integration is represented by architecting and implementing the network (the infrastructure level), highly dependent on project capabilities; and commercialization is represented by operating, productising and distributing the products and services. The locus of innovation is moving to the edge as the processing power of consumer devices and competition increases. It is more and more feasible to come up with a new application, select and discard it without going into bankruptcy. The cost of failure tends to decrease. Thus, the issue turns out not to be a technology driven company but how to leverage those technologies to the benefit of customers and shareholders. This makes the issue of not only concentrating on internal processes, but also on boundary processes to achieve such aim. Much has been researched about supply-push and demand-pull. However, they are not separated. The boundary processes link and stretch them. The right timing to deploy the new infrastructure and to deliver new services (decreasing delivery time, for example) becomes important parts of the innovation strategy. So, including the timing dimension, the innovation equation encompasses invention + integration + timing + commercialization.

Although BT, as a large incumbent fixed-line telecom operator, is innovating radically in transforming its network, this is not what is happening with other incumbents in Europe and throughout the world. Interviewees from other incumbent operators say that what BT is doing is 'too radical' for their context. Also, in this context, as the telecom operators are not producers of technology, they innovate to the extent their suppliers innovate. The key innovation factor for the operators is the selection of the most appropriate partners. All of the selected BT partners for the BT 21CN project are large companies: Siemens, Cisco, Alcatel, Ericsson, Fujitsu, Ciena, Lucent and Huawei. The smallest is Ciena. However, the majority of these large firms are partnering with smaller firms to supply their solution to BT. As the telecommunications networks are Large Technical Systems, where some components are CoPS (Complex Products and Systems), the key to innovation and success in the market is to combine its core capabilities with those of smaller firms in order to deliver complete, end-to-end solutions to sophisticated and demanding business customers. Thus, in this context, large firms and small firms partner with each other to innovate. It is true however that the IP technology was first developed by smaller, non-incumbent firms of the telecommunications market.

From the perspective of incremental-radical innovation, taking the voice-only service as the existing product of incumbent fixed-line telecommunications operators, the NGN make it a commodity, which is still used and purchased but also bundled with other services. Voice-only service generates less and less revenues. There is a general consensus that broadband is cannibalising the incumbents´ business, and there is an increasing pressure of Internet companies like Skype, Google and Yahoo with their VoIP (Voice over Internet Protocol) services, pressing prices down and challenging incumbent business models. In terms of organisational capabilities, the transition to NGN is competence destroying, compared to the PSTN technology. However, most of the incumbent operators are making the transition in an 'incremental' way, as it takes much time, years to complete. In LTS, like the telecommunication networks, there is much inertia to change, and it may take much more time to change than in the mass market products context. So, incumbents have more time to position themselves in the 'radical' innovation.

Both component and architectural knowledge are changed in the transition to NGN. The component knowledge is not at the level of the microprocessor, transistor, etc.,

but at the level of telephone exchanges, which can be considered CoPS (Complex Products and Systems). BT claims, for example, that the number of 'elements' (or components) in its network will decrease from 100.000 to 30.000, simplifying the network operation and saving BT about £ 1 billion in operational expenses from the year 2008/2009. The interconnection of these elements will change such a way that there will be a different network configuration and points of presence, where BT customers, partners and even competitors connect to BT network. A programme called Consult21 was created by BT to deal with this issue of changes in interconnection and relationship with stakeholders. Also, there is no one-to-one correspondence between the equipment used in PSTN and the one used in NGN, which reinforces the component and architectural change.

The term 'disruptive' is being overused in the telecom industry to express the impact of VoIP (Voice over Internet Protocol) on the incumbent telecommunications operators business. VoIP and broadband bring with them not only the threat of a new technology, but the whole world of Internet and its business model based on free/low cost services: disintermediated services which do not pass through the 'control' and billing system of incumbent operators. VoIP services provided by firms like Skype have a disruptive trajectory. However, unlike other markets analysed by Christensen (Christensen, 1997, Christensen and Overdorf, 2000, Christensen and Raynor, 2003, Christensen et al., 2002), the transformation in telecommunications networks is in a Large Technical System (LTS), in a regulated environment and with high inertia. And due to this inertia, incumbents are having time to adapt to the new technology and their business seems not to be destroyed. Also, incumbents have the option to partner or even buy Internet companies, minimize the effect of VoIP on their core business, and learn. For example, BT partnered with Yahoo in 2004 and started offering VoIP, but with no reduction in prices. After the purchase of Skype by E-Bay in 2005, BT started to offer a VoIP service even cheaper than Skype.

Innovation in incumbent telecommunications operators cannot be analyzed only within the firm. As these operators are large adopters of technologies, the selection of suppliers to work with is of the highest importance. Matt Bross, CTO of BT Group, characterizes the innovation 'continuum' as composed by three elements: research and discovery, validate and articulate, and execute (Berris, 2005). It is clear from this perspective that the innovation continuum may not happen within one firm, it happens

across boundaries, from the invention, through to the supplier´s network and the suppliers themselves, to the service providers, the distribution and to the final customers. The challenge now is that innovation locus is moving closer to the customer. BT and other service providers are starting to invest in a new network to provide 'new services' without knowing exactly what these services are going to be. The new services dilemma breaks the paradigm of the control and predictability: the willingness to know how things will end before they begin.

The fact that BT, as an incumbent, is embracing a radical innovation in a more radical way may be partly explained by the strategic leadership. BT changed its top management significantly in the beginning of the 2000´s, a few years before announcing the BT 21CN. Main changes seem to be in the CEO and CTO positions, assumed by outsiders. These may have accelerated the decision-making to deploy the BT 21CN.

Although Miller et al. (1995) argue that innovation in CoPS tends to remain in the fluid phase of product innovation of Utterback and Abernathy (1978) model, product and process innovation in this context seem to occur in different firms. Product innovation is intense on the supplier side, but as soon as it is deployed in the service provider network, it begins the process innovation, and a process of mutual adaptation occurs between supplier and service provider in order to deliver services to the mass market. A dominant design is achieved at the industry level through standardization bodies. The Tushman and Rosenkopf (1992) model seems to be the most appropriate model for this context of transition to NGN, as it starts to consider the complexity of innovation and the external (e.g. socio-political) factors which may interfere in the evolution of the innovation.

Finally, the transition to NGN represents also the 'saturation' of a technology: the circuit-switched technology of PSTN networks. This is evidenced by the fact that many incumbent suppliers announced the discontinuation of their investment in products based on circuit-switched technology, intensifying their investments in IP technology. The circuit-switched technology seems to have achieved its limit in the provision of flexible services which customers are demanding and will demand more and more in the future. The S-curve applies in this context and explains one of the reasons for the transition to NGN.

6.1. Open Innovation at BT

BT, a traditional telecommunication operator in the UK, has been examining 'the process of innovation itself as they attempt to transform themselves and drive sustainable sources of value creation' (BT, 2006, p. 4).

Open innovation means that 'organisations can draw on external resources and best practices to complement the value of own "internal" innovation assets – and achieve greater real returns on their overall investment in innovation' (BT, 2006, p. 6). And 'innovation itself is valued as a commodity that can be bought and sold, loaned, licensed, hedged and re-invested' (BT, 2006, p. 6). Products and services need to be delivered much faster in the past. Traditional firms like BT were used to deliver a single or few set of products and services for a long time (usually years), for a definite set of customers (with no other significant choices). Now customers have more choice and certain services can last few months or even weeks or days. Thus, the capability to offer new services faster became too complex for just one firm to provide, relying on its internal R&D and product development pipe.

With the high availability of technology in the telecommunications market, the expectation of innovation is higher and incumbent firms, in order to sustain their growth and competitive advantage are not expected to innovate alone. In fact, they reached a point where external collaboration is needed to sustain growth and profitability. One of the arguments of the open innovation model is that large firms do less own R&D and rely more on external partners to deliver new products and services. In the telecom industry it is known that this shift to less own R&D by the incumbent operators was a reality by the end of 1995, when most of the R&D performed for the infrastructure (network and its elements) was relegated to the specialist equipment providers (Fransman, 2002). During the 2000's, this situation remained the same way for BT.

In 2002, BT hired a new CTO, Matt Bross, coming from the USA, and with experience in a non-incumbent telecom operator, Williams Communications. He says that having never worked for an incumbent telco before is positive as he was unafraid of breaking the boundaries and changing the innovation processes of BT.[18] And that seems to be the challenge in the transition to NGN. Surely, implementing the new network is a very complex activity, requires a lot of skills in project management and

[18] Interview with BT CTO Matt Bross in Global Telecoms Business, Sept/Oct 2005 n82, p.34

systems integration. However, one central challenge is to change people's mind, behaviour and attitude: people are used to PSTN processes and naturally resist changing to the new NGN-based processes[19]. The PSTN processes are related to functional structure and clear end services, and the NGN processes are related to platform multifunctional structure and on enabling new services (without having a clear idea of what services will be developed). BT's approach to innovation is going to change the way the firm operates[20]. This new way of operation, new innovation processes is the focus here.

6.2. Value Innovation

Services provided in the Internet are changing the way customers perceive value. Besides the low cost airlines (like EasyJet and Ryanair) and the travel sites (like Expedia and Lastminute.com), communication services are being profoundly affected by the Internet.

Skype, founded in 2003, and sold to e-Bay by the end of 2005 for US$ 2.6 billion, is a remarkable example. Niklas Zennström stated Skype's value proposition very clearly: 'To change the way people communicate for free'[21]. Skype implemented the notion that it is possible to make a long distance call with good quality for free or very low cost, compared to traditional methods. This is changing the rules of the mainstream industry. As long as Christensen (1997), with his concept of 'disruptive technology', emphasizes the trajectory of one technology around a mainstream market, the concept of value innovation modifies the rules and best practices that characterize the mainstream market.

As it is widespread in the telecommunication industry, the uncertainty level is high, as the technology and its trajectory is predictable to a certain extent, but not the way it is going to be used, even more now that customer interaction is increasing. In order to minimize this uncertainty, traditional telecom operators are creating what can be called 'platform for innovation'. This platform is based on Internet technologies (e.g. IP – Internet Protocol) and enables the operator to deliver services combining voice, video and data seamlessly. The immediate effect is the convergence of networks and services, and the possibility of many firms from different industries to cooperate in

[19] Interview with BT Executive
[20] Idem 1.
[21] Skype Night event on 30 November 2005.

ways that were not possible (or feasible) before. Market boundaries between infrastructure (BT, Deutsche Telekom, France Telecom) and content (e.g. Time Warner, Disney) firms are blurring and opening up new opportunities.

New value propositions are redefining business models. No wonder now that innovation is more around business models than around products and services. And customers talk less about the networks and technologies, and more about the services and how to use them. And ultimately, the recurrent question is 'what is value in the telecom industry?' Also, as market boundaries are increasingly being broken, the idea of 'telecom industry' needs to be revised.

The idea of value innovation sets a space where imitation and conformance to existing market rules are outdated. If start-up and traditional firms want to survive, they are now invited to change the rules of the market. And this is not possible to do it alone. So, that is why the power of partnership between start-ups and traditional firms become important, also in the early stages of a research project, and the concept of open innovation becomes more and more popular in the telecom industry. Open and value innovation are closely interconnected.

6.3. Service Innovation

Open and value innovation are setting up the causes and conditions for service innovation: while building a platform for innovation based on Internet technologies, what are the services that will render revenues and profits?

While the traditional telecom operators and service providers struggle to find out what are the services 'of the future', Internet firms like Google, Yahoo and Skype, and websites like Myspace.com and Youtube move fast, creating new rules and new 'blue oceans' of market. However, traditional telecom operators are targeting the more robust market (business and critical mission applications) that Internet firms will unlikely address. Other concern is the limitation of the Internet infrastructure, as demand for high bandwidth services grow, and the argument that the Internet architecture has 'ossified' (Handley, 2006). Paradoxically, the architecture of the Internet, which allows unprecedented change, does not evolve significantly since the early 1990's (Handley, 2006, p. 127).

One consequence of the convergence of networks and services is that the internal organisation divisions are also being broken. The silos in structure and management

are being dismantled and a reconfiguration of organisational structure and capabilities is taking place. BT, for example, is identifying and implementing the so-called 'common capabilities' which allow the faster development of new services. Common capabilities are reusable elements, building blocks that reduce the time to deliver new services. Some of these common capabilities are: authentication, digital rights management, secure connections, directory and profile. Another interesting aspect of the capability approach is the decoupling of the physical elements in the infrastructure from the service and support logic, such a way that any change in the service level does not translate necessarily into a change in the infrastructure level. This approach is commonly adopted in the computer industry, where new applications are developed around a 'common' operating system (e.g Windows, Unix or Linux) (Levy, 2005).

The temporary and unique characteristic of creating new services and the faster time-to-market that is demanded stimulates the development of 'good project management' practices. For the infrastructure transformation, BT created the 'BT 21st Century', which is an umbrella project for the whole transformation of its PSTN infrastructure into a new IP-based NGN infrastructure. Also the use of project management concepts and project managers has been increasing in BT and other traditional telecom operators.

6.3.1. The Rise of Networked IT Services as Integrated Solutions at BT

The phenomenon of integrated solutions is usually analyzed from the supplier perspective, e.g. a manufacturer of one specific product that offers services around it, such as financial services, operational services, business consultancy and system integration (cf. Davies (2003)). BT started its transformation around the year 2000, when high debts were threatening the survival of the firm. At that time, in April 2000, it was created one division called Ignite to be responsible of broadband IP network business, including Syntegra, their systems integration business. Ignite was a response to the growing market for data communications led by the IP technology. By the end of 2001, BT Ignite was being considered to be floated[22]. In November 2001, Andy Green was appointed as CEO of BT Ignite[23]. In 2002, BT Ignite was described as the 'business services and solutions division, serving customers worldwide'[24]. And its

[22] BT Annual Report 2001 p. 8
[23] BT Annual Report 2002 p. 5
[24] BT Annual Report 2002 p. 15

activities were realigned to focus on multi-site corporate customers[25]. In April 2003, BT Ignite was renamed to BT Global Services[26], BT's 'managed services and solutions provider, serving multi-site customers worldwide'. And the target was the '10.000 global multi-site organizations with European operations'[27].

In 2005, BT Global Services is described as addressing 'the networked IT services needs of multi-site organisations including major companies with significant global requirements and large organisations in target local markets'[28]. Networked IT services was the expression adopted as ICT (Information and Communications Technologies) services was not understood by some customers in North America[29].

The starting point can be the value stream in CoPS shown by Davies (2003, p. 343), where he highlights for stages: manufacturing, systems integration, operational services and service provision. Integrated solutions occur in the 'manufacturing-services' interface for suppliers of CoPS. In the case of BT, as a large user of CoPS, integrated solutions occur in the service provision. Networked IT services are provided to multi-site firms.

As Davies (2004) points out, in order to analyze how firms are moving into high-value integrated solutions, it is necessary to identify (i) the firms' strength or 'base' and (ii) how firms diversify to other activities which render or will render profitable growth. BT passed through difficult times in the beginning of the 2000's and in 2002, Ben Verwaayen, BT CEO, suggested that BT needed to understand their strengths better and play those strengths. In this chapter, I argue that providing integrated solutions to large multi-site corporations is the strength that BT is playing to transform itself. Networked IT services represent both the convergence of telecommunications and IT, and the emergence of integrated solutions as the main business model for the transition to Next Generation Networks.

The core capability of BT was and continues to be the design, operation and maintenance of networks and offer services based on those networks. These networks used to be telecommunications networks, and at a certain point, it was renamed to

[25] Idem
[26] BT Annual Report 2003 p. 15
[27] BT Annual Report 2003 p. 15
[28] BT Annual Report 2005 p. 8
[29] Presentation by Andy Green, CEO BT Global Services

communications networks[30]. Although there are signs that value will migrate to services on top of the network (broadband horizontal applications), there are currently major opportunities to offer integrated solutions to large multi-site corporations in Europe. BT, through its major transformation project, BT 21CN continues to invest and improve its core capability in designing, operating and maintaining networks. However the nature of the services being offered is changing from fragmented products and services, like fixed-network calls, exchange lines, receipts from other operators, wireless products and private services to integrated solutions including 'desktop and network equipment and software; transport and connectivity; managed LAN (local area network), WAN (wide area network) and IPVPN (internet protocol virtual private network) services; managed mobility; applications hosting; storage and security services; and business transformation and change management services'[31]. IT systems have increased substantially in large firms. Their complexity and internetworking make such firms to spend huge amounts of money and effort building and managing them. BT (and other operators) sensed an opportunity to provide their large business customers with the simplicity of one contract/provider, allowing them to concentrate on their core business (when IT is not their core business).

Incumbents like BT chose not to produce and manufacture their systems and equipment since the 1990's, preferring to buy from the market. Thus, BT concentrates its efforts in the architecture and design of the network and selects the best vendors to realize them. The performance of integrated solutions can be measured by the performance of BT Global Services. The table below shows how the turnover has evolved and in 2006, it has surpassed both BT Retail and BT Wholesale.

Moving from a base in services

BT has been experiencing decreasing turnover from fixed-to-fixed voice calls in the last years. This can be seen in part from the revenues from BT Retail. The strategy is then to move from traditional fixed-line voice services to networked IT services. This comprises integrated solutions for large firms which intend to outsource their network operations. The traditional value stream for capital goods is as follows (Davies, 2004, p. 737):

[30] In the BT Annual Report 1999 p. 5, there are remarks about changing from telecommunications to communications.
[31] BT Annual Report 2005 p. 33

Manufacture → systems integration → operational services → service provision

The interface between systems integration and operational services represents the locus of what Wise and Baumgartner (1999) going downstream from manufacturing to services. Incumbent operators like BT are service firms that do not have manufacturing activities for a long time. In BT's perspective, systems integration occurs when building infrastructure, such as the BT 21CN. In this case, BT needs systems integration capabilities to match the systems integration capabilities of the suppliers and integrate multiple vendors in a single mega-project. The value stream is extended by BT considering the service provision as an integrated solution, where BT offers systems integration, managed services and consultancy services to large multi-site corporations.

The end service provision is transformed into another stage of systems integration and operational services as follows:

Manufacture → systems integration → operational services → systems integration → operational services → service provision

Integrated solutions occur then in two interfaces: one in the manufacturing-services interface with specialized equipment suppliers, and another in the communications-business IT infrastructure of multi-site firms.

Among the capabilities of BT to deliver networked IT services are business transformation, change management, large scale project management, process transformation, solutions design and innovation.

Among the capabilities for integrated solutions, the following seems to be important for BT:

Systems Integration

BT has won many contracts to 'provide and manage networks' for multi-site organizations. Providing networks means to integrate different equipment and systems from various external suppliers (e.g. Cisco, Nortel, …).

Managed (Operational) Services

Besides building and/or upgrading the network, BT becomes responsible for monitoring the performance of the network and taking care of the maintenance and preventive actions to keep the network running according to the SLA levels.

Consultancy Services (Professional Services)

'Consultancy services are also provided to help organisations understand network performance, operate their networks and applications efficiently and transform their business to gain advantage in the digital networked economy'[32].

About Financing

BT does not report on financing services specifically. Vendor financing may be provided by the vendors directly.

The Performance of BT Global Services

The activities of BT Global Services include: Global IP Infrastructure Services, Applications and Application Management Services, Outsourcing and Managed Services, Business Transformation Services. These activities are substantially done with partners: Cisco, Intel, Alcatel, Nortel, Vodafone, and Marconi for Global IP Infrastructure Services; Computacenter and Microsoft for Applications & Application Management Services; Siemens, CSC and HP for Outsourcing and Managed Services; and Accenture for Business Transformation Services.

The types of contracts that BT is now dealing with are of higher values, long term (for some 3 to 10 years usually) and one important part for the profitability of this business is the re-sign of major contracts. BT claims that around 90% are re-signed. 'Long-term contract is essential for the profitability of the business model'.

Each contract represents a different customer with different needs. In this sense, skills in large scale project management are important. In some instances, the learning in one project can be transferred to another, but the real gain (and profit) occurs when the contract is re-signed. Large business-to-business contracts where factors like trust, reliability and security are valued.

In the year 2005, BT Global Services had its first full year operating profit[33]. It is interesting that this division was being considered to be sold in the beginning of the 2000's, during the debt crisis.

As the CEO of BT Global Services declared: 'We have to be an integrator'[34]. As BT is offering networked IT services as integrated solutions for the interconnection of

[32] BT Annual Report 2006 p. 33
[33] BT Annual Report 2005 p.33

multiple sites of large multinational firms, BT cannot be physically present in every place where the customer wants to be. So, BT needs to work with partnerships and integration. BT Global Services has restructured its division from a fragmented one to another more simplified from the customer perspective.

7. Discussion

As the cost of failure is lower, firms may grow not analyzing the size of markets or its profitability, as they are largely uncertain and unknown in advance. They may grow by 'early adopters' and setting up strategies to scale up the adoption to mass market. This mechanism of scaling up, typical of startup companies, is becoming of paramount importance for incumbent companies. To grow around early adopters and be able to combine and integrate early adopters of different stages and communities may be an important source of competitive advantage. It is expected that the transition to the 21CN, the all-IP network, will provide BT with the capability to 'play' with new services with low cost of failure, and with the agility of smaller firms.

In the telecom industry there is nowadays much discussion about the platform for new services, and convergence of fixed and mobile networks. 'Telecommunications industry is becoming the production technology of many industries' (Thurow, 1992). A standard platform called IMS (IP Multimedia Subsystem) is under evaluation and there is much hype around it now (in 2005). This IMS platform aims the 'creation and control of high value, real-time IP applications, such as conferencing, messaging & multiplayer games' (Finnie, 2005). Underlying this platform is the necessity of telecom operators to make money from applications and confront the low cost or free model of the Internet. Then, it is possible to see a clear tension between the low cost/free model of the Internet and the charged (as much as possible for the premium services) of the incumbent telecommunication firms model. Examples of the Internet model are Skype, Yahoo and Google, which offer free or low cost communication services. More radical approaches are being attempted by firms like Popular Telephony, which is trying to deploy the concept of serverless networks, extending the decentralized and distributed characteristics of the Internet model to business customers. The battle in services will be between services controlled and charged by

[34] BT CEO Global Services Andy Green's presentation in 2005

the telecommunication companies and the disintermediated services, where the Internet companies use the broadband pipes of the telecom companies, but these do not take part in the revenues that these services provide.

The transition from PSTN to IP NGN is about enabling IP communications, where incumbent fixed-line operators build a 'flexible factory of innovative services', a converged network, transporting voice, video and data in one single network, reducing operation and capital expenditure, and making possible new sources of revenue with the combined services. With this IP-based network, it is expected that the incumbent operators have more flexibility in adapting the network to the customer and not the opposite. This implies in finding new niche markets as well as retaining existing and new customers. It may be possible, then, to provide 'mass customization of services', which is not possible with the current traditional PSTN technology. As long as more and more people have access to several competitive communication providers, it becomes fundamental to be able to retain customers. Thus, the telecommunications networks are now called customer-centric.

Open standards at the complex system level are blurring the boundaries of networks and industries, and driving convergence. And convergence is driving new services. Combined voice, data, video and mobility services can be offered by different types of firms: fixed and mobile operators (e.g. BT and Vonage), cable TV firms (e.g. NTL), Internet firms (Skype, Google and Yahoo).

It is interesting how the words 'disruptive' and 'simplicity' are being used in the telecommunications industry nowadays. 'Disruptive' is used to express any 'radical' change, not only the way Christensen (1997) conceptualized it. Simplicity is used in the sense of delivering simplicity to the customer. 'Simple to use interfaces and devices' is now a common expression in the industry. Complexity and simplicity seem to be different aspects of the same reality. In order to achieve simplicity at the end customer, the all-IP Next Generation Network is being built, and the result is very complex. It is the role of the suppliers, working with the service providers, to manage and understand complexity in order to deliver simplicity.

Cost savings obtained by economies of scale, scope and system are the drivers behind the momentum of telecommunications systems (Davies, 1996). The same way these are the drivers behind the transition to NGN. However, they are not the only drivers.

It seems that these cost-saving drivers are important in order to justify to the board and shareholders the capital investment in the transition. Another driver has to do with competitiveness and being able to build and maintain a network which will be flexible enough to cope with future demands in terms of services and applications. It is possible to say that the intensity of the drivers may vary along with the evolution of the transition. Cost-saving drivers are more intense in the beginning, but as long as the transition evolves, the possibility to create new services and applications becomes the main driver.

Thurow (1992) questions if computer telecommunications is truly revolutionary, pointing out that 'historically only two inventions have revolutionized our industrial world […]: train and electricity' (p. 1). He argues that the answer to this question will be possible when looking back to the events, but he suggests that this could be a third major revolution. Beniger (1986) points out the control revolution of the information society. Control refers to the 'purposive influence toward a predetermined goal' (p. 7). The term *revolution* was borrowed from astronomy and first used in political discourse in seventeenth-century England, meaning the restoration of a previous form of government. Then, with the French Revolution, it acquired the meaning of an abrupt and often violent change, as it is nowadays (Beniger, 1986). It seems that the transition to NGN will lead to the services revolution, where new services may change profoundly human habits.

'Services cannot proliferate unless users have the facilities to control them, wherever they are' (Feneyrol, 1998). The issue of control is one of the most important in the information society. One point is users controlling the services in order to customize it according their needs. The other point is the service provider controlling the service in order to obtain revenues from it. With the Internet and broadband, the service providers run the risk of being only 'pipe' suppliers, but not being able to control and charge the services which use that pipe.

8. Final Considerations

Analysing the empirical data collected and using the framework of infrastructure and services (in layers), it became clear that the some of the main issues for the survivability of BT are:

- To find its strengths or core capabilities and exploring them to generate new source of revenues. Networked IT services proved to be such a core capability, offering integrated solutions to large customers, interconnecting multi-site operations.
- To transform the infrastructure, adopting the IP (Internet Protocol) technology, and switching off the circuit-based PSTN. For this BT established a large and complex project: BT 21CN. Here the aim is to build a network that will serve as a platform that will allow the development of new services by BT and with the collaboration of external parties. Main capabilities in focus here are project management and systems integration for large and complex projects in the context of a large user of technology and complex products and systems.
- To revitalise the innovation processes within BT, adopting the open innovation model. A new structure is put in place, where innovation is owned at the chairman level. Also, this shows how BT is reorganised its structure for innovation and establishing mechanisms to take better advantage of external innovations and integrate into BT's internal processes. It also shows how BT is using venture capital, Intellectual Property rights and collaboration with universities in order to foster innovation.

Technology-focused innovation is becoming commoditised in this fast moving and unpredictable world (BT, 2006). 'It is not technology per se that matters, but technology-in-use, and that is precisely what is so hard to predict ahead of time' (Chesbrough, 2003, p. xiii). It is not the technology but its use that is disruptive[35].

Innovation is occurring increasingly around business models[36] and people are talking less about the network and technology associated, and more about how to use the network and technology[37]. So, in a world where knowledge is abundant and technology is available to whom is capable to absorb or buy it, service innovation may flourish as a consequence of technology-in-use practices.

The concept of open innovation tries to change the direction of the innovation flow, in the past predominantly from the laboratory to the store shelf, now with the input of

[35] From interview with a telecom executive
[36] From interview with a telecom executive
[37] Idem.

the end-user and from partners of various parts of society (not only industry, but academia,

Convergence is about the manifestation of a single reality, not bounded by technological limitations. The transmission of voice, video and data, separately, using different technologies and networks was a matter of simplification and of the limited capabilities of past times. The evolution of technology leads to a reality that converges on the customer. Integrated solutions can be considered an instance of convergence.

Innovation is taken as a long-term project to deliver a structured innovation process championed at chairman level. And traditional telecom operators are being forced to innovate their process of innovation in order to survive. One initial step is to create a more dynamic R&D culture, as BT is doing with its 'open innovation' initiative.

Incumbent telecommunications operators are supposed to be increasingly extracting value from platform and software sharing, exposing its 'capabilities' to third parties and developing business models to interoperate with other companies. Thus, the ability to expose their capabilities in services, not to hide them, will be determinant of its success. And, in this context, the concept of open innovation and value innovation also find a fertile ground to be applied in services in the communications industry. Important dynamic capabilities identified in this context are strategic planning, project management, new product/service development (especially software development), supported by systems integration.

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Appendix 1 – Research stages, data collection and empirical sources

Table 1: Overview of the research stages for the data collection and empirical sources being used.

	Stage 1: March 2005 – July 2005 (Exploration)	**Stage 2: August 2005 – March 2006 (Exploitation)**	**Stage 3: April 2006 – March 2007 (Exploitation and Confirmation)**
Objectives	• Understanding industry structure, processes and resources to deliver and build NGN; • Identifying main suppliers of NGN; • Identifying main fixed-line incumbent telecom operators building NGN; • Exploring the dynamics of capabilities development, disruption and inter-firm collaboration.	• Exploring in detail the specifics of industry change in terms of innovation and capabilities development in order to deliver and build the NGN; • Exploring in detail the dynamics of innovation and capabilities development in the transition to NGN of BT 21CN.	• Finalizing data collection about the innovation dynamics of the transition to NGN at industry level; • Finalizing the data collection about the capabilities development in BT and BT 21CN; • Resolving remaining discrepancies.
Interviews	Interviews with suppliers, service providers, industry analysts, consultants and regulators: • 45 interviews in CEBIT 2005; • 26 interviews in VON Europe 2005; • 12 interviews in IEE Course; • 8 interviews in LightReading Carrier Ethernet.	Interviews with suppliers, service providers, industry analysts, consultants and regulators: • 5 interviews in LightReading Live – The Future of Telecom; • 21 interviews in Carriers World 2005; • 38 interviews in Broadband World Forum Europe 2005; • 20 interviews in ITU-T NGN Focus Group and Industry Event	Interviews with suppliers, service providers, industry analysts, consultants: • 29 interviews in CEBIT 2006; • 9 interviews in 21st Century Communications World Forum; • 3 interviews in VoIP for Business.
Secondary Sources	• Annual reports; • SEC filings; • Press releases; • Newspapers an magazine articles; • Product catalogues; • Official websites; • Pulver Research website; • Market research reports; • Trade Conference presentations; • Webinars.	• Annual reports; • SEC filings; • Press releases; • Newspapers an magazine articles; • Product catalogues; • Official websites; • Pulver Research website; • Market research reports; • BT Technology Journal; • Trade Conference presentations; • Webinars.	• Annual reports; • SEC filings; • Press releases; • Newspapers an magazine articles; • Product catalogues; • Official websites; • Pulver Research website; • Market research reports; • BT Technology Journal; • Trade Conference presentations; • Webinars.
Events involved in	• CEBIT 2005 • VON Europe 2005 • LightReading Carrier Ethernet • IEE Course on Telecoms NGN	• LightReading Live: The Future of Telecom • Carriers World 2005 • Broadband World Forum Europe 2005 • ITU-T Focus Group on NGN • ITU-T NGN Industry Event • CEBIT 2006 • 21st Century Communications World Forum • VoIP for Business 2006	• Broadband World Forum Europe 2006 • IP 06 • The New Telco: Europe 2006 • IP Leaders 2007 • VoIP for Business 2007 • C5 World Forum 2007 • Carrier Ethernet Expo 2007