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Álvaro Rocha
Ana Maria Correia
Tom Wilson
Karl A. Stroetmann (Eds.)
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Effects of NGNs on Market Definition

João Paulo Ribeiro Pereira

School of Technology and Management, Polytechnic Institute of Bragança (IPB), Portugal
jprp@ipb.pt

Abstract. Historically, electronic communications networks were built to support specific services. For example, fixed and mobile telephone networks were developed to support voice telephone calls, whereas cable networks, satellites, and over-the-air broadcasts were built to support television services (unidirectional linear video). However, these communications networks are currently incorporating new technology and are rapidly evolving into multi-service networks that support voice, video, and data over a single, fully integrated communications platform. NGNs provide to customer access to a large range of services, leading to the increase of the bandwidth demand - For example, if customers encounter their demand on a single network, a triple play product, the bandwidth demand for that network will increase. Moreover, the migration to NGN may require upgrades to the infrastructure to provide sufficient service quality. The entry of new competitors can be based on the resale of services from the incumbent, on building up their own infrastructures, on renting unbundled infrastructure from incumbents, or, on the combination of the above elements. The availability of these options to competitors and price definition are generally determined by regulatory policies. So, the introduction of NGNs by telecommunication network operators obligates the national regulators adapt their access regulation regimes to the new technological conditions. Regulation and/or promotion of competition by regulatory measures need to be analyzed and compared. So, in this paper we explore the role of competition policy and regulation.

Keywords: NGNs, Broadband Access Networks, Telecommunication network operators, policy and regulation.

1 Introduction

New applications and greater Internet use have increased the demand for broadband connections. The traditional copper-based access networks will not be capable of supporting this increase in traffic for much longer. There will come a time when existing access networks can no longer meet increasing customer expectations. As a result of the introduction of NGNs, operators need to upgrade their access networks because in several cases existing access networks can no longer meet increasing customer expectations. Evolving consumer expectations will require changes to the existing access network – next generation access. However, existing technologies faces some difficulties and are not ready for large-scale roll-out yet [1, 2]. In the case

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of DSL technologies, the great majority of operators with copper networks are improving their networks, making investments to deploy fiber optics closer to customers and offering higher-speed access, which is required for new emerging services (reducing the distance between fiber and the users.). However, the bandwidth of DSL technology is depend of the distance, and is currently limited to 16 Mbps for ADSL2 solution and 52 Mbps for VDSL solution - Where loop lengths are sufficiently short, either to the central office or to the cabinet, VDSL will often represent the preferred price/performance choice in the near to medium term. HFC operators of cable TV networks have to invest in return link capabilities, bandwidth shared by users. Like DSL, HFC technology need to reduce the distance between fiber and the users. Fiber solutions, particularly Passive Optical Networks (e.g. FTTCab, FTTC, FTTB, FTTH), provide downstream bandwidths up to 622 Mbps and high distance range (up to 20km). However, the deployment involves relative high construction costs (particularly trench and ducts – civil works). PLC uses the power supply system, but there are some unsolved problems with interference and range.

Additionally, the power network operators would have to invest significant sums in their infrastructure. Mobile telephony networks currently are being improved by setting up UMTS (384 kbps), HSDPA (2 Mbps), and LTE (up to 100 Mbps). However, UMTS and HSDPA technologies will not provide sufficient bandwidth in the near future to be regarded as a competitive network for triple play bundles and other applications demanding high bandwidth. Some broadband wireless access technologies offer promising opportunities with speeds comparable with fixed solutions.

2 Challenges to Regulation

The selection of the optimum technological solution for an NGA network depends upon the business model and ambitions, as well as the current position of the operator [3-6]. New technologies are creating new possibilities for last-mile competition, although the last mile continues to represent a market segment with high initial cost and low marginal cost in which only a limited number of telecommunications companies find it cost-effective to create and maintain network infrastructure [7].

The access network is usually the most expensive component in terms of capital investment (specifically passive infrastructure) and OA&M costs. Of the several costs, civil engineering costs are greatest when it is necessary to run a new fiber or copper connection to the cabinet, building, or home. Moreover, access to existing infrastructure, such as the ducts of the incumbent or other market players or sewage pipes, is critically important to avoid digging. For [8], a local loop network can be divided into three main layers or segments: a service layer and two infrastructure layers (see Figure 1.). Layer 1 includes passive infrastructures, such ducts and cables, and requires the greatest investment. Layer 2 consists of active infrastructures, such as the technical installations at the end of the fibers that send, receive, and manage the optical signals. Layer 3 includes several services that consumers buy from telecommunication operators.

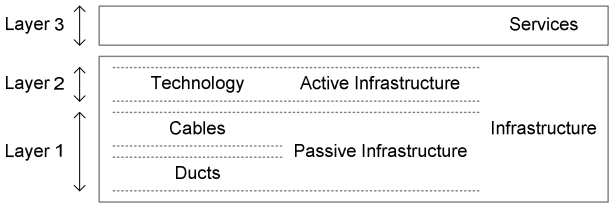

Fig. 1. Network layers [8, 9]

The arrival of NGAN has implications for the competitive conditions in access markets. In the access network, the challenges posed to the implementation of loop unbundling by the migration to VSDL and by FTTB/FTTH raise serious questions regarding how it might best be achieved that remain unanswered [7]. Experimentation in different countries is likely to provide insight into whether some combination of access to street cabinets (sub-loop unbundling), rights of way, ducts, and/or building wiring might be sufficient to maintain the effectiveness of loop unbundling and shared access as a ladder-of-investment complement to bitstream access.

Typically, without regulation, the resulting market outcome is likely to be an under provision of broadband services in sparsely populated regions and an overprovision in metropolitan areas [8]. Under provision may result from the high fixed costs associated with the network deployment if demand is too low. On the contrary, overprovision might be due to network duplication, which is a likely result in regions where deployment costs are low.

2.1 Competition in Next Generation Access

The emergence of technologies enables the introduction of new services, and opens up new revenue sources. While previously the main value of telecom was to realize simple communication between people, nowadays several new elements are added including mobility, personalization, portability, higher quality, etc. [10]. So, the offer of new services such as content, games and other broadband services, involves a number of business players (also known as actors). These players include not only traditional telecom roles (service operator, network operator), but also players from other industries (e.g. content, IT, consumer devices, etc.). Each player can represent several roles (for example, in the first scenario presented in Figure 2, the network operator acts as a service operator and in the second scenario they are different players. These changes have also raised the significance of the regulatory role.

Figure 2 show two basic service provisioning models. In the first scenario, the network operator (which acts as service operator) and the content provider are the two main business players. The network operator is responsible for the correct provisioning of contents (e.g. downloads of music, games and videos, data, …) to the subscriber. In this business model structure, the contents are created by the content producer and sell to the subscriber by the network operator. The network operator is responsible for the provisioning of the bandwidth that the service operator offers to the subscriber. In the second scenario, the user buys services from the service operator

and thus subscribes for telecommunication services. Service operator acts as the main responsible player towards the subscriber. In order to reach its customers, and provide them with services (like voice and video telephony, Internet access, value-added services etc.), service operator needs to buy network access and transport services from the network operator. Network operator is a player who operates both access and core portions of a network infrastructure. In this scenario, network operator is the responsible for the network equipment purchase and maintenance cost, and service operator for the management costs.

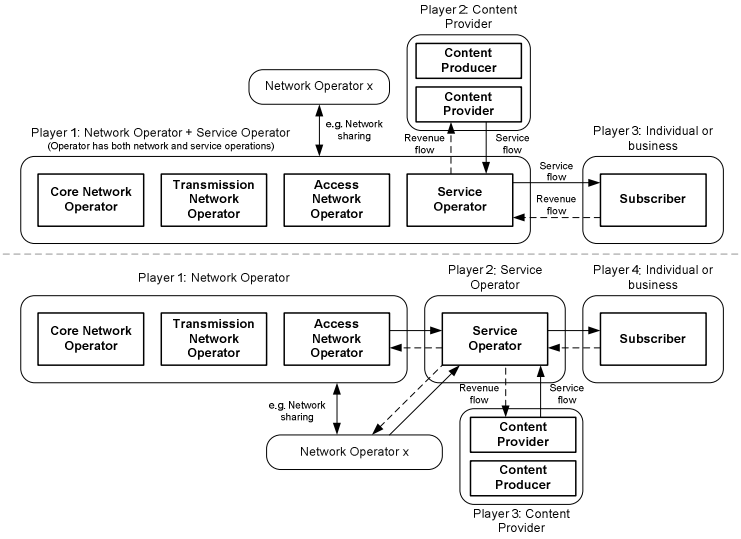

Fig. 2. Business models: basic service provision [11]

For example, [12] argues that European mobile operators must separate the network operator and service operator businesses to face the diminution voice revenues (because of the increasing competition and consequently the reduction of the prices). Network operators are extending their network coverage and capacity, whereas service operators promote new services that are more profitable and more attractive to the customers (e.g., providing new and advanced value-added data and content services such as rich video and audio, games and m-commerce).

2.2 Market Situation

Despite the key objective of the EU is to promote investment in new infrastructures [13], this goal has not been fulfilled in Europe. A high level of investment is a strong prerequisite for building networks that permit the provision of emerging broadband services. Therefore, whereas entrants have the theoretical alternative of building copper networks, it is not likely to happen. The strategic selection scope for deployment is, therefore, limited to the decision of which type of FTTH to deploy. A key decision in FTTH deployment is how far from the subscriber the access

node/switch should be placed. Under structural separation, the incumbent generally sells wholesale services to other providers, who then market final services to the users. That is, the infrastructure access charges shape the final prices [14].

Table 1 shows the broadband access lines market share. The market share of the incumbent fixed operators since July 2003 has followed a downward trend which is now stabilizing around 44% of the broadband market.

Table 1. Fixed broadband lines - operator market shares at EU level and PT, 2006 - 2010 (Source: EC)

Level	Operator	Jul-06	Jan-07	Jul-07	Jan-08	Jul-08	Jan-09	Jul-09	Jan-10	Jul-10
EU	Incumbents	47,7%	46,9%	46,8%	46,1%	45,7%	45,5%	45,2%	45,0%	44,0%
	New entrants	52,3%	53,1%	53,2%	53,9%	54,3%	54,5%	54,8%	55,0%	56,0%
PT	Incumbents	72,1%	71,1%	70,1%	39,7%	39,1%	40,6%	41,9%	43,0%	45,9%
	New entrants	27,9%	28,9%	29,9%	60,3%	60,9%	59,4%	58,1%	57,0%	54,1%

Figure 3 illustrates the DSL market share evolution by type of operator (incumbent and new entrants) in the DSL market (Portugal and EU) - trend in the % of DSL lines provided by incumbent fixed operators. The incumbents' share of the DSL market stabilizes around 55% in the EU level, decreasing since 2005. However, the figure and the report of EC [15] shows that in Portugal the market share of the incumbent operator continued to increase since July 2008. The new entrants' market share decreased in the last year for both non-DSL lines and DSL lines.

In EU cable market, new entrants share was 96.5 % in January 2011 (96.9 % in 2010) and incumbents market share only 3.5 % (3.1 % in 2010). The Market share of the incumbent and new entrants in other internet technologies (not DSL or cable) is: 90.6 % share for new entrants and 9.4 % for incumbent operators.

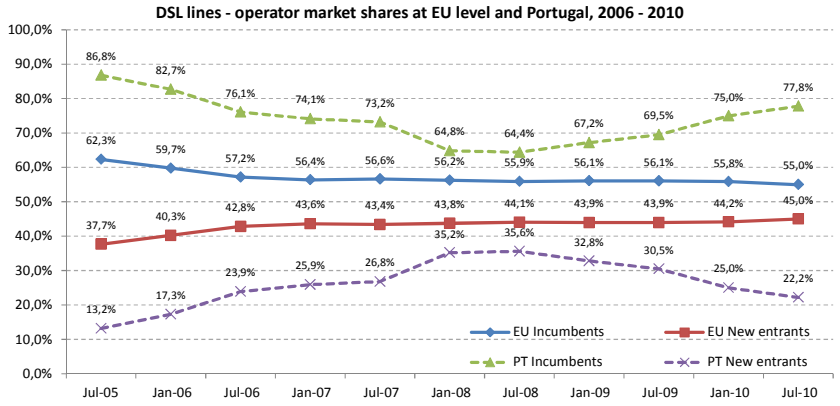

Fig. 3. DSL lines - operator market shares in DSL market: EU level and PT, (Source: EC)

3 Regulatory Options/Strategies for Access Networks in NGNs

The advent of NGN (new network technologies, access infrastructures, and even services) has changed the concept of telecommunication networks and has profound implications for operators and regulators. The definition of policies and regulations for competition in the access networks constitute one of the most debated issues in telecommunications today. The regulation of telecommunications networks and services is seen as a necessary requirement in most countries to meet government objectives and to ensure public interest [16]. Regulation is fundamental to generate positive welfare effects where markets alone would not tend to perfect competition.

But, as referred by [17], the major problem is how to measure these welfare effects, as they can occur as consumer surplus, producer surplus, societal gains (e.g., increased tax income, better working conditions, etc.). Their empirical study uses price situation to examine the welfare effects measured by the state of competition. They assumed that the increase of competition reduces prices in the market and that competition can also increase consumer welfare without reducing prices (achieved by innovation). Public policies should promote an efficient investment and competition in all markets (see Figure 4).

Regulators face substantial challenges in dealing with the evolution of the technology of electronic communications networks from circuit switching to packet switching based on the IP. As would be expected, NGNs have different configuration which will have competitive and regulatory implications. However, operators and countries are approaching the migration to NGN differently. The migration to NGN changes the character of competition substantially and brings about the decoupling of the service (provision) from the network (transport) [18, 19]. Specifically, in an IP-based NGN, any network can provide any service, any network can simultaneously carry multiple services, and a service provider does not have to be a network operator (and vice versa). Regulators face the question of how to adapt to this changing competitive and dynamic environment in which many incumbents have announced or begun the migration to NGN as well as the implementation of optical access networks [18, 20]. The objective with the NGA access regulation has been to foster investment and innovation in a new and enhanced infrastructure while preserving a strong market competition [21].

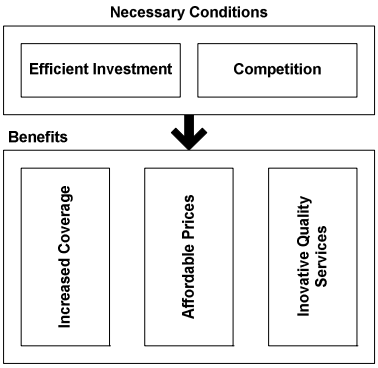

Fig. 4. Policies effects [22]

The two main economic reasons that have been used to justify interventions in access networks are the beliefs that access networks constitute a natural monopoly for which competition is not feasible in principle and that regulation is, therefore, necessary to control monopoly power and to achieve universal service in which all (or most) users have the opportunity to affordably access the services of the network. The challenge of telecom operators to provide a profitable deployment of broadband services depends if is a high or a low competition area. In areas with high competition already exists competition between broadband network operators, and the main question is know the market share of all intervenient. However, in low competition areas high investments cost must be incurred to promote broadband. [3] argued that national or regional policy concerns can also affect NGA roll out. Without some type of intervention, there is the risk for a new digital divide, with urban customers on short loops being able to receive IPTV/multi-media services and HDTV while those in rural areas might not be able to receive such services. Therefore, the access network poses serious challenges to the regulator [7].

The question then becomes whether it is more important to stimulate investment or to ensure competition. Investment in network quality is important for consumers because it provides access to both better quality and speed to services, such as Web browsing and email, and services that require more bandwidth, such as video. Investment in network quality also improves the service value for consumers and attracts new consumers to the market. The promotion of competition in the telecommunications market means supporting competition not only among incumbents' competitors, but also between incumbents and their competitors [23].

Therefore, there are two major options for access regulation [3, 20]: temporary or permanent deregulation (i.e., the removal of sector-specific rules and regulations) or mandated access (i.e., the obligation to grant access to bottleneck facilities at a regulated price and quality). Deregulation increases investment incentives, as it overcomes the "truncating problem" and allows above-normal profits. However, in the absence of alternative infrastructures or in areas of low population density under limited competition or the threat of entry into the upstream market, an integrated incumbent might leverage its market power to competitive downstream segments. Normally, the deregulation in NGNs may be applicable in competitive normal-speed markets. In the case of high-speed markets, deregulation incentives investment, but exist the risk that operators' market power is likely to increase market concentration in the long run.

For NRAs, one request of decisive importance is if they must foster service-based competition in the first phase of liberalization or to focus on infrastructure-based competition. This decision (infrastructure or service-based) would lead to lower prices, more differentiated and innovative products and improved services for consumers [17].

When access is available at different levels of the incumbent's network, new entrants will be able invest in the infrastructure gradually as sufficient economies of scale became achievable [24] - This concept is the ladder of infrastructure competition. This concept defends that new entrants (or access seekers) may enter the market offering broadband access by reselling the wholesale services of the

incumbent operator (requires least investment) where they only cover minor elements of the value chain (Figure 5). When the number of customer grows and financial means become available, the operator move on to higher rungs of the ladder [17, 25]. Next, new entrants need to building their own infrastructure and acquiring only the residual infrastructure from the incumbent's wholesale department. This includes a move for the operators from service to infrastructure-based competition.

The migration to NGAN has raised a range of issues related to building wiring and infrastructure sharing. The deployment strategies for operators and entrants are completely different. In addition, parameters, such as existent infrastructure, geographical characteristics, infrastructure renting costs, and consumer willingness to pay, influence the definition of the strategy. So, telecommunication operators can select among a set of deployment strategies that are characterized by path dependency and diminishing usage of the legacy copper loop [16]. The range of the selection space is based upon how much of the copper they use and, consequently, how far toward the customer they deploy new fiber. In the final step, operators replace all of the copper with FTTH. Within that scenario, FTTH can be implemented as either active Ethernet or passive optical networks, although most incumbent operators tend to select PON.

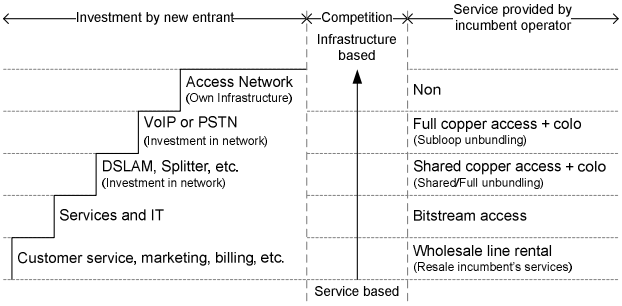

Fig. 5. Ladder of investment [24, 26]

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The strategy of a new entrant in an access network that does not have an infrastructure can be one of the following three alternatives [13, 16]: (1) Renting

infrastructure (i.e. conduit, cable, equipment, etc.) from other operators and offering only services (infrastructure sharing); (2) Deploying a new infrastructure; or (3) Not participating at all (see Figure 6). Figure 6 also shows the deployment strategies commonly used by incumbent and new entrants.

Regulators must decide whether to promote competition on the basis of a single infrastructure with regulated access (service competition) or to encourage the build-up of competing, parallel infrastructures (infrastructure competition) [27]. Then, is important create the right incentive for operators to make an efficient build/buy choice and define the appropriate pricing principles. To obtain economic efficiency, a regulator should [24]: (1) Encourage the use of existing infrastructure of the incumbent operator where this is economically desirable, avoiding inefficient duplication of infrastructure costs by new entrants (incentive to buy); and (2) Encourage investment in new infrastructure where this is economically justified by (1) new entrants investing in competing infrastructure, and (2) the incumbent operator upgrading and expanding its networks (incentive to build).

In this context, the cost models are fundamental in the determination of the access price that can be used by regulators in the definition of wholesale prices.

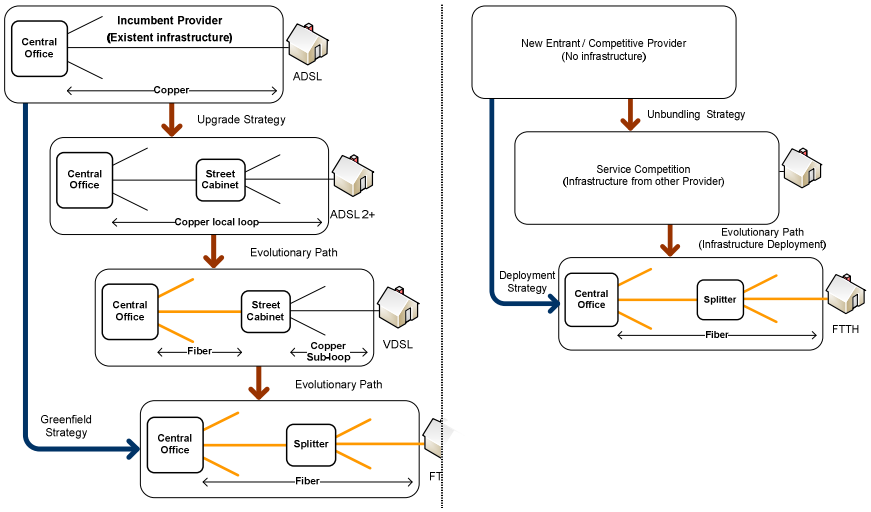

Fig. 6. Deployment strategies for incumbent operators and new entrants [9, 11]

4 Conclusions

The analysis of the broadband market suggests that where infrastructure competition exists, as in DSL and wireless broadband, service providers will more aggressively price their offerings, driving down the access price for consumers. However, in the case of limited infrastructure competition, broadband access price remains high for consumers. Infrastructure competition between DSL, Cable and wireless solution, had a significant and positive impact on the broadband penetration. We verify that

opening access networks (and network elements) to competitive forces increases investment and the speed of development. Despite increasing competition, incumbents are maintaining their dominant position. More than 60% of all broadband subscriptions make use of incumbent's broadband access infrastructure. In countries/regions where alternative technological platforms are not developed, the deployment of the DSL technology depends on the use of the networks infrastructures that are propriety of incumbent operators. To facilitate market entry of new competitors and develop competition in the access market, the regulatory authorities are focused on unbundled access to the local loop (fully unbundled local loop and shared access to the local loop) and on different forms of network access (bitstream and resale).

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