The unlikely emergence of Next Generation Networks in the light of prevailing telecom regulation

Instigating a decision supporting framework for stimulating network innovation (especially in telecommunications) based on first & second mover theory under network effects

Broos, L. C. P. , LLM, MSc

Abstract— **Acknowledging the currently limited scientific insights in the relation between regulation and innovation, this paper aims to shed a new light on the (im)possibilities to pace innovation by means of regulation. More concrete, it will focus on the meso level (industry) discussions about stimulating the deployment of so-called "Next Generation Networks" (NGNs) for telecommunication. From structured application of innovation timing theory combined with the concept of network effects in telecommunications industry and confronting these with new entrance strategies, a better understanding of the variegated influence of several regulatory measures results; because of network effects enhancing some first-mover advantages, a first mover is likely to become a provider with sustainable market power in an emerging telecommunication market. If a leapfrog-enabling technology gateway is available, investing in a NGN appears to be a more attractive strategy for the new entrant in an unregulated telecommunications market than investing in a "Same Generation Network" or setting-up Service Based Competition. Cost-based mandated access leads to declining attractiveness of investing in NGNs. Relaxing mandated access obligations appears to influence the development of NGNs positively. Furthermore we state that interconnectivity and portability obligations as well as guaranteeing more regulatory certainty have positive effects on all new entrance strategies.**

I. Introduction

The current far-reaching European legislative reform of the telecommunications sector leads to a lively debate in the media about (1) the balance between consumer protection on the one hand and entrepreneurial freedom of telecommunication companies (providers) on the other hand (for example the discussions about the maximal minimum duration of telecom subscriptions for consumers and the discussions about network neutrality) and (2) what the impact of the new legislation would be on the innovativeness of the industry, for example: will mandated access to next generation networks stimulate or hamper investment by providers? The first debate is mainly a political discussion and will not be discussed in this paper. This paper focuses on the latter, which is mainly the result of insufficient scientific insights in the relation between regulation and innovation. At this point, in 1989 Irwin and Vergragt [1] already noticed:

"Regulation has rarely been considered as a positive means of technical control e.g. through stimulating new forms of technological response rather than simply restricting the operation of the marketplace. The whole issue of regulation, therefore, has been conceptualized as a post-innovation check on undesired side-effects rather than as a tool for directing technology towards socially desirable ends."

In addition, Lundvall [2] strongly questions the methodological basis of the rare literature trying to create such a "tool". Given the current debate as mentioned above, not much progress seems to have been made since then.

This paper aims to shed a new light on the possibilities to pace innovation by means of regulation. More concrete, it will focus on the meso level (industry) discussions about stimulating the deployment of so-called "Next Generation Networks" for telecommunication. According to the Standardization Sector of the International Telecommunication Union [3], a Next Generation Network (NGN) is a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. NGNs would offer unrestricted access by users to different service providers and support generalized mobility which will allow consistent and ubiquitous provision of services to users[1].

Especially in the telecommunications industry, creation and exploitation of *first and second mover advantages* (following industrial organization theory and discussed shortly below sub II) appear to be quite central in the strategy of telecom providers. So, influencing providers' strategies into a more innovative direction by means of regulation, could possibly be realized by changing institutional factors determining the existence and strength of first and second mover advantages. However, some specific network industry-typical characteristics ("*network effects*", discussed

Manuscript received June 30, 2009.

L. C. P. Broos is with the LEGS (Legal and Economic Government Studies) department, University of Twente (L.C.P.Broos@utwente.nl).

[1] NGNs are commonly built around the Internet Protocol, and therefore the term "all-IP" is also sometimes used to describe the transformation towards NGN [4].

978-1-4244-5791-5/09/$25.00 © 2009 IEEE

shortly below sub III) must be taken into account applying this innovation timing advantages theory.

Given a market in which a telecom provider with sustainable market power (a so-called "SMP operator" or *incumbent*) is present with a telecommunications network (based on for example cable or xDSL) and servicing end-users already, we will consider the institutional influence of some regulatory practices on the attractiveness of several strategic options for a *new entrant* planning to enter that same marketplace [2]. Hereto, common regulatory practices in telecommunications will be confronted with innovation timing advantages and network effects. For this purpose, we assume three strategic options for the new entrant aiming at offering telecommunication services to end-users: (1) Creating a "Same Generation Network" (SGN), for example a second or a third UMTS-network, or deploying an optical fiber network next to already existing similar optical fiber networks, (2) offering services making use of the incumbent's network ("Service Based Competition" (SBC)) and (3) creating a NGN, for example deploying a fiber network in a region where until then only ADSL or cable coverage existed. For the purpose of this paper, we consider SGN as the least innovative strategy. SBC might lead to more innovative *services* being available on the network involved (which might be a NGN already), but as this paper focuses on innovation of the physical network itself, NGN is considered as the most innovative new entrance strategy. The question thus is, how to regulate new entrants into the direction of NGN instead of SGN or SBC.

By exploring (1) network industry characteristics, (2) innovation timing (dis)advantages in telecoms based on first & second mover theory and (3) institutional factors influencing these (dis)advantages, a decision supporting framework for stimulating network innovation (more specific NGN-development) will be introduced and some research directions for further improvement of this framework will be suggested.

This paper is structured as follows. In the second paragraph we will illustrate the major role of first and second mover advantages in the telecommunications industry. In the third paragraph we will explain the concept of network effects which have a serious impact on corporate strategy as well. In the fourth paragraph common regulatory practices in telecommunications will be confronted with innovation timing advantages and network effects to analyze the institutional influence of several regulatory practices on the attractiveness of new entrants' strategic options. Finally, in the last paragraph some conclusions will be drawn about the relation between prevailing and intended telecom regulation versus the deployment of NGNs and about the value and suggestions for further improvement of the instigated framework.

[2] Given this assumption concerning the initial market situation, this paper might be of less relevance for regions with different initial conditions.

II. INNOVATION TIMING ADVANTAGES

In this paragraph we will illustrate the relevance of first and second mover advantages – for which Lieberman & Montgomery provided a unified conceptual framework as well as a critical assessment in a prize-winning paper [5] – in the strategy of telecom providers. It goes without saying that the presence and strength of first and second mover advantages in telecom markets can differ according to regional circumstances (including the maturity of telecommunication facilities) and regulatory history in a certain region. Lieberman & Montgomery identified thee sources of first-mover advantages (FMAs) which may be enjoyed by firms which are - due to initial asymmetries – able to introduce innovative services in an early stage [3]: technological leadership, pre-emption of assets and buyer switching costs.

Technological leadership may result in lower production costs per unit because of pole position on the learning and experience curve. Furthermore, technological leadership might lead to more success in patent or R&D races, where advances in product or process technology are a function of R&D expenditures. As the importance of patented communications technology to the functioning of society is increasing [6], this source for FMA is becoming increasingly important. Telecom providers enjoying pole position on the learning and experience curve may be able to gain higher profits than they would be able to without this lead over the competition. Although – because of the typical network-characteristic of large sunk costs and low marginal costs per unit – there will usually be a drive to pre-empt as much demand as possible before competition enters the marketplace (asking for a penetration price strategy), to a certain extent the first mover position allows a *price skimming strategy* to recover its sunk costs quickly before competition steps in and lowers the market price[4].

Secondly, the first-mover firm may be able to gain advantage by *pre-empting* rivals in the acquisition of scarce assets. A well-known example occurred in the UMTS-market, where telecommunication companies bought expensive UMTS-frequencies which remained partly unused for a long time. By doing so, competitors were restrained from using those frequencies, which resulted in relative high

[3] Strictly speaking, *early* mover advantages might be a better label than *first* mover advantages; apart from technological leadership, FMAs can be available to more "early movers" instead of exclusively to the first mover (Gilbert e.a., 1996), just like SMAs can be available to several 'late' movers. Sometimes, SMAs are not at all available to the second mover as such but evolve later in time and can only just be enjoyed by actor(s) introducing their product or service even later in time than the second mover did. So, for a second mover, it is possible to innovate 'too early' resulting in neither FMAs nor SMAs. It is also possible to innovate "too late" to gain any SMAs (Gilbert e.a., 1996). In this paper, by first mover we also intent to address other early movers gaining 'first mover advantages' and by second mover we mean any mover gaining second mover advantages.

[4] Given an inelastic demand curve for the specific telecom service

978-1-4244-5791-5/09/$25.00 © 2009 IEEE

consumer prices for usage of the scarce UMTS-frequencies that were actually exploited by the providers. Also, huge pre-emptive investments in ducts and dark fiber might be seen as an example of pre-emption, taking away incentives for new entrants to invest in this market segment.

Buyer switching costs in telecommunication markets are created by providers like in a schoolbook example. Billing initial costs of connection, making customers pay upfront for provider specific gear (for example a modem), contractual binding of customers (for example by imposing a minimum contract duration or exit fees) are common commercial practices. With switching costs, late entrants must invest extra resources to attract customers away from the first-mover firm.

Lieberman & Montgomery [5] also identified four sources of second-mover advantages (SMAs, also referred to as first-mover *dis*advantages): (1) the ability to "free ride" on first-mover investments, (2) resolution of technological and market uncertainty, (3) technological discontinuities that provide "gateways" for new entry, and (4) various types of "incumbent inertia" that make it difficult for the incumbent to adapt to environmental change. These phenomena can reduce, or even completely negate, the net advantage of the incumbent derived from the mechanisms considered previously. In other words, by waiting a bit longer advantages appear like the *possibility to free-ride* on the investments of pioneering telecom providers, for example by using infrastructure of an incumbent being obliged to service the new entrant on behalf of regulatory authorities. Late movers can gain an edge through *resolution of market or technological uncertainty*. In many new product markets, over time often a dominant design emerges and the demand situation becomes more clear. Pioneering telecom firms investing in optical fiber had to cope with a high degree of uncertainty about the emergence of sufficient bandwidth-intensive services to make it worth while realizing fiber to the home. After partial resolution of this uncertainty, second movers started investing in optical fiber infrastructure facing less business risk. Also, as Gilbert & Birnbaum [7] argued, after some time usually regulatory uncertainty diminishes because of the existence of more explicit NRA[5] policies[6], concrete rulings of and experience with regulators et cetera. Further on, we will consider this specific type of resolution of uncertainty next to the resolution of market and technology uncertainty. Information about *shifting technology or customer needs* supported new telecom entrants in their decision to invest no longer in copper networks (DSL) but to shift towards optical fiber to defeat DSL. Finally, there is the circumstance of *incumbent inertia*, which makes the incumbent less flexible to respond to changing customer needs or technology shifts, providing a gateway for other providers than the SMP-operator to play at leapfrog with the incumbent. High sunk costs laid down in the DSL network of an operator makes it unlikely that this operator will volunteer to invest in optical fiber networks; such cannibalism would only be justified under a concrete competitive threat.

To sum up, we may say that the examples above clearly show the relevance of innovation timing advantages to telecom providers' strategy.

III. NETWORK EFFECTS

In this paragraph some typical characteristics of telecommunication networks will be mentioned along with their influence on telecom providers' strategy.

One typical characteristic is the combination of high sunk costs and low marginal costs, leading to extraordinary economies of scale. Sunk costs are investment costs incurred before a certain activity takes place which cannot be recovered by the possible sale of the asset they produced. Highly specific investment (e.g. R&D, infrastructure) are usually sunk costs and represent barriers to exit. Marginal costs indicate by how much the total costs change because of modification in the production level by one unit [8]. Servicing one more telecom subscriber on a telecom network usually does not substantially increase the total costs of the telecom provider.

Secondly, telecommunication networks are subject to positive network externalities; consumers value a telecommunications system more as more users adopt it [9].

Given the combination of these two network effects, a logical first-mover strategy would thus be to gain the highest possible market share before competition enters the market (maximize economies of scale) and to prevent consumers using competing telecom networks to connect to it's own subscribers, or at least to make it more expensive or more difficult for second-mover subscribers to connect to first-mover subscribers. By doing so, consumers experience advantages in subscribing to or staying with the provider with the largest customer base (community). Further on we will refer to this phenomenon as "community-effect".

The first-mover strategy sketched in this paragraph benefits from the mechanism that network effects enhance some FMAs; market penetration and economies of scale contribute to the strength of the first mover's technological leadership, community-effects enhance buyer switching costs. In an emerging telecommunication market, a first mover applying such a strategy is likely to become a provider with sustainable market power (a so-called "SMP operator" / incumbent). However, community-effects loose value under interconnection obligations and may even drop to zero when providers would additionally be prohibited to charge different prices for call terminating on their own network and call terminating on the network of others.

So, to conclude, next to innovation timing advantages, also

[5] National Regulatory Authority

[6] A concrete example is the current attempt of the European Commission to come up with a recommendation for NRA's in telecommunications about how to deal in the near future with regulated access to NGNs (better known as Next Generation Access Networks).

978-1-4244-5791-5/09/$25.00 © 2009 IEEE

network effects matter in terms of strategic decision-making of telecom providers.

IV. Influence of Regulation on the Attractiveness of a New Entrant's Strategic Options

In this paragraph common regulatory practices in telecommunications will be confronted with innovation timing advantages and network effects to analyze the institutional influence of several regulatory practices on the attractiveness of new entrants' strategic options. To understand the influence of specific (changes in) regulatory provisions on the strategy of telecom providers, it is essential to understand the sole influence first of innovation timing advantages and network effects as mentioned above, like reviewing a hypothetical situation where no telecom regulation would apply (yet) at all. In other words: looking at a telecommunication market in which an incumbent is present - which is likely because of the network effects enforcing FMAs as set out in §3[7] - we are interested in the attractiveness of several new entrant strategies. Hereto, in Table 1 the FMAs (F1-F4), the SMAs (S1-S4 including S2') and the network effects (N1-N2) are confronted with the three new entrant strategies as mentioned in §1: SGN, NGN and SBC.

Table 1: attractiveness of new entrant strategies in an unregulated market

		attractiveness of new entrant strategies in an unregulated market		
	facing	SGN	NGN	SBC
F1	technological leadership incumbent	-	+	-
F2	pre-emption of assets by incumbent	-	+	-
F3	buyer switching costs	-	-	-
F4	price skimming by incumbant	-	+	-
S1	free rider effects (inf. spillover)	+	-	-
S2	resolution of uncentainty (market / techn)	+	-	-
S2'	resolution of regulatory uncertainty	+	+	-
S3	shifts in tech/customer needs	-	+	-
S4	incumbant inertia	-	+	-
N1	expensive infra, low marginal costs	-	+	-
N2	community effect	-	-	-

In an unregulated situation with only one provider (the incumbent) offering telecommunication services using its own network, this incumbent is not likely to be willing to share his network with new entrants in order to make SBC possible[8]. Without the SBC option, a new entrant may choose to enter into competition with the incumbent by introducing a SGN or by investing in a NGN. The new entrant might be able to develop a SGN under more efficient conditions than the first mover had been able to in the past because of S1, S2 and S2'. However, because of F1-F4 and especially because of the FMA-enhancing network effects, these SMAs are not likely to overwhelm the FMAs. At the same time, using S3 and S4 to become a first mover itself with regard to a new generation network technology and thereafter enjoy F1, F2 and F4 might be more interesting for the new entrant. If such a leapfrog-enabling technology gateway is available, investing in a NGN appears to be the most attractive strategy for the new entrant in an unregulated telecommunications market.

Now we will consider the institutional influence of several common regulatory practices on the attractiveness of the same new entrant's strategic options. The scope and aim of this paper only allows for analyzing the influence of a limited number of illustrative examples of regulatory measures. There is no exhaustive pretention at all to consider any and all possible strategy-influencing and mutually interfering regulatory practices.

One important common regulatory practice in telecommunications to start with, is mandated access to the incumbent's network[9] to stimulate innovation of network services ("essential facilities doctrine"). Often, such an obligation is applied in combination with strict rules determining the maximum prices for the mandated access to prevent the incumbent from preventing competition on its network by setting sky-high access prices. Under these conditions, the attractiveness of the new entrant's strategies is influenced as illustrated in Table 2, where an arrow-up stands for positive influence, an arrow-down for negative influence and a naught for lack of significant influence *in comparison with* the unregulated situation.

[7] Historically, many telecommunication networks emerged as a public service and recently, most of those networks have been privatized. The private provider exploiting such a network often possesses an incumbent position anyway, also because of this historical background.

[8] However, deviating business strategies are conceivable, like incumbents offering network-services (voluntary and of course profit-based in the longer run instead of mandated and cost-based) to new entrants, in order to shorten the ROI of the physical network and to prevent new entrants from building a competing network. Like this, SBC might become an option for a new entrant. Nevertheless, as long as network-based competition remains absent, the monopolistic power of the incumbent to determine tariffs and conditions might make this option unattractive. A different situation might occur if a network owner decides *not* to offer services to end-users himself but to leave this up to separate service providers ("functional separation"). As this situation deviates from the initial market conditions as described in this paper as point of departure for the analysis, this scenario won't be discussed further in this paper.

[9] For example, mandating access is considered as a means of increasing competition in Directive 2002/19/EC ('Access Directive') [14]

978-1-4244-5791-5/09/$25.00 © 2009 IEEE

Table 2: institutional influence of cost-based mandated access

		attractiveness of new entrant strategies in an unregulated market			institutional influence of cost-based mandated access		
	facing	SGN	NGN	SBC	SGN	NGN	SBC
F1	technological leadership incumbent	-	+	-	0	↓	↑
F2	pre-emption of assets by incumbent	-	+	-	0	↓	↑
F3	buyer switching costs	-	-	-	0	0	0
F4	price skimming by incumbant	-	+	-	0	↓	↑
S1	free rider effects (inf. spillover)	+	-	-	↓	0	↑
S2	resolution of uncentainty (market / techn)	+	-	-	0	0	0
S2'	resolution of regulatory uncertainty	+	+	-	0	0	0
S3	shifts in tech/customer needs	-	+	-	0	0	0
S4	incumbant inertia	-	+	-	0	↓	↑
N1	expensive infra, low marginal costs	-	+	-	0	↓	↑
N2	community effect	-	-	-	0	0	0

If SBC is made possible and affordable by regulation, SBC gains attractiveness at the expense of NGN because of F1 (the new entrant can enjoy the technological leadership of the incumbent by using the incumbent's network), F2 (previously pre-empted assets become indirectly available to the new entrant by using the incumbent's network), F4 (as a result of the price regulating element of the mandated access obligations, price skimming intentions of the incumbent won't strike the new entrant any more or the new entrant may even enjoy part of the consumer surplus by following the price skimming strategy the incumbent applies for its own customers), S1 (no need to find out how to build a SGN if you can free ride on the incumbent's network), S4 (no need to get inert by investing in a NGN if the incumbent's network is available without high initial investments) and N1 (the SBC option takes away upfront investments in expensive infrastructure and maintenance, only "pay for use" remains). All in all, under the circumstances mentioned above, cost-based mandated access leads to declining attractiveness of investing in NGNs in the first place and takes away incentive (S1) to build a SGN as well. In other words: NGNs are more likely to emerge in unregulated telecommunication markets; cost-based mandated access seems to have a disastrous effect on the development of NGNs. To make matters worse, the incumbent under cost-based mandated access obligations might become less willing to invest in its own network as profits can no longer be totally pre-empted as part of the potential turnover floats to the service based competitor(s)[10].

In the same way, we can assess the institutional influence of other common regulatory practices, like interconnectivity obligations, portability obligations, harmonizing European regulatory power, universal service obligations for the SMP operator, facilitating rights of way et cetera. The confrontation matrix of these measures with innovation timing advantages and network effects are summarized in Table 3[11].

The table shows us that interconnectivity obligations have a positive effect on the attractiveness of each scenario for the new entrant. Interconnectivity obligations breaks through the strong mutually strengthening effect of F3 and N2; because of interconnectivity all subscribers to any provider form one big community resulting in community-effects for all competing providers. For customers there is no financial stimulus anymore to stick with the provider where most of their friends subscribed, as it is possible to communicate with any subscriber from any provider under the same conditions[12]. However, providers with only a few subscribers benefit more from this effect than providers who already enjoyed major (own) community-effects.

Portability obligations are regulatory measures aimed at establishing easy and inexpensive provider switches for customers. For example, shortening the maximal duration of telecom subscriptions, rules aimed at minimizing the downtime a customer faces when switching between providers, obligations to make telecom offers better comparable, enforcing standards (e.g., standardizing a high-speed modem for all providers of similar network technology) et cetera all contribute to lowering buyer switching costs (F3) which is positive for a new entrant irrespective of the chosen strategy. The same applies for reducing regulatory uncertainty, for example by harmonizing the interpretation and application of European Directives by NRA's. The current development to centralize European regulatory power might contribute to this.

SMP operators are – more than other providers - encumbered with universal service obligations. From this perspective SBC is more attractive than becoming a SMP operator on a NGN. To conclude, facilitating rights of way positively influences SGN and NGN strategies of a new entrant because of savings on infrastructure building costs.

V. Conclusions, Reflection and Suggestions for Further Research

First of all, this paper shows that structured application of innovation timing theory combined with the concept of network effects in telecommunications industry and related to

[10] It goes without saying that this might be totally different if several competing networks are open to SBC, in which case a network access market arises in response whereto network operators might improve their networks to offer a better service to service based competitors (see also [13]). Like this, they try to attract as much end-users to their network as possible and secure at least a little indirect turnover from those users.

[11] SBC* stands for Service Based Competition provided that cost-based mandated access obligations are in place. When assessing other regulatory measures, it makes sense to assume that cost-based mandated access obligations are already in place, otherwise SBC would be no option anyhow.

[12] Whether or not these conditions are the really the same, depends on the commercial freedom that regulators leave at the providers to set different termination fees for cross-provider connections than for establishing connections within their own network.

new entrance strategies provides a better understanding of the variegated influence of several regulatory measures. Also, when reassessing regulatory regimes, the framework can support regulatory decisions by providing more structural insights in the relation between regulation and new entrance strategies.

The instigated framework for example contributes to a better understanding of the current debate about Next Generation Access Networks; traditionally, European regulatory policy strongly promoted mandated access obligations. Recently, Viviane Reding (Member of the European Commission, responsible for Information Society and Media) stated:

"Some argue that we need a regulatory forbearance to encourage investment in new network infrastructure. But in my view there is no evidence to show that 'regulatory holidays' would generate more investment than competition. We have to be clear on this point: regulation should promote competition, and should not favour monopolies. Investment in new and competing infrastructure will accelerate the day when transitional access obligations can be further relaxed – or even removed." [10]

The argumentation in this statement seems to be contradictive to the conclusion above that mandated access obligations can seriously hamper the emergence of NGNs. In this respect, we would like to draw attention to a development in the United States where the Federal Communications Commission (FCC) recently ruled that telecom providers can build fiber-optic networks into certain (non-commercial) buildings without sharing their infrastructure with rivals:

"As part of the 1996 Telecommunications Act, the Baby Bells are required to lease or "unbundle" access to their copper network wires, which enable telephone and dial-up Internet services. But last year, the FCC ruled that new broadband networks built with fiber optics to serve single-family homes would not be subject to the same sharing requirements imposed on the older copper wire infrastructure. In March, the U.S. Court of Appeals for the District of Columbia upheld the FCC's ruling. This week's ruling extends the reach of the original by addressing multitenant buildings. Michael Powell, chairman of the FCC, (...) said that by clarifying the rules, big phone companies now have more incentive to deploy these fiber networks, particularly in urban areas." [11]

Also within Europe, more and more voices are raised for limiting the historically uncompromising mandated access obligations. In the draft recommendation of the European Commission to national telecom regulators (see footnote nr. 6), different kinds of business arrangements are identified that operators can pursue to share the risk of developing the new networks, while still abiding by EU competition law. The arrangements include joint-investment by different companies, long-term access contracts between larger and smaller operators, and 'volume discounts' for operators that want to rent a relatively large chunk of network capacity [12][13].

On the basis of the framework instigated in this paper, we may contribute to this European discussion by stating that relaxing mandated access obligations like in the recommendation or even further, appears to influence the emergence of NGNs positively[14]. Furthermore we may state that interconnectivity and portability obligations as well as guaranteeing more regulatory certainty have positive effects on all new entrance strategies.

Apparently, interconnectivity and portability obligations also contribute to lower prices and more freedom of choice for consumers. So, this "public value" goes hand in hand with stimulating more innovative strategies for new entrants. However, relaxing mandated access obligations might lead to higher prices and less freedom of choice for consumers as a result of lower attractiveness of the SBC option. Here we end up at the very fundamental challenge of optimal balancing public values on the short term (lower prices and more freedom of choice for consumers) and public values on the longer run (enjoying the benefits of more innovative networks). At this point further research on the area of "smart rules" is of vital importance.

Although constructing a framework as instigated in this paper appeared to be a fruitful exercise, the framework needs to be refined in a more sophisticated way. Currently, hardly any attention has been paid to mutually interfering measures, to the protection by measures under consideration of other public values than innovation, to the influence of existing and potential *other* regulatory measures (for example functional separation of networks and services) et cetera. Also, the framework in its current appearance only applies for markets where only one incumbent (network) is available.

[13] According to Innocenzo Genna, chairman of The European Competitive Telecommunications Association (ECTA), which represents many smaller telecoms operators, the arrangements could "allow dominant firms to escape regulation, limiting choice in TV and broadband services" and that the Commission "appears to have compromised its strong stand against regulatory holidays in the telecoms sector and appears to be condoning collusion". According to the European Telecommunications Network Operators' Association (ETNO), which represents large operators such as Deutsche Telekom and Telefónica, has criticised the Commission for not offering enough regulatory flexibility... Michael Bartholomew, ETNO's director, said that "a more innovative and targeted regulatory approach, which encourages all players to invest and share risk" is needed (Brunsden, 2009). These opposite opinions perfectly fit in the framework which clearly distinguishes the incumbent positions from the new entrants'.

[14] However, once the NGN emerged in a certain region, further development of *services* on that network (service based competition) might be stimulated by imposing mandated access obligations in a next phase. Granting a "regulatory holiday" might thus be effective for a NGN to come into being, provided that such a holiday is granted in advance (in order to secure regulatory certainty) for a period long enough to get satisfying return on network-investments.

978-1-4244-5791-5/09/$25.00 © 2009 IEEE

Furthermore, the current framework is based on and limited to qualitative insights though more quantitative support would be valuable. Finally, cross-effects of non-institutional influences should be considered as well. All in all, some refinement still has to be done, but the effort promises scientifically and economically relevant decision-supporting knowledge about the relation between regulation and innovation.

REFERENCES

[1] Irwin, A. and Vergragt, P. (1989) "Re-thinking the relationship between environmental regulation and industrial innovation: The social negotiation of technical change", *Technology Analysis & Strategic Management*, Vol. 1, No. 1, p. 58.

[2] Bengt-Åke Lundvall, I. (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London and New York: Pinter Publishers, pp. 139-140.

[3] Standardization Sector of the International Telecommunication Union (2004) *General overview of NGN* (2004), ITU-T Recommendation Y.2001

[4] Online available: http://en.wikipedia.org/wiki/Next_Generation_Networking, 25 June 2009

[5] Lieberman, M. B. and Montgomery, D.B. (October 1987) *First-mover advantages*, Research paper No. 969

[6] Krechmer, K. "Communications Standards and Patent Rights: Conflict or Coordination?", presented at The Economics of the Software and Internet Industries conference in Toulouse, January 2005

[7] Gilbert, J. T. And Birnbaum-More,P. H. "Innovation timing advantages: from economic theory to strategic application", *Journal of Engineering and Technology Management*, Vol. 12 (1996), pp. 245-266.

[8] Piana, V. (2003) "*Costs*", Economics web institute [online]. Available: http://www.economicswebinstitute.org/glossary/costs.htm#cost, 29 June 2009.

[9] Grubera, H. and Verboven, F. "The evolution of markets under entry and standards regulation: the case of global mobile telecommunications", *International Journal of Industrial Organization*, Vol. 19 (2001), pp. 1189–1212.

[10] Richards, E. and Foster, R. and Kiedrowski, T. (2006) "*communications the next decade: A collection of essays prepared for the UK Office of Communications*", p. 6.

[11] Reardon, M. "Baby Bells win another FCC victory", *CNET News,* 5 August 2004.

[12] Brunsden, J. "Telecoms firms hit out at network guidelines" [online]. Available: http://www.europeanvoice.com/article/2009/06/telecoms-firms-hit-out-at-network-guidelines/65181.aspx, 12 June 2009.

[13] Bijlsma, M. and Van Dijk, M. "Nieuwe generatie netwerken, nieuwe generatie regulering?", *CPB document 145*, May 2007.

[14] Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive), consideration 19

978-1-4244-5791-5/09/$25.00 © 2009 IEEE

Table 3: institutional influence of several common regulatory measures

		attractiveness of new entrant strategies in an unregulated market			*institutional influence of interconnectivity obligations*			*institutional influence of portability obligations*			*institutional influence of harmonizing European regulatory power*			*institutional influence of universal service obligations for SMP operator*			*institutional influence of facilitating rights of way*		
	facing	SGN	NGN	SBC	SGN	NGN	SBC*	SGN	NGN	SBC*	SGN	NGN	SBC*	SGN	NGN	SBC*	SGN	NGN	SBC*
F1	technological leadership incumbent	-	+	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	pre-emption of assets by incumbent	-	+	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	buyer switching costs	-	-	-	↑	↑	↑	↑	↑	↑	0	0	0	0	0	0	0	0	0
F4	price skimming by incumbant	-	+	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S1	free rider effects (inf. spillover)	+	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S2	resolution of uncentainty (market / techn)	+	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S2'	resolution of regulatory uncertainty	+	+	-	0	0	0	0	0	0	↑	↑	↑	0	0	0	0	0	0
S3	shifts in tech/customer needs	-	+	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S4	incumbant inertia	-	+	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N1	expensive infra, low marginal costs	-	+	-	0	0	0	0	0	0	0	0	0	0	↓	↑	↑	↑	0
N2	community effect	-	-	-	↑	↑	↑	0	0	0	0	0	0	0	0	0	0	0	0

978-1-4244-5791-5/09/$25.00 © 2009 IEEE