

Dimensions of broadband policies and developments

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1. Introduction

There is a continuous discussion on the development and comparison of broadband infrastructures and broadband strategies in the different countries and regions around the world (e.g. Lemstra and Melody, 2014; Yoo, 2014). Is the US ahead of Europe, or is it the other way round, and how about East Asian countries? And, are there any policy reasons for it? Not only can different statistics be used and be presented in different manners. There is also an on-going debate on the primary factors affecting broadband development. In this paper, three of the most important policy dimensions affecting broadband developments are presented and country examples are discussed.

An often debated issue regarding broadband development is infrastructure (or facility-based) vs. service competition (Bourreau & Doğan, 2004; Briglauer, 2013). Is it best to promote infrastructure competition in order to expand and upgrade telecommunication infrastructures or can service competition also be an avenue to infrastructure competition? European countries have seen service competition as a way also to promote subscription take-up but also infrastructure competition in the long run, while the US relatively early gave priority to infrastructure competition.

A second important factor is the emphasis on respectively regulatory vs. developmental measures (Lemstra & Melody, 2014; Falch & Henten, 2015). Some countries have prioritized building a regulatory framework for the development of the telecommunication area without much direct public economic support for building infrastructures, while other countries have followed a developmental track with a higher degree of direct economic support for infrastructure expansion. Though the US actually has public programs for supporting infrastructure improvement and expansion, the US is often seen as an example of a country following a regulatory model, while countries in East Asia, for instance South Korea, have provided public economic support to infrastructure build-out and have followed a developmental track.

A third dimension is concerned with the priority given to network development vs. the use and application of the network resources (Igari, 2013). In some countries, the implicit assumption has been that if networks are built, content, services and applications will follow. In other countries, public content, services and applications and the support for private content, services and applications have been given more emphasis. Japan is an example of a country that has focused on expanding networks and increasing capacity. Some European states have to a larger extent given emphasis to developing public services.

In the paper, we will denote these three dimensions:

- Infrastructure vs. service competition
- Regulatory vs. developmental policies
- Networks vs. content prioritization

All three dimensions are important for the development of broadband infrastructures and can be found in numerous varying combinations in different countries. The prioritization of infrastructure competition over service competition is not necessarily followed by a focus on a developmental strategy with public economic support to infrastructure expansion. The US is an example of a country combining infrastructure competition with a regulatory emphasis, and Japan is an example of a country following a strategy with a focus on infrastructure competition and a developmental policy. There is not a simple relationship between the three different dimensions.

The paper examines these strategic priorities and discusses country examples and their combinations of the dimensions of broadband strategies. The aim of the paper is to build a conceptual framework for analysing broadband policies in different countries. Emphasis is on policies and regulation. It is acknowledged that many other factors influence broadband developments, first and foremost the economic wealth of the countries in question and the factors which broadband policies have none or very little influence on such as geography or educational level and distribution. This paper focuses on dimensions, which are influenced by policies and regulation and which, therefore, are subject to some degree of change - taking policy inertia into consideration.

First, there is an overview section of the trends in the literature on broadband developments with a policy focus. Thereafter, the three dimensions applied in this paper are presented and discussed – with infrastructure vs. service competition first, regulatory vs. developmental policies second, and networks vs. content prioritization last. Furthermore, there is a section, where combinations of policies relating to the three dimensions are analysed using country examples. Last, there is a conclusion summarizing country examples.

2. Trends in the literature on broadband developments

How can national differences in the adoption of broadband services be explained? This question has directly or indirectly been the subject of numerous studies on broadband policies and strategies. In order to answer this question, at least three different approaches can be identified: theoretical modelling of incentive structures relating to different regulatory policies, econometric studies estimating the impact of various socio-economic and policy factors, and comparison of country cases. Each of such studies has applied its own categorization of policy and regulatory measures and is highly influenced by the kinds of relevant policy measures considered for implementation in practice at the point in time. However, they are also inspired by theoretical

concepts developed in academic papers on innovation economics, new institutional economics, information economics, or political economy.

Since Schumpeter put emphasis on the role of technology in economic development (e.g. Schumpeter, 1946), the factors stimulating innovation slowly started attracting attention and so have the kinds of policies stimulating these factors. Schumpeter focused on technology as an engine for economic growth. Even though he did not treat innovation as an entirely exogenous process, he can be seen as the originator of the technology push hypothesis (Coombs et al., 1987). Schmookler (1966), on the other hand, saw innovation as an interactive process involving market-pull as well as technology-push (Coombs et al., 1987).

In the 1960s and 1970s, the extent to which the rate and direction of innovation was dependent on supply and demand was debated (Nemet, 2009), and this distinction is applied in later studies on technical change and economic theory for instance in the concept of the techno-economic paradigms (Freeman & Perez, 1988).

Looking at innovations from the policy side, Hall (1986) makes a distinction between direct and indirect policy tools, where direct policy tools include direct government participation in innovative activities, while indirect policy tools include improved information flows, public purchasing policy, co-ordination of activities of private firms, patent policies, and subsidies and fiscal incentives. A similar distinction is made in a study on broadband policies by Falch (2007). This study distinguishes between direct intervention, regulation and facilitation. Like the new institutional economists, Hall (1986) sees innovation policy in the context of market failures such as uncertainty and incomplete information that may lead to underinvestment in innovation activities. The scope of innovation policies is thus to correct possible market failures.

In their analysis of institutional factors in IT innovation (King et al., 1994) combine the two dimensions supply-push vs. demand-pull and influence vs. regulation, in a 2x2 table where they categorize different innovation policies.

TABLE 1: INSTITUTIONAL FACTORS IN IT INNOVATION

	Supply push	Demand pull
Influence	Knowledge building Knowledge deployment Subsidy Innovation directive	Knowledge deployment Subsidy Mobilization
Regulation	Knowledge deployment Subsidy Standards Innovation directive	Subsidy Standards Innovation directive

Source: King et al. (1994)

Subsidies are included as a category in all fields, as subsidies can be provided to R&D (supply push) as well as to the use of an innovation (demand pull). Subsidies may either be provided through specific funding initiatives or as a part of the regulation of the market. It should be noted that the term regulation used by King et al. differs from the kinds of regulation usually included in a telecom regulatory framework. Regulation in the King et al. context is directed at the facilitation of innovative activities, such as requirements for investments in R&D, subsidies for R&D, and knowledge deployment. Regulatory tools addressing competition issues are not mentioned at all in this framework. The only regulatory tool, which may fall under the auspices of a normal telecom regulator mentioned in the framework, is standardization. The King et al framework has been applied in a number of other ICT innovation studies (Damsgaard & Lyytinen, 2001; Silva & Figueroa, 2002; Lee et al., 2002; Thai et al., 2016). Frieden (2005) applies a similar framework, where he distinguishes between regulation, supply stimulation and demand stimulation.

A large number of both theoretical and econometric studies focus on regulation as the key policy tool for the promotion of broadband investments - see Cambini & Jiang (2009) for a literature review. The distinction here is between regulation of retail prices and regulation of access including regulation of wholesale prices. The issue is how to provide the right incentives to incumbents as well as new entrant operators in order to stimulate investments. Especially in Europe, many papers test the ladder of investment hypothesis formulated by Cave (2006).

Bauer et al. (2005) represents an early attempt to measure the impact of national broadband policies with a slightly different categorization of regulatory tools. A distinction is made between unbundling, separation of cable and telecom networks, and government funding to support broadband deployment.

An on-going discussion in broadband policy is whether investments in the infrastructure should be promoted through the creation of a competitive market or by providing public subsidies. This leads to a distinction between regulation and direct intervention. In other studies the distinction is between promotion of competition by the use of various regulatory measures and infrastructure support, for instance by engagement in PPP arrangements (Picot & Wernick, 2007; Falch & Henten, 2007). Montolio & Trillas (2013) make a similar distinction as they talk about policies 'related to market power (regulation and competition policy) and those related to positive externalities (network externalities and impact on overall economic growth)'. It should be noted that while the first type is carried out at the national or international levels, the second type is often carried out at more decentralized levels (regional or municipal).

The general trends in the literature on broadband developments are mostly centred on supply and demand factors, supply-push and demand-pull, direct and indirect policy interventions, and regulatory measures. In this paper, we will concentrate on three issues: infrastructure vs. service competition, regulatory vs. developmental policies, and networks vs. content prioritization. Infrastructure vs. service competition is a topic often dealt with in connection with regulatory

discussions; regulatory vs. developmental policies clearly relate to supply-push and demand-pull and to direct and indirect policy measures; and networks vs. content is also an issue concerning supply and demand factors.

3. Infrastructure vs. service competition

A recurring issue in the policy debates on broadband developments has been concerned with infrastructure (facility-based) and service competition. Infrastructure competition means the competition between alternative broadband infrastructures whether the same technologies are used or competition relies on the use of different technologies. Service competition means that network operators use the same infrastructures but compete on network services. The technologies mostly used are DSL (based on PSTN-infrastructures), cable modem (based on cable networks), fibre, and mobile or other wireless technologies. It should be noted that the definition of infrastructure varies, as full unbundling in many publications is defined as facility-based competition. The argument is that operators must invest in their own active components such as switches and routers and that only the passive cables are shared. In this context, facility-based competition is defined as competition between independent network infrastructures, where only sharing of ducts or masts is allowed.

When broadband started being spread to the general residential and business market in the 1990s, there weren't any mobile broadband solutions available and the issue was how to create competition in the fixed broadband area. As infrastructures were, to a very large extent, owned by the incumbent telecommunication operators, the immediate and primary question was how these infrastructures could be made accessible to alternative operators. The broadband competition issue was thus similar to the narrowband telephony issue, where competition was also primarily set to be based on service competition. In mobile telephony, the issue was different as networks had to be established from scratch and priority was on creating competing infrastructures.

Though focus was on service competition in broadband provision, there was no disagreement as to whether service competition was as 'good' as infrastructure competition. Infrastructure competition was generally considered to be the most sustainable solution in the long run. However, for the time being, service competition needed to be promoted as it would otherwise take long to create competition on broadband markets. The question thus became how infrastructure competition could be established in the longer run while building service competition in a shorter perspective, bringing broadband prices down and increasing subscription to broadband services.

The theory of the ladder of investment (LoI), stylized by Martin Cave (Cave, 2006), came to be the answer to this question – at least in Europe. The idea in the LoI theory is that new operators will enter the markets using the infrastructures of existing operators, and then they will climb up the rungs of the ladder as they get a better grip on the markets, eventually deploying their own infrastructures. This theory has been extensively scrutinized since it was launched (Briglaue et al.,

2003; Bourreau et al., 2010). It has been used in practice by regulators, and it has been debated and tested by academics. From the academic side, there has been much criticism. The critique has been that the possibility for alternative operators to get access to the networks of the incumbents will tend to limit investments in new infrastructures by newcomers. Furthermore, it has been indicated that new operators do not embark on a journey going from the lowest service-based rungs to the highest infrastructure-based levels. They will either stay with service competition or go directly to infrastructure investments.

In a response to such critique, Cave has shown that there are actually operators which start from leasing capacity or using bit stream access and eventually grow into using unbundling (Cave, 2014). However, this is also where it ends. There is not a path that leads from unbundling to investments in own cable infrastructures. The LoI only applies to the different categories of competition not including new cable deployment.

With respect to the issue regarding implications for investments of service-based competition, Yoo (2014) has argued that it may be true that service-based competition leads to lower prices and, consequently, higher *subscription* rates, but service-based competition does not lead to higher *coverage* by high-speed connections – Next Generation Access networks (NGA). Yoo has shown that there is a correlation between high percentages of DSL lines provided by new entrants and low percentages of NGA coverage.

The general conclusion seems to be that service-based competition promotes immediate competition, leading to lower prices and higher subscription rates, but that it may limit investments in new infrastructures and coverage by high-speed technologies. Service-based competition supports static competition, while infrastructure-based competition supports dynamic competition.

When broadband using DSL technology broke through, service-based competition became the preferred mode of regulatory intervention. Provisions for mandatory access rules and interconnection prices were established. This applies to Europe as well as the US and most other countries. However, the policies of the US and the European countries relatively quickly diverged. While the EU maintained a strong emphasis on service-based competition, the US decided to abandon the focus on service-competition and to give priority to infrastructure competition.

Service-based competition has primarily been applied on DSL technology but can also apply to cable and fibre. The primary reason for DSL being at the centre of discussion is that the PSTN infrastructures were the most widespread networks, and that the incumbent telephone operators did not have the same dominant position in other technology areas such as cable and fibre. In fact, operators in Europe were forced to divest their cable networks in order to promote competition.

Mobile has taken quite a different regulatory trajectory. When digital mobile communications was launched in the early 1990s, more than one operator was generally licensed and provided with

frequencies to operate. In order to promote the deployment of mobile networks, national roaming was mostly not allowed. There was to be full infrastructure competition. This has, however, changed with the developments in mobile. Competition on mobile markets has been fierce driving down prices to a level where the number of operators with own networks (MNOs) has started shrinking. With the continuous new generations of mobile technologies, it becomes less economically sustainable with full and direct infrastructure competition. This is the reason why, facility sharing has increasingly been promoted politically.

Seen from a very general point of view, the regulatory trajectories of fixed and mobile technologies, respectively, have thus developed in opposite directions. While fixed line broadband regulation has become less oriented towards service-based competition, mobile has developed towards putting more emphasis on service competition. This has, however, been combined with a greater degree of public funding of fixed infrastructure upgrades, where the most prominent combination will be service competition on the basis of the infrastructure with public funding. Other combinations are, however, possible. Public funding can go to operators in, for instance, an open bid, where the winning operators will compete with other infrastructure providers. Combinations will be discussed in a later section of the paper.

4. Regulatory vs. developmental policies

The second dimension distinguishes between two different approaches to ICT policy – a regulatory and a developmental approach. This distinction is inspired by Chalmers Johnson (1982) and by Giandomenico Majone (1997), and is applied in a few studies on broadband policy (Lemstra & Melody, 2014; Falch & Henten, 2015). In his book on the Japanese post-war miracle, Johnson introduced the concept of the developmental state as opposed to the regulatory state. According to the Johnson, the role of the state bureaucracy in a developmental state includes ‘first, to identify and choose the industries to be developed (industrial structure policy); second to identify the best means of rapidly developing the chosen industries’ (Johnson, 1982).

The developmental state is contrasted with the regulatory state, where the state is mainly concerned with facilitating economic competition, but not with direct intervention in substantive matters. Japan was an example of a developmental state while the US is mentioned as an example of a regulatory state. Johnson (1982) claims that state intervention and especially the role of the Ministry of Trade and Industry (MITI) played an instrumental role in the successful economic development in Japan. In a later contribution, he suggests that other East Asian countries (Hong Kong, Taiwan, South Korea, and China) each have developed their own versions of the developmental state (Johnson, 1999).

According to Majone (1997), European countries were forced to change their mode of governance in direction of a regulatory model in response to the challenges created by increasing international competition and deepening economic integration within the EU in the late 1970s. This included privatization of public enterprises including public utilities, liberalization of markets, and

regulatory reforms. Historically, public ownership has been the main mode of regulation in Europe (Majone, 1997). With privatization, new modes of governance had to be developed. Especially within the area of public utilities, privatization had to be accompanied by regulatory reform.

In the context of the present paper, regulation embraces primarily activities carried out by national telecom authorities. This includes sector specific regulation, while regulatory issues addressing the economy more generally are omitted from this framework.

The objective of a regulatory approach is to create a stable policy framework for a liberalized telecom market with real competition. The instruments in this approach are rulemaking and correction of market failures. However, direct market interventions are to be avoided. This approach is theoretically supported by institutional economics. The argument is here that a stable regulatory environment reduces transaction costs and stimulates investments (Spiller & Tommasi, 2008).

The developmental approach is to stimulate investments and the use of ICT through various public sector initiated activities. The instruments include policies, which are more intrusive than those applied in the regulatory approach. These could be public investments and direct market intervention, e.g. in the form of public private partnerships providing public support to infrastructure development or subsidies to use or supply ICT services. This approach is supported by, for instance, Stiglitz (1998) and is in line with concept of the developmental state (Johnson, 1982). However, it includes also less intrusive measures such as demand stimulation via public consumption or upgrade of ICT skills of the citizens.

Within the area of ICT, EU policies have included regulatory as well as developmental initiatives. The EU initiatives have followed at least three different tracks. The first track initiated by the EU Commission focused on the telecom manufacturing industry and included funding of precompetitive research and standardization. Even though these activities carefully were defined in a way so that market distortions were to be avoided, the first track is clearly in line with the developmental mode of governance. The second track focuses on the liberalization of the telecom service industry and was introduced with the Green Paper in 1987 (CEC, 1987). The aim was to stimulate growth and competition on a common European wide telecom market, and the instruments were privatization, liberalization, and regulation. The third track has a broader perspective, as it includes the entire ICT ecosystem. This stream includes a series of consecutive development plans such as e-Europe, i2010 and Europe 2020. These plans contain a number of developmental initiatives stimulating the use of ICT applications such as e-government and e-health.

Majone (1997), at the time, observed a European trend towards the regulatory mode of governance. However currently, it seems that with regard to ICT, the developmental governance mode has gained importance. One reason is that the regulatory instruments used - or at least the manner in which they have been used - according to some scholars (e.g. Melody, 2013), have

proven to be insufficient to facilitate the development of broadband infrastructures at an adequate speed, and many countries are searching for alternative policy instruments (Falch, 2008). According to (Galperin, Mariscal & Viicens, 2013) a similar trend can be observed in Latin America.

Lemstra & Melody (2014) apply the concept of the developmental state in a summary chapter comparing national strategies. In this study, the US is seen as an example of a regulatory state, while South Korea applies the developmental model. Between these two extremes we find most of the EU countries. UK is leaning towards the regulatory model, while France is more oriented towards the developmental model. However, even in the US, a number of developmental initiatives have been taken (Falch & Henten, 2010).

According to (Greenwald & Stiglitz, 2012) industrial policies are back in fashion. Within the ICT area this is related to the growing importance of access to ICT services. This revival does not imply a return to Keynesian inspired policies practiced in the post-war period. Today developmental initiatives must be designed in a way, so that they conform to the EU internal market regulation and a liberal market environment. Resource allocation and choice of technologies are, whenever it is possible, left to private enterprises, e.g. with the establishment of public private partnerships.

5. Network vs. content prioritization

The third dimension is concerned with networks and content. Are broadband policies mainly concerned with the deployment of networks or are they also concerned with the creation and diffusion of content? It's obvious that content and networks are complementary. Wide distribution of content is no longer viable without appropriate network facilities and networks without content will be meaningless. However, emphasis in policy prioritization can differ from a primary focus on content creation or network deployment. The question is: which is the primary driver for the complementary content and network development?

In the present paper, focus is on policy implications. The complementary development of content and networks does not necessarily need any public intervention, but if deemed important, public policy can support network provision as well as demand, and content provision as well as demand. Network provision (supply) as well as demand can be based on developmental as well as regulatory policies, and the same applies to content provision (supply) and demand. Furthermore, network provision as well as demand can be combined with the prioritization of infrastructure-based or service-based competition. And, the same applies to content provision as well as demand. There are multiple combination possibilities.

In European ICT policies, the whole Digital Agenda pays much attention to the content side. The Digital Agenda is, to a large extent, concerned with the applications of ICTs, i.e. what ICTs and specifically broadband can be used for concerning residential as well as business applications. There are in European ICT policies two main trajectories since the beginning of the telecom reform

process. One trend focuses on the network side and has primarily been concerned with the liberalization and regulation of the telecom industry. The other trend has also referred to network developments but has, first and foremost, been dealing with the development of content, applications and services. The Digital Agenda is the latest version of this trend, which previously has been promoted under the headings of e-Europe, i2010 and Europe 2010.

Some countries in Europe have been especially concentrated on content, applications and services. This applies, for instance, to the Nordic countries, where much focus has been on e-government applications. Requirements on citizens and businesses to seek information, to report to public authorities and apply for public services have contributed to promoting the uptake of broadband. The prime concern may not have been on the implications for broadband extension, but it has been seen as a concerted action for supporting a digital society comprising content, applications and services as well as network infrastructures.

While telecom policy, addressing infrastructure issues, has been subject to intensive academic research for more than a century, research on policies regarding content, applications and services is of a more recent origin. Apart from the fact that telecom infrastructures formerly were subject to public ownership in most places and that network policies, therefore, were endemic, the reason could be that industrial policies traditionally have focused on infrastructures and the manufacturing sector rather than on services. Another reason is that the IT sector historically has developed in a liberal environment with limited regulation.

In the wake of the privatization of the telecom networks, competition regulation has aimed at ensuring that the former monopoly markets were transformed into competitive environments. Less attention has been paid to regulate monopolies in the service markets. This is not to say that ICT content and applications are entirely unregulated. There is, indeed, no sector specific competition regulation, but there is regulation in other areas. ICT services are regulated as any other kinds of services. In addition to this, the development of electronic information services has created new regulatory issues with regard to privacy, marketing, security, etc. However, the scope differs from telecom regulation.

When it comes to facilitation policies, the situation is the opposite. The focus on competition has implied that public involvement in network development has been considered as a no go area, as it will distort competition. EU, for instance, only allows funding of infrastructure in rural and peripheral regions. On the other hand, public involvement in the development of content, applications and services is less controversial. The public sector is a major supplier of services, and the provision of electronic public services is promoted in different manners in any country. The primary aim may be to enable either public savings or improved quality of service delivery (24 hours access, shorter response time, etc.). However, public demand and supply of electronic services may also stimulate private use and demand for network services.

6. National strategies

When looking at country experiences regarding the various strategies, it is important to note that any country can apply many different strategies at the same time. It is, for instance, possible to implement both developmental and regulatory policies at the same time. Few countries will claim that they don't regulate telecom markets in order to stimulate competition. Still there is a difference among countries with regard to the degree that market forces are assumed to be able to secure adequate broadband investments. This can most clearly be seen in the extent to which programmes providing financial support to infrastructures are implemented. Also, network expansion and the development of content supplement each other well. Moreover, infrastructure and service competition can also both be used at the same time. The question is the degree to which the different policy dimensions are implemented.

Within the EU, telecom markets were liberalized in the late 1990s. But according to Majone (1997) the move to a more regulatory approach started much earlier and was related to the ambition of creating an internal European market. Even though the EU countries are using a common framework, there are big variations in how it is applied in practice.

In the 1996 US Telecommunications Act, the objective was 'to promote facility based competition in all markets'. The adoption of the 1996 act included an obligation to provide interconnection at cost based rates (in order to promote service based competition). However, this led to the cancellation of most of the investment plans announced by potential alternative operators for introducing facility based competition, and in 1998, FCC moved towards a more facility based approach, where certain network elements, such DSLAMs (providing ADSL services) were exempted for this regulation.

To some extent, the development in Europe has been the opposite. Broadband unbundling was not a part of the liberalized EU telecom market when broadband was introduced in 1998, and most European countries did not address the issue before year 2000. In 1997, the UK the regulatory agency Oftel argued that unbundling 'could jeopardise the development of competition already underway' (Lemstra, 2014). From 2000, unbundling of the local loop has been a part of the EU regulatory framework, and operators with a dominant market position are required to provide full unbundling at cost based rates to their competitors. The final goal is still to achieve facility-based competition, and several EU reports have proudly announced a growth in facility based competition for xDSL services. However, facility-based competition is, in this context, defined as full unbundling (as opposed to bitstream access).

The impact on platform competition is less clear. In the UK, the initial regulated interconnection rates were set at a relatively high level in order not to spoil the potential for facility-based competition. However, the rates are now in line with the rest of EU. Moreover, the UK has supplemented the ULL (unbundling of the local loop) regulation with a demand for a functional separation of BT in order to ensure fair competition at the wholesale market for DSL connections.

Full functional separation is a regulatory remedy recognized by the EU regulatory framework, but applied only in the UK (Cadman, 2014).

In spite of the on-going debate on the ladder of investments, the regulatory framework has in principle remained unchanged since 2000. However, there is a trend towards more focus on using other remedies than the promotion of competition to stimulate network investments. This includes different kinds of developmental policies such as public investments or public subsidies.

UK is the European country with most focus on a regulatory approach. With the entry of a second operator already in 1984, the UK established itself as a frontrunner with regard to liberalizing its telecom market. UK has also introduced a market based approach to spectrum allocation before any other country within the EU. With regard to broadband policy, the major difference from other countries is the functional separation mentioned above.

Denmark has for many years followed a similar kind of policy. Since the second part of the 1990s, Denmark has had the ambition to host one of the most liberal telecom markets. This philosophy was labelled 'Best and cheapest through real competition and was the basis for a political agreement made in 1999, which still defines the framework for current policy initiatives.

A cornerstone in this policy was that no public funding of infrastructure investments should be made. The Danish Telecom Agency had a strong commitment towards ensuring competition by way of new entrants. Denmark had for a long period a 'best practice' clause that ensured that Danish interconnection rates always were among the cheapest in Europe. Denmark was also among the first countries to demand ULL. Within the past decade, the competition policy has been relaxed and the provision of public funding in a limited scale for infrastructure development in rural areas is being implemented.

Sweden, on the other hand, has a long tradition for a strong regional policy focus and direct public involvement in development of ICT infrastructures. In 1999/2000 the Swedish government adopted a broadband policy, which included substantial public support to infrastructure development. The financial support included €280 million to a national operator-neutral backbone, €358 million to municipalities to develop access and €290 million to regional networks and to create local infrastructure plans (Forzati & Mattsson, 2014). The public involvement goes beyond the mere financial support and, today, 175 out of 290 municipalities have deployed their own fibre networks (Forzati & Mattsson, 2014).

Although the French telecom market has been liberalized according to the EU guidelines, France represents a more developmental approach and has initiated a large number of developmental initiatives facilitating broadband development. This is in line with the French tradition, as France also in other areas has hosted major developmental initiatives in high-tech industries, such as the introduction of high speed trains.

The privatization of France Télécom started in 1997 and the government is still a major shareholder in the company. The historical background for the developmental initiatives is that the French telecom infrastructure up to the 1980s was much less developed than in the US and Northern Europe. Development plans were, therefore, initiated to catch up with these regions. The idea was not only to upgrade the infrastructure, but also to create a market for French industry.

In 1983, France Télécom introduced a videotex system called Télétel, which was a kind of web service before the Internet. Similar systems were introduced in other countries (Prestel in UK, Bildschirm Text in Germany, and Prodigy in US), but videotex became widespread only in France (Andreasen et al., 1989). The reason was that the French system was heavily subsidized and terminals were offered for free. The system was so successful that France Télécom did not introduce their own Internet service before 1996 (Loridan-Baudrier, 2014).

In France, developmental policy initiatives go beyond the public involvement in the incumbent operator. Since 2004, local authorities have been allowed to engage in network operations, and they can also facilitate private investments in various ways. In 2010, the government announced a 'high-speed' plan in order to close the digital gap and stimulate investments in rural and remote areas. The plan involved funds for research and development as well as for network investments.

The US is often seen as the primary example of a regulatory state. With regard to telecom, the incumbent operators have always been private, and regulation has from the beginning been a crucial element in governance. However, the US has a tradition for taking developmental initiatives as well. The universal service obligation (USO) has some developmental aspects although it formally is a regulatory tool. In contrast to other remedies it does not aim at facilitating competition. In fact, the arrangement may distort competition if not properly designed. Universal service regulation has many things in common with developmental programmes offering financial support to infrastructure development.

Universal service regulation played an important role in the US, at the time where small local operators dominated parts of the rural areas. In Europe, there was no need for a universal service regulation as long as networks were operated by state owned monopolies. Universal service regulation is included in the EU regulatory framework, but the reality is that it has never played the same role as in the US. In the EU framework, universal service is about coverage in high cost areas. In the US, it is also about affordability and connection of schools, and several programmes addressing these issues have been covered by universal service funds.

In addition to this, the US government has launched a number of other programmes providing substantial subsidies for both telecom and broadband networks. Two examples of such programmes are the Broadband Technology Opportunities Programme (BTOP) including 233 projects (totalling US \$3.936 billion) and Broadband Initiatives Programme including 320 BIP

projects (totalling US \$3.529 billion) (2010 figures) (Egan, 2014). Furthermore, the individual states implement their own developmental initiatives supporting local operators.

It is difficult to make a comparison of how various countries prioritize content development versus development of networks, as these policies complements each other, and all countries claim that both are important. It is, however, possible to compare countries with regard to how successful their policies have been in these two areas.

Igari provides a comparative analysis of Denmark and Japan, where it is stated that, while Japan has been very successful in their promotion of network facilities, they have been much less successful in developing public content and ICT usage (Igari, 2014). Denmark is mentioned as a country with emphasis on content development. Already in the mid-1990s, Denmark announced in their information society plan, Info2000, that focus should be on the service side and that the public sector should take the lead in this development. Other countries have in their strategies focused more on the hardware site. The French Minitel project was an interesting example of this, but even though the support went to the production of terminals, the most important implication was its stimulation of content and service production.

South Korea is often mentioned as the champion with regard to stimulation of network investments. However, an important part of the story is that the government has combined a strong push for network building with demand stimulating measures such as improvement of IT literacy (Choudrie & Lee, 2004).

In many aspects, the US has been the leading country with regard to the development of new services and content. The US has fostered platforms like Facebook, Netflix, YouTube, and Google. However, the US has in its policy been more focused on network development than the creation of content. Whether this is an example of a successful supply-push strategy, where the availability of network facilities has promoted ICT usage and content production is debatable. The US has from the outset had a strong position both in IT and in content production. Furthermore, the US has not been leading the roll-out of broadband. Only in the past few years, they have experienced a remarkable growth in the demand for broadband – due to the availability of attractive content.

7. Conclusion

The three different dimensions can be found in the broadband policies of all countries though they may have a more or less prominent position in the individual countries. They all in different manners relate to the basic issue of supply and demand, which is a fundamental question for all strategies for broadband development. Service-based competition gives priority to the supply of a variety of service offers and the immediate development of subscriptions, while infrastructure-based competition prioritizes the supply of a variety of network offers and the coverage of network resources. Developmental policies focus on the supply of network resources, and regulatory policies establish the framework for market-based supply of and demand for network

provision. Emphasis on network development vs. content development is concerned with the supply and demand regarding either networks or content.

All combinations of the dimensions are possible, but some combinations are more logical and coherent than others. It is unlikely that a country will have an emphasis on infrastructure-based competition and at the same time give priority to a developmental strategy and focus on content provision. But it is possible that such policy prioritizations, to some degree, may form part of the overall policy direction of some countries. What we are looking for in this paper are the typical combinations, which form a coherent set of policies. An example of a coherent set of policies could be a combination of service-based competition with a developmental strategy and a focus on network provision. In the table 2, an overview of countries discussed in this paper and their policy combinations is shown.

TABLE 2: CATEGORISATION OF NATIONAL STRATEGIES

US	Infrastructure-based competition; regulatory approach; network emphasis
UK	Service-based competition; regulatory approach; network emphasis
France	Service-based competition; developmental approach; network emphasis
Denmark	Service-based competition; regulatory approach; content emphasis
Sweden	Service-based competition; developmental approach; , network (and content) emphasis
Japan	Infrastructure-based competition; developmental approach; network emphasis
South Korea	Infrastructure-based competition; developmental approach; network (and content) emphasis

As it goes with most categorisations and models, they only present the main directions, and many contradictions and details are missing. However, they do represent strategies that entail some degree of logic and coherence. France, for instance, has an overall emphasis on service-based competition, which is combined with a developmental strategy and a priority on network development. The US, on the other hand, has a preference for infrastructure competition in combination with a regulatory strategy and an emphasis on network development, while Denmark gives priority to service-based competition, a regulatory strategy and emphasis on content creation and distribution.

In future work on the issue, a larger variety of countries will be included in order to better describe typical combinations of policies. Furthermore, specific policy choices will be examined. The aim of this is also to determine typical policy options.

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