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Study for Ofcom

Competition & investment:

An analysis of the drivers of superfast broadband

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Bad Honnef,
July 2015

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Summary of findings

This study provides evidence-based analysis on the drivers of fast and superfast broadband (SFBB)[1]. We assess whether the UK (and Europe) are falling behind other global regions and explore the respective roles of market-based and regulatory factors in explaining fast broadband outcomes. The assessment is based on empirical analysis from 12 countries, of which seven are European.

This study aims to provide insights that may be relevant to the upcoming review of the EU Framework for Electronic Communications, as well as providing an input to Ofcom's Strategic Review of Digital Communications.

We find that **the main factor which has driven next generation access (NGA) deployment is infrastructure competition** – primary from cable, and in some cases from independent FTTH investors. Cost factors such as the technologies deployed (FTTC vs FTTB vs FTTH[2]) and density of housing may also have affected NGA coverage. Meanwhile, **demand-based factors such as the availability and popularity of online video, may help to explain some of the differences in take-up of fast broadband**.

Although some have claimed that regulatory policies such as forbearance on access to NGA networks may stimulate deployment, we did not find proof that this was the case. Nor did we find at the other extreme that structural separation necessarily provides better outcomes for consumers. In general, **regulatory factors appear to date to have had less influence over NGA coverage and take-up than market-based factors** such as infrastructure competition or online video. However, the existence and type of **regulation does seem to have an impact on the number of players offering fast broadband services to end-users**, which may affect consumer outcomes such as prices and speeds in the longer term.

For example, there is a limited choice of retail fast broadband offers in the US, which has pursued forbearance, while the degree of choice is greater in countries such as the UK which have mandated 'local access' to NGA networks. Countries such as France and Spain, which have focused on incentivising alternative operators to 'climb the ladder of investment' by mandating passive access remedies in the absence of active access ('deep passive strategy'), have witnessed greater infrastructure-based competition in NGA in dense urban areas, but the degree of choice outside these areas is limited.

Another observation is that **regulatory objectives may influence technological choices**, which in turn influence cost. When technological choices are left to the market, we commonly see NGA deployment strategies which aim at cost-efficiency

1 Fast broadband in the context of this report means speeds of 30Mbit/s or more. Superfast broadband refers to speeds of 100Mbit/s or more. References to Next Generation Access in this report refer to technologies capable of reliably delivering 30Mbit/s or more.

2 Fibre-to-the-Curb, Fibre-to-the-Building, Fibre-to-the-Home

such as FTTC or a mix of FTTx technologies depending on geography. This strategy may support more widespread NGA deployment. On the other hand, when regulators have specifically sought to promote technologies such as FTTH, and designed regulation to achieve this, there has been some FTTH deployment in the market – at least for a portion of the territory. However, these deployments may imply higher costs, which may not necessarily be matched by demand. For example, broadband usage is relatively low in several countries with FTTH networks including France and Japan.

Looking at outcomes for consumers in fast broadband as a whole, our assessment is that **the UK (and much of Europe) are not 'falling behind' North America**. Meanwhile, the world-leading outcomes in Korea and Japan may stem from Government programmes and incentives for fibre which were introduced in the 1990s.

Fixed investment (capex) does appear to be higher in countries with a higher fixed revenue per capita. There could be various reasons for this, such as higher costs resulting from lower population densities or a higher willingness by consumers to pay for increased bandwidth. However, **we do not find any clear relationship between the regulatory approach or competitive intensity[3] and either revenues or investment**.

Our analysis raises several points which are relevant to EU and UK policy-making.

- There is a strong case for maintaining a focus on promoting competition (and specifically infrastructure-based competition) as it is a key driver for fast broadband. This should remain a key objective for national regulatory authorities at EU and national level. Access-based regulation may remain an important tool to ensure consumer choice where infrastructure-based competition alone would be insufficient
- Policies aimed at favouring FTTH could influence FTTH deployment. However, user requirements should be taken into account. In some countries supply does not seem to match end-users' demand for bandwidth. Technological neutrality is likely to result in more cost-efficient solutions.
- Demand-based factors such as online content are important drivers for fast broadband take-up. There may therefore be a case for policy-makers and regulators to complement supply-side measures with measures which foster the availability and consumption of online content and applications
- There is no single regulatory approach that provides a 'magic bullet' for fast and superfast broadband. Different conditions imply that different approaches may be needed in different countries or different regions, for example depending on the potential for infrastructure competition. The ladder of investment remains a relevant concept in which to consider regulatory approaches to NGA.

3 As measured by the Herfindahl-Hirschman Index (HHI)

Executive summary

I. Background

The effect of regulation and competition on investment in superfast broadband (SFBB) networks (often referred to as next generation access, or NGA networks) has been subject to a long-standing debate. Some telecommunication operators claim that relaxing regulatory controls could help to boost roll-out of fast networks such as fibre-to-the-home (FTTH)[4], while others claim that regulation does not hamper investment and may improve consumer outcomes in broadband[5].

In the context of this debate, the European Commission is considering a more 'ambitious' reform of the EU Framework governing Electronic Communications. Amongst other questions, the Commission has signalled that it plans to assess how to encourage the deployment of very high capacity networks, while maintaining effective competition and adequate returns on investment[6]. Ofcom is also undertaking a strategic review of the UK telecommunications sector[7], for which the same questions are relevant.

In this study we seek to inform discussions about what drives superfast broadband through analysis of empirical data. Specifically we (i) compare fixed NGA outcomes across 12 EU and international markets; (ii) describe different regulatory and policy approaches to superfast broadband deployment; (iii) gauge which factors affect consumer outcomes in NGA as well as fixed investment more widely; and (iv) identify potential implications for regulatory objectives. The countries examined in Europe are France, Germany, Italy, Netherlands, Spain, Sweden and UK, while outside Europe, we focus on Australia, Canada, Japan, South Korea and the US.

A key focus is to understand whether the UK and Europe are 'falling behind' other regions in superfast broadband and what role the regulatory environment might play, in relation to other factors, in determining NGA outcomes.

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4 BCG (2013) Reforming Europe's Telecoms Regulation to Enable the Digital Single market https://www.etno.eu/datas/publications/studies/BCG_ETNO_REPORT_2013.pdf (for ETNO) notes that "while Europe was once a leader in the technologies that comprise the backbone of the digital economy, many markets in Asia and America now enjoy fiber access penetration that is up to 20 times higher and LTE penetration that is as much as 35 times greater than Europe's." In order to recover Europe's position, the study advocates a move from sector-specific regulated to a harmonised and substantially reduced pan-European regulatory approach, relying mostly on established competition law".

5 TU Delft (2014) research funded by ECTA Explaining Telecommunications Performance across the EU http://www.ectaportal.com/en/upload/TCI/Explaining_Telecommunications_Performance_across_the_EU_14-04-14.pdf claims that lower LLU prices and the combined strength of infrastructure and access-based competition drive broadband performance

6 EC Communication May 2015 "A Digital Single Market (DSM) strategy for Europe" http://ec.europa.eu/priorities/digital-single-market/docs/dsm-communication_en.pdf

7 Ofcom (March 2015) Digital Communications Review http://stakeholders.ofcom.org.uk/telecoms/policy/digital-comms-review/

II. The UK's and Europe's NGA performance in context

Various studies[8] have claimed that Europe in general (and by implication the UK) has been falling behind North America and Asia as regards performance in superfast broadband.

Our assessment is that this characterisation is overly simplistic. For example, Table 1 shows that although NGA *coverage* is higher in North America than in most European countries, US and Canadian customers pay more for fast broadband and do not experience faster download speeds than consumers in the UK or several other European countries.

Meanwhile, while NGA outcomes in Korea and Japan are world-leading in many respects, Japanese customers use less bandwidth (and consume less online video) than those in the UK and Sweden.

Table 1: Summary of rankings for consumer outcomes[9]

	NGA coverage (IDATE 2014)	NGA take-up (IDATE 2014)	Speeds Mbps (Akamai 2014)	Usage GB per sub (Cisco 2014)	Prices - high basket >30Mbits (OECD 2012)	International ranking	EU ranking
Australia	12	11	10	7	8	11	
Canada	4	5	7	4	10	7	
France	10	9	10	11	6	10	6
Germany	7	10	8	8	4	8	4
Italy	11	12	12	10	9	12	7
Japan	3	3	2	6	4	2	
Korea	2	1	1	1	1	1	
Netherlands*	1	8	4	N/A	5	3	1
Spain	8	7	9	9	11	9	5
Sweden	9	2	3	2	7	4	2
UK	6	6	6	5	2	5	3
US	4	4	5	3	12	6	

Based on ranking of averaged rankings (NL over 4 observations)

Outcomes in the other international comparison country – Australia – trail those in Europe.

From a financial perspective, capex as a proportion of revenues for fixed telecoms tend to lie within a band of between 10-20%. In the UK capex ratios are in the mid-range and have been similar to the US in recent years (see Figure 29). Although in absolute

8 For example, BCG (2013) for ETNO, McKinsey (2012) A 'new deal': Driving Investment in Europe's telecom infrastructure

9 The average rank consistens of a ranking of the simple average of rankings for different metrics. Each observation is given equal weight. Using different weights would result in different outcomes, but the choice of weightings might be difficult to justify objectively.

terms, fixed capex and revenues in the US have consistently exceeded those in the UK and many European countries[10], most of the European countries examined had higher capex and revenues per capita than Japan or Korea.

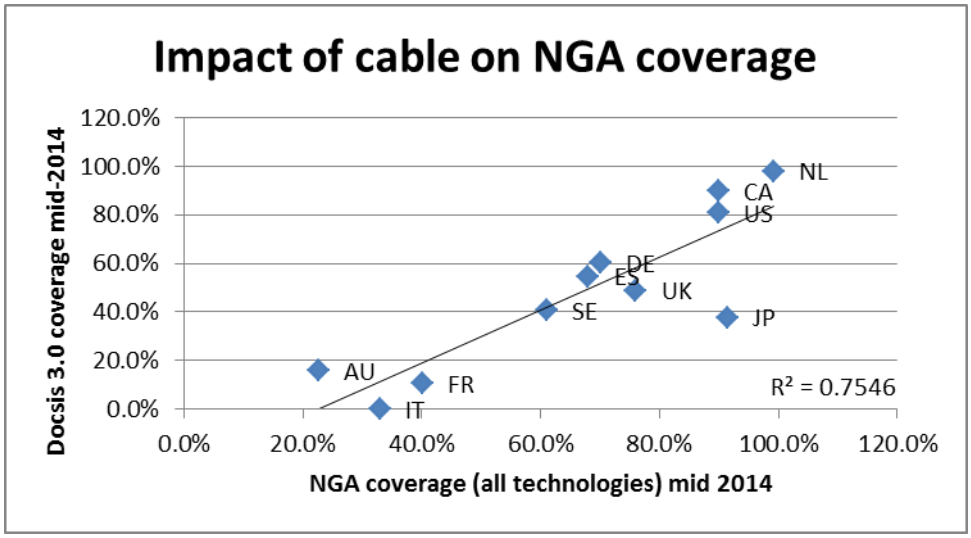
III. How do market factors affect NGA outcomes?

A range of factors may be behind the different NGA outcomes in the countries we assessed. These include market-based factors such as the prevalence of cable, population density or technological choices which affect cost, and factors such as online video, which may affect demand for fast broadband.

The role of infrastructure-based competition

We found that one of the main factors explaining the variations in NGA coverage is the presence of cable. This is likely to be because of the relatively low cost of upgrading existing cable networks to high speed DOCSIS technology, and the competitive stimulus that cable provides to the incumbent to upgrade its network (often to FTTC/VDSL). As shown in Figure 1, cable appears to be a primary factor explaining high NGA coverage in the US and Canada.

Figure 1: Impact of cable on NGA coverage



Source: WIK based on IDATE FTTx World

Likewise competition from independent FTTH investors has provided an important stimulus for FTTH deployment in several countries. Municipalities, utility companies and infrastructure specialists, have played a role in triggering FTTH deployment in Sweden

10 Measured on the basis of an average of fixed capex per capita over time (OECD 2002-2011)

and the Netherlands, while alternative operators alongside cable companies have contributed to FTTH deployments in France and Spain.

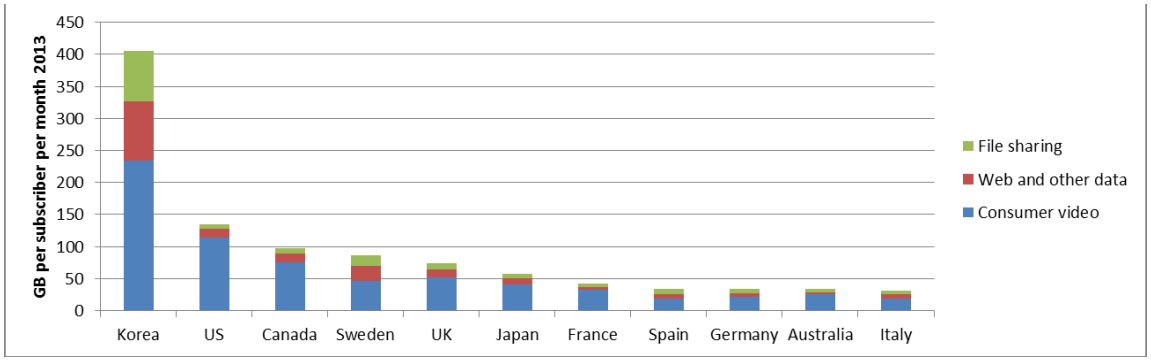
Cost factors

The choice of technology (FTTC vs FTTB/H) also affects the cost and economic case for widespread deployment, as does the population distribution. For example, high capex rates in the US and Canada may reflect the high costs of serving more dispersed populations. On the other hand, low capex levels in Japan and Korea may result from the density of the population (often in Multi-Dwelling-Units) in capital cities (see Figure 13).

Video as a driver of NGA take-up

While infrastructure-based competition is an important driver of NGA deployment, we find that NGA *take-up* may be influenced by demand-side factors such as the availability and popularity of online video (see Figure 2). Local language online content may be one factor as to why take-up of NGA in the US and Canada is relatively high despite high prices, while it is low in countries such as Germany and France even though there is no significant price premium for fast broadband in these countries.

Figure 2: Usage of online video from fixed connections



Source: WIK based on Cisco VNI (data as of 2013)

IV. How does policy and regulation affect NGA outcomes?

Various claims have been made about the effects of public intervention and regulation on investment and competition in fast broadband. We explored the role of public initiatives as well as different regulatory strategies in contributing to NGA outcomes.

Public initiatives

A common factor which may have contributed to the early deployment of NGA in Japan and South Korea is the focus in both countries on public initiatives. Between 1991-2006[11] Japan offered a reduction in local and corporation taxes to operators installing fibre facilities[12], while in Korea in 1994, the Korean Government decided that "a national fibre optic network was crucial for economic growth" and offered grants and soft loans as part of a rolling series of public initiatives. It seems likely that these initiatives were one of the main reasons why deployment in these countries started so much earlier than elsewhere. However, these countries also benefit from other factors which eased the supply of FTTH deployment, including a high proportion of households inhabiting MDUs and dense housing in capital cities, as well as aerial deployment and sewers which are likely to have reduced costs. Take-up, usage and other factors such as speed and price are all attractive in South Korea, suggesting that supply and demand for fast broadband are well-matched. In Japan however, bandwidth usage is relatively low despite high speeds and high NGA coverage. This may result from lower demand for online content such as video. This outcome raises questions about whether supply is in itself sufficient to create demand[13].

State aid is another measure used to finance NGA deployment in various countries. There are however few apparent linkages between the level of state aid and NGA deployment, potentially due to differences in the scope of uneconomic areas as well as the costs of serving them.

Economic regulation

As regards economic regulation for NGA, different approaches have been taken ranging from forbearance in the US and Canada, to structural separation and service competition in Australia. In between these scenarios, different European countries have focused regulation at different rungs of the ladder of investment, with some focused on maintaining competition at the 'local access' level, while others have aimed to incentivise entrants to 'climb the ladder of investment' to FTTH by focusing on deep passive access without any downstream active access remedies.

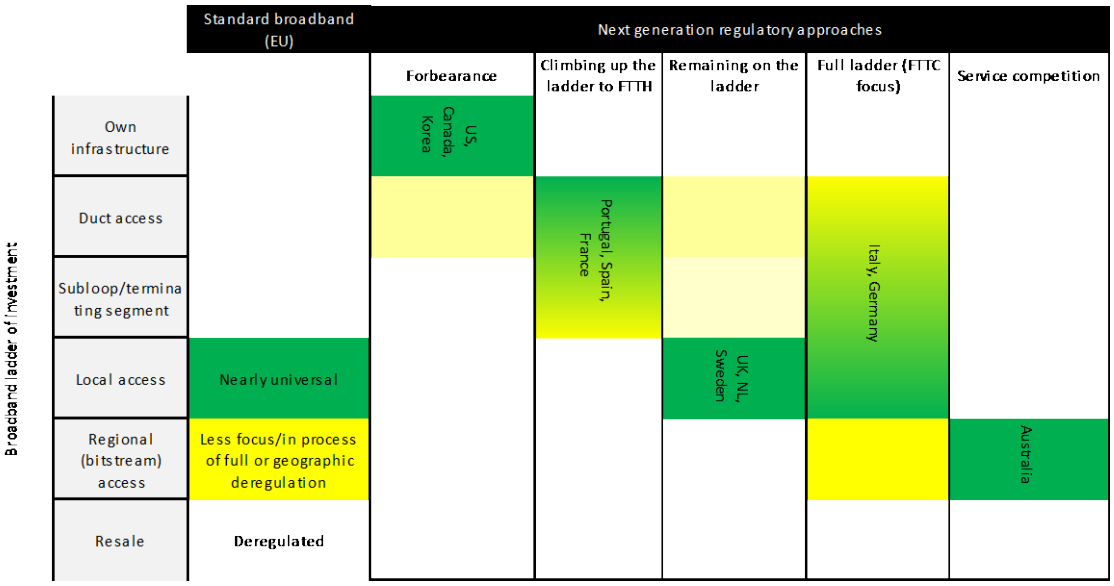
These different strategies and their relationship to the broadband 'ladder of investment' are shown in Table 2.

11 Provisional Measures Law for Telecommunications Infrastructure Improvement電気通信基盤充実臨時措置法

12 Presentation to ITS Conference in Beijing 13/06/2006 – Evolution of IP Network and Convergence in Japan – impact of hard law and soft law – members of the Research Institute of Telecommunications and Economics, Keio University, Obirin University

13 Marcus, Elixmann (2013) Build it, but what if they don't come? http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2285113

Table 2: Contrasting approaches to NGA regulation



Source: WIK

The effect of regulatory forbearance

It has been suggested by some operators[14] and analysts that limiting unbundling and regulated access to NGA networks ('regulatory forbearance'), such as the approach applied in the US and Canada, aids NGA deployment. But we did not find a clear pattern of evidence to support this theory. As the high NGA coverage in the US and Canada is largely explained by cable coverage, it cannot be proved that regulatory forbearance was a key factor in supporting NGA deployment in these countries. Conversely, there are examples of countries with historically strong NGA regulation, including the Netherlands and Sweden, which nonetheless have positive NGA outcomes.

We also did not find any clear link between regulatory forbearance on NGA (or indeed other regulatory approaches) and fixed revenues or investment, suggesting that regulation may not be a primary factor in driving these financial outcomes.

In view of the abundant literature[15] on this point, we also examined the theory that local loop unbundling might hamper investment in NGA, because it sets an expectation as regards regulatory intervention. In this context, we did find that in general, countries with higher LLU take-up had lower NGA deployment. However, this may be explained by the fact that countries with high LLU also have lower cable coverage, which is a driver of NGA deployment. In other words, the negative link is more likely to be due to market characteristics (low infrastructure-based competition) which lead regulators and

14 For example, BCG (2013) for ETNO, McKinsey (2012) A 'new deal': Driving Investment in Europe's telecom infrastructure

15 For a summary of relevant literature from Grajek, Roller, Nardotto, Crandall see Mathis, Sand-Zanrman (March 2014) http://idei.fr/doc/by/sand_zantman/Competition_and_Investment.pdf

operators to focus on access-based competition, than to the presence of LLU in itself. We note that there are also circumstances in which the higher speeds driven by LLU[16] might incentivise NGA deployment by the incumbent as a source of competitive advantage[17]. Such deployment and the resulting migration away from legacy technologies could also result in an increase in take-up of NGA at the expense of LLU, which is consistent with our findings.

Effects of structural separation

At the other end of the scale from forbearance, structural separation has been proposed by some operators[18] and financial analysts as a potential solution to derisk investment and promote competition in NGA. Although we cannot rule out positive results at a later stage or in other markets, our analysis suggests that, to date, the creation of a structurally separated National Broadband Network (NBN Co) has not by itself delivered positive outcomes for NGA in Australia, either for NGA coverage, take-up or other factors such as pricing. A particular concern is that uncertainties and delays, as well as plans to remove the existing infrastructure-based competition, may have chilled investment incentives. However, Australia suffers from low cable coverage and low bandwidth demand, factors which may also have undermined NGA outcomes, independent of the regulatory strategy. Since the launch of Netflix earlier in 2015 however, there have been some indications of an increase in bandwidth use in Australia[19].

Effects of 'deep passive access'

Within Europe, various approaches have been taken to regulation for NGA. While the UK, Sweden and the Netherlands have focused regulation largely around 'local access' to NGA networks (a level of access equivalent to 'local loop unbundling'), some countries have adopted strategies to incentivise entrants to 'climb the ladder of investment' to FTTH.

France and Spain have applied regulatory regimes that require entrants to install their own FTTH infrastructure to the base of each building or (in less dense areas of France) to the 'terminating segment' – a point roughly equivalent to a fibre subloop. In these countries, there is no active access to fibre-based NGA. Instead, they have focused on detailed regimes to foster the use of duct access, and sharing of in-building wiring (or

16 See Nardotto, Valletti et al (2014) Unbundling the incumbent: evidence from UK broadband for evidence of speed effects from unbundling

17 Either to 'escape regulation' if NGA is not regulated, or to obtain higher returns (if NGA access conditions allow higher returns than LLU)

18 See for example FT March 12 2015 'Ofcom urged to break BT's grip as telecoms sector faces sgake-up' http://www.ft.com/cms/s/0/da90aa76-c888-11e4-8617-00144feab7de.html#axzz3eAnd3HD0 Doyle (2008) for Singtel Optus – Structural separation and investment in the National Broadband Network environment https://www.optus.com.au/dafiles/OCA/AboutOptus/MediaCentre/SharedStaticFiles/SharedDocuments/08.06.18%20Dr%20Chris%20DOYLE%20report.pdf

19 See http://www.smh.com.au/digital-life/digital-life-news/these-graphs-show-the-impact-netflix-is-having-on-the-australian-internet-20150402-1mdc1i.html

the fibre terminating segment in the case of France). ARCEP has indicated[20] that its strategy was aimed at fostering FTTP deployment, infrastructure competition and ultimately lighter asymmetric regulation, while CNMC's strategy aimed at promoting multiple competing infrastructures and investment in NGA[21], with an implied focus on FTTH[22].

This strategy does not seem by itself to explain NGA deployment. NGA coverage in Spain (and Portugal, which also adopted this strategy) is relatively high, while NGA coverage in France is relatively low. Rather, cable coverage and cost factors, such as the relative proportion of the population living in urban areas, may as in other cases, be a key factor which has affected the degree of deployment in these countries. However, EU countries which pursued passive access strategies in the absence of active access, have seen a degree of infrastructure-based competition on NGA (FTTH/B and cable) in dense urban areas, which may have been influenced by these strategies. NRAs in France and Spain have nonetheless acknowledged that the scope for end-to-end infrastructure-based competition on NGA may be limited to certain urban areas, and are pursuing different strategies to promote competition in NGA services outside these areas.

It is notable that, notwithstanding the higher degree of infrastructure competition in FTTH within urban centres, consumer outcomes in France and Spain fall below the average in the researched countries. In particular take-up of NGA and usage of bandwidth is relatively low, while NGA prices remain above levels in the UK. Higher prices might be explained partly by the higher cost of FTTH in comparison with FTTC and other demographic factors increasing cost. However, in view of the low demand for online video and other bandwidth intensive services, it could also be asked whether the policy focus on FTTH has matched the demand-side bandwidth requirements of consumers.

V. Conclusions on the drivers of NGA outcomes

In Table 3, we have summarised the results of our analysis by showing NGA outcomes alongside candidate influencing factors including market supply, policy and demand-side factors.

NGA outcomes are shown both in terms of the overall rank including 5 metrics (coverage, take-up, speed, usage and price), and for NGA coverage and take-up, which are metrics for which targets have been set within the Digital Agenda for Europe[23].

20 ARCEP response to questionnaire conducted on Ofcom's behalf March 2014
21 CNMC response to questionnaire conducted on Ofcom's behalf March 2014
22 CNMC notes lack of demand for SLU which would have been a prerequisite for FTTC-based infrastructure competition
23 The European Commission Digital Agenda for Europe (2010) sets targets for universal availability of 30Mbit/s broadband and for 50% of households to be taking up 100Mbit/s by 2020. http://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:52010DC0245&from=EN

These two metrics have also been extracted from the wider NGA ranking because they may be influenced by or drivers of the other three consumer outcome measures.

For market supply-side factors, we have listed (i) infrastructure-based competition, based on cable coverage together with an estimate of coverage of other independent NGA infrastructures; and (ii) % population within urban areas as a proxy for cost.

Under policy factors we have highlighted the degree to which there is regulatory forebearance on NGA, which has been suggested as a factor which may affect NGA deployment, as well as the presence of strong public initiatives such as tax incentives, soft loans and high levels of state aid.

On the demand-side we have highlighted video usage, which may be linked to NGA take-up, and NGA price, which may influence take-up in the presence of demand.

For easier comparison, we distinguish between four groups of countries based on the degree of coverage and take-up of fixed NGA (>30Mbit/s).

Table 3: Summary of NGA outcomes and potential drivers

	Outcome measures			Market supply-side factors		Policy supply-side factors		Demand-side factors	
	NGA outcome average rank	NGA Coverage (>30MBit/s) % HH (IDATE)	NGA Take-up (% coverage) (IDATE)	Coverage infrastructure-based competition	% population in urban areas (OECD)	Financial incentives/state aid	NGA regulatory forebearance	Video usage/ file sharing (Cisco VNI)	NGA basket (>30M) price (OECD)
Korea	1								
Japan	2								
US	6								
NL	3								
Sweden	4								
Canada	7								
UK	5								
Germany	8								
Spain	9								
France	10								
Australia	11								
Italy	12								
		Green >80% Yellow 50-80% Red <50%	Green >50% Yellow 25-50% Red <25%	Estimates based on cable, independent FTTH - Green >70% HH Yellow 40-70% Red <40%	Green= 70%+, yellow=50-70%, red=<50%	Green=significant state financial initiatives or state aid. Red=minimal state aid/financial support	Green = complete NGA forebearance. Red= cost-based NGA regulation	Green >100GB per month yellow 50-100GB Red <50GB	By rank - 4 lowest cost = green etc

All data 2014 except price (2012)

Based on our analysis of 12 countries, we conclude that NGA access regulation is less likely to determine NGA coverage than widespread infrastructure-based competition (for example between the incumbent and cable provider), demand factors and other factors such as the technical solutions adopted (DOCSIS 3.0 and FTTC can be deployed at lower cost than FTTH) and demographics, such as the urban density and prevalence of multi-dwelling units, which also lowers the cost of deployment.

This does not mean that access-based competition plays no role. An analysis of regulatory approaches and outcomes for example highlights that the regulatory approach is likely to affect the degree to which there is choice in retail providers for fast broadband (see Table 14). Choice is limited in the US, which has pursued forbearance, but is widely available in the UK based on wholesale inputs alongside cable. Infrastructure-based choice is available in countries which focused on deep passive remedies, but the geographic scope is limited mostly to dense urban areas.

As volumes of NGA wholesale products in many countries are still low, there is insufficient data at this stage to fully gauge what the effects of choice in fast broadband may be on consumer outcomes. We note however that retail prices for NGA in the countries with the least choice – the US and Canada - are amongst the highest amongst the examined countries (see Table 14), while NGA prices are lower amongst those countries which focused on local access strategies for NGA, which also tend to have greater choice. If confirmed, this pattem could mirror previous experience with local loop unbundling in the UK, where access may have contributed to price reductions for higher speed services and accelerated the uptake of broadband in the early deployment phase[24].

It is possible that a later analysis may reveal more insights around the effect of NGA regulation on consumer outcomes including prices, take-up and speeds.

VI. Implications for UK policy

From a UK perspective, the analysis suggests that:

- Policies which incentivise infrastructure-based competition are likely to continue to yield positive outcomes for NGA deployments today and in the future
- Consideration should be given to consumers' needs in shaping regulatory policy. Strategies which explicitly seek to favour FTTH may not necessarily match user requirements.
- There is no 'magic bullet' as regards regulatory approaches, as they are affected by national circumstances, and may differ between countries as well as within

24 See Analysys Mason (2012) Disentangling unbundling: the impact of local loop unbundling on broadband take-up and quality and Nardotto, Valletti et al (2014) Unbundling the incumbent: evidence from UK broadband which finds acceleration of broadband in the early phase, but with diminished effects on market maturity

countries. For example, it cannot be concluded on the basis of the analysed countries that complete forbearance on NGA access or structural separation of the access network would necessarily improve NGA outcomes in the UK. The conditions which led to those approaches in the US, Canada, Korea and respectively Australia (for structural separation) are in many cases not applicable in the UK. Some outcomes in those markets – notably price in the US and Canada, and NGA coverage and take-up in Australia - are substantially worse than in the UK.

- Access regulation may play an important role in enabling choice where infrastructure competition alone would be insufficient to achieve this. Experience from basic broadband markets suggests that choice can be a driver of price and speed innovation, and support uptake in the early deployment phase of new technologies.

- The ladder of investment remains a relevant concept in which to consider approaches towards NGA regulation. It is possible that different aspects of the ladder may be relevant in different geographic areas. The degree (and geographic scope of) infrastructure-based competition in European countries which focused on incentivising competing NGA infrastructures, may provide some useful insights as to the potential as well as the limitations of passive approaches.

- On the basis that cost as well as demand factors (such as online video, publicity around high bandwidth connections) may affect NGA outcomes, there may be a case to focus NGA policy on areas beyond economic regulation.

VII. Implications for the review of the EU framework for electronic communications

The EU framework for electronic communications currently requires national regulatory authorities to focus on three main priorities[25] – namely:

(i) promoting competition in electronic networks and services; and

(ii) contributing to the development of the internal market; and

(iii) promoting the interests of citizens

A significant focus in this context is currently placed on the role of ex ante SMP regulation, which is applied in case of market failure. Regulators are given significant flexibility in applying rules which reflect conditions specific to their markets.

25 Article 8 Directive 2002/21/EC as amended by Directive 2009/140/EC

Firstly, we are able to conclude that promoting competition (and in particular infrastructure-based competition) remains an important means to achieve positive consumer outcomes, and should remain as a core objective for European NRAs.

Notwithstanding the importance of the internal market, our analysis also suggests that national (or even local) conditions, such as the existence and potential for infrastructure-based competition, may affect market dynamics. In turn, these factors may affect the appropriate regulatory response in each case.

Lastly, an important conclusion is that a focus on ex ante SMP regulation as a primary regulatory tool may be too narrow in an environment in which factors other than access-based regulation play an important role in driving market outcomes. Industry-wide (symmetric) measures may be relevant in some cases, and NRAs should be given an appropriate set of tools in this area. Given the relevance of demand in supporting NGA outcomes, it may also be useful for NRAs to have an explicit role on the demand-side, for example through fostering the competitive provision and usage of innovative content, applications and services.

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Abbreviations

ADSL	Asymmetric Digital Subscriber Line
CAPEX	Capital Expenditure
DCF	Discounted Cashflow
DOCSIS	Data over Cable Service Interface Specification
FTTB	Fibre-To-The-Building
FTTC	Fibre-To-The-Curb
FTTH	Fibre-To-The-Home
FTTP	Fibre-To-The-Premise
FTTx	FTTH/B/C
GPON	Gigabit Passive Optical Network
IRU	Indefeasible Right of Use
LLU	Local Loop Unbundling
MDF	Main Distribution Frame
NGA	Next Generation Access
NRA	National Regulatory Authority
ODF	Optical Distribution Frame
PIA	Passive Infrastructure Access
PON	Passive Optical Network
SLU	Subloop Unbundling
SMP	Significant Market Power
VDSL	Very High Speed Digital Subscriber Line
VULA	Virtual Unbundled Local Access

1 Introduction

The effect of regulation and competition on investment in fast and superfast broadband (SFBB) networks[26] (often referred to as next generation access, or NGA, networks) has been subject to a long-standing debate. Some telecommunication operators claim that relaxing regulatory controls could help to boost roll-out of fast networks such as fibre-to-the-home (FTTH)[27], while others claim that regulation does not hamper investment and may improve consumer outcomes in broadband[28].

In the context of this debate, European institutions will be evaluating the EU Framework for Electronic Communications. Amongst other questions, they will consider what should be the main objectives of national regulatory authorities and the role that ex ante economic regulation plays in achieving these objectives.

In this study we seek to (i) compare fixed NGA outcomes across 12 EU and international markets; (ii) describe different regulatory and policy approaches to superfast broadband deployment; (iii) gauge which factors affect consumer outcomes in NGA as well as fixed investment more widely; and (iv) identify potential implications for regulatory objectives. A key focus is to understand whether the UK and Europe are 'falling behind' other regions internationally and what role regulation might play, in relation to other factors, in determining NGA outcomes.

In Chapter 2 we compare NGA outcomes in 12 countries – namely the UK, France, Germany, Spain, Italy, Netherlands, Sweden, US, Canada, South Korea, Japan and Australia. The largest five EU countries offer the closest comparisons in terms of market size to the UK. Other countries were selected by virtue of their strong record in NGA deployment and/or to provide geographic diversity as well as a diversity in the regulatory approaches adopted.

In Chapter 3 we consider the effect of demographic, market supply and demand factors on NGA outcomes.

In Chapter 4 we summarise the main potential policy and regulatory drivers for SFBB and describe their implementation by means of brief case studies.

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26 By fast broadband we meet download speeds of 30Mbit/s or more. Superfast broadband implies download speeds of 100mbit/s or more. NGA refers to technologies capable of reliably delivering download speeds of 30Mbit/s or more

27 BCG Reforming Europe's Telecoms Regulation to Enable the Digital Single market https://www.etno.eu/datas/publications/studies/BCG_ETNO_REPORT_2013.pdf (for ETNO) notes that "while Europe was once a leader in the technologies that comprise the backbone of the digital economy, many markets in Asia and America now enjoy fiber access penetration that is up to 20 times higher and LTE penetration that is as much as 35 times greater than Europe's." In order to recover Europe's position, the study advocates a move from sector-specific regulated to a harmonised and substantially reduced pan-European regulatory approach, relying mostly on established competition law".

28 TU Delft research funded by ECTA Explaining Telecommunications Performance across the EU http://www.ectaportal.com/en/upload/TCI/Explaining_Telecommunications_Performance_across_the_EU_14-04-14.pdf claims that lower LLU prices and the combined strength of infrastructure and access-based competition drive broadband performance

In Chapter 5 we examine what effect different regulatory approaches may have on NGA outcomes and investment.

In Chapter 6 we summarise the respective effects of regulation and other factors on NGA outcomes and investment, and draw conclusions as to the implications for regulatory objectives.

2 NGA outcomes

In this section we identify and compare five metrics for NGA outcomes in order to gauge how the UK performs in relation to other European countries and international 'leaders' in NGA.

2.1 Metrics for assessing NGA outcomes

There are various metrics by which fixed broadband consumer outcomes can be measured. The results may vary according to which metrics are used. In this report, we focus on 5 key metrics – namely Next Generation Access (NGA) coverage, take-up, prices, usage and actual speeds.

NGA coverage

NGA coverage indicates the proportion of households that could in theory receive services based on NGA networks. There are various ways in which NGA could be interpreted. In line with the broadband targets of the Digital Agenda for Europe and associated data from the Digital Agenda Scoreboard, we take NGA as meaning technologies which are capable of delivering 30Mbit/s or more (also referred to in this report as 'fast broadband'). Such technologies include:

- Cable Docsis 3.0 or higher
- FTTx including FTTC/VDSL, FTTB and FTTP

We do not include LTE within the definition as this is considered a shared medium in which high speeds may be provided, but cannot necessarily be guaranteed. In the context of market reviews conducted by Ofcom as well as those in most other European markets, LTE has not been found to be a substitute for fixed broadband.

Certain technologies including Docsis 3.0 and FTTB/P are already capable of delivering 100Mbit/s or more (also referred to in this report as 'superfast broadband' (SFBB)). In time, and with the introduction of technologies such as VDSL vectoring and G.fast other forms of FTTx may also be able to achieve these speeds.

Rather than focusing on NGA technologies in a technologically neutral manner, some countries have placed greater focus on specific technologies for the deployment of fast broadband such as FTTB/P. We also consider FTTB/P coverage within the study, but not as a core consumer outcome measure.

The source of NGA coverage data used in this report is IDATE[29].

29 IDATE from World FTTx Market and estimates

NGA take-up

NGA take-up is a core measure of the degree to which consumers are actually benefiting from NGA technologies. NGA take-up may be described either in service or technological terms – for example as:

- Take-up of packages advertising 30Mbit/s+
- Take-up of FTTx or DOCSIS 3.0; or
- Take-up of FTTH/B

We reference IDATE data[30] which refers to take-up of NGA technologies. We also reference data collected by the European Commission on NGA take-up, which focuses on take-up of broadband at speeds >30Mbits or >100Mbit/s. The two should be roughly equivalent, except where NGA technologies are used to deliver standard broadband.

Prices

In a vibrant competitive market, consumers should benefit from competitive prices in relation to the service they receive (value for money).

There are various sources of pricing data, using differing methodologies. In order to compare like with like, we focus pricing analysis on broadband price baskets collected by Teligen on behalf of the OECD[31]. Basket definitions depend on:

- Headline download speeds
- Whether the service is offered on a standalone basis or as part of a double play (with telephone) or triple play service (with telephone and TV)
- Whether or not there are data caps

Basket-based prices, adjusted for purchasing power parity (PPP), are more likely to offer a direct comparison between services than Average Revenue Per User (ARPU), which may be affected by volumes and types of services offered.

Usage

Usage of bandwidth is an important indicator as to the extent to which consumers and business make use of broadband connections in practice, and can indicate the degree to which there may be latent demand for high speed connectivity.

Bandwidth usage per subscriber per month, can be measured by operators directly (but is often not published), collected by applications installed on end-user equipment or

30 Idem
31 OECD (2013) Communications Outlook

predicted by equipment manufacturers. In this study, we use estimates of bandwidth usage (and the proportions used for different purposes) from Cisco Visual Networking Index (VNI)[32].

Actual speeds

Although headline (advertised) speeds may indicate the approximate speeds customers can expect to receive the actual bandwidth is a more relevant measure of the speeds consumers actually enjoy. There are however challenges with collecting this data on a consistent and reliable basis.

A number of companies aim to measure actual speeds offered – on the basis of different methodologies. Akamai measures average speeds based on user requests made to Akamai's HTTP/S platform. Ookla measures maximum sustainable speed between the computer of users requesting a speed test and the nearest server. Samknows measures speeds on the basis of equipment/software installed at customer-sites and aims to provide a representative sample.

For the study we reference speed metrics from all three sources in order to compare them.

2.2 NGA deployment

NGA deployment is now fairly advanced in many developed countries, including the UK. However, different countries have pursued different paths and paces for the roll-out of NGA technologies.

2.2.1 Early phases of deployment

The earliest deployments of 'fast broadband' in many countries can be traced back to upgrades in cable technology to Docsis 3.0, and the installation of fibre by independent players including municipalities, utility companies and in some cases alternative operators. For example, one of the earliest extensive FTTH deployments was carried out by Stokab in Sweden starting in 1994[33], while Virgin Media's launch of superfast broadband in the UK started in 2008[34].

Subsequently, incumbent telecoms operators increased the speed of their networks by deploying fibre further towards the customer – variously by means of FTTC/VDSL (as has been the case in the UK and Germany) and via FTTH.

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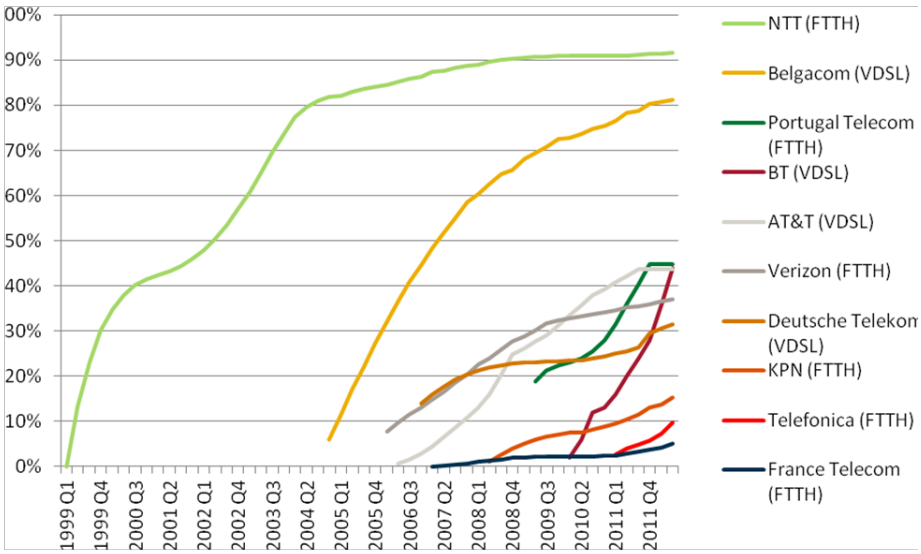
32 Cisco VNI http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html

33 FTTH Council Webinar – history and current status of Stokab http://www.ftthcouncil.eu/documents/Webinars/2013/Webinar_16October2013.pdf

34 Virgin Media launches the UK's fastest broadband http://about.virginmedia.com/press-release/284/virgin-media-launches-the-uks-fastest-broadband

Figure 3: Growth in household coverage SFBB, incumbent operators (to 2011)



Source: Broadband Stakeholder Group: demand for Superfast Broadband

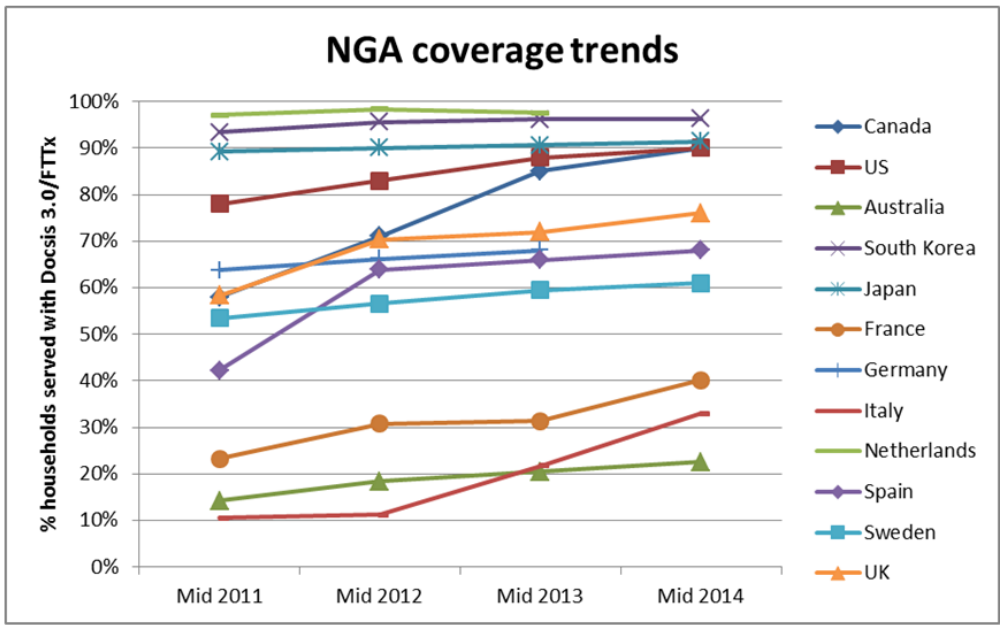
One of the first extensive FTTH deployments by incumbents was initiated by NTT in Japan in 1999. Meanwhile, the first widespread FTTC/VDSL deployment in Europe was initiated by Belgacom in Belgium in 2004.

NGA investments by the non-overlapping US incumbents AT&T and Verizon started relatively early, but have since reached a plateau.

In contrast, BT's FTTC/VDSL coverage started relatively late compared with several other countries, but has progressed quickly and continues to expand.

2.2.2 Recent developments

Figure 4: Growth in NGA household coverage, all technologies / operators



Source: IDATE from World FTTx Market and estimates

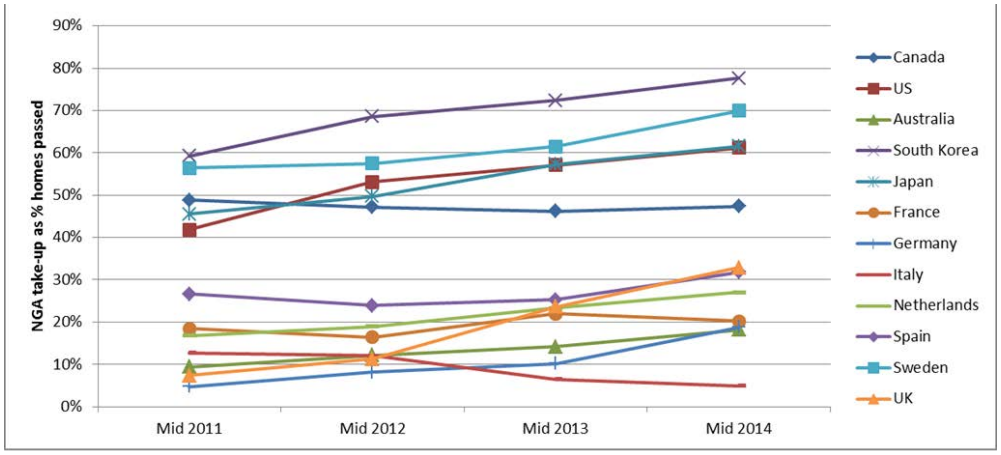
Since 2011, taking all technologies into account, NGA coverage has become nearly universal in the US, Canada, Netherlands, Japan and Korea, while coverage in the UK, Sweden, Germany and Spain now lies above 60% (and approaches 80% in the UK).

In contrast, France and Italy have relatively low coverage, although this is growing swiftly in both cases.

NGA coverage in Australia remains weak.

2.3 Take-up of superfast broadband

Figure 5: NGA take up as % homes passed



Source: IDATE from World FTTx Market and estimates

When considering the reasons for high (and low) take-up, it is most informative to consider the take-up of fast broadband as a proportion of households that could subscribe to the service (served households).

On this measure, demand for NGA is high and growing in South Korea, Japan, Sweden and the US with more than 60% of homes passed subscribing to the service.

Take-up is relatively low in most other European countries. However, there have been strong increases in take-up in the UK – even as the footprint for NGA has expanded. Germany, Spain, Australia and the Netherlands have also seen some increases in take-up recently.

In contrast, demand has been relatively flat in France and take-up in Italy is failing to keep pace with expanding deployment.

2.4 Speed

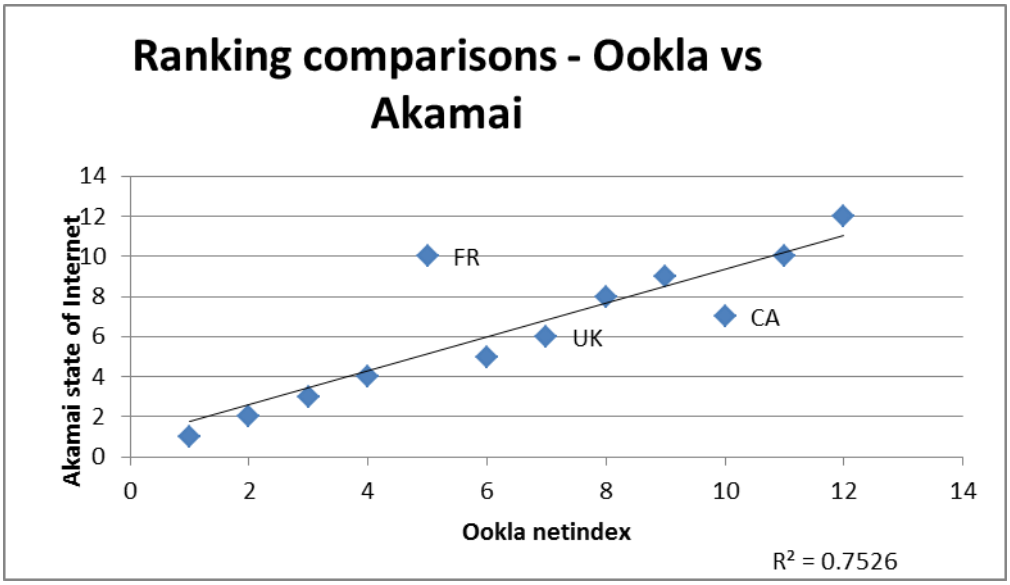
Although most benchmarks focus on technologies and 'headline' speeds, the actual speeds received by customers may be a more relevant metric of the benefits received from fast broadband in practice. However, measurement techniques and outcomes vary widely, making this a less reliable measure.

There are a variety of sources for actual average fixed speeds (all technologies) received by customers including Ookla, Akamai and Samknows, each pursuing different methodologies (see paragraph 2.1). Ookla and Akamai both cover wide geographic

areas making them useful for international comparisons. However, it is interesting to note that in terms of values these two sources differ widely with Ookla consistently projecting higher speeds[35]. For example, when comparing Ookla and Akamai with Samknows data, which recorded an average actual speed of 19Mbit/s for the UK mid 2014[36], Ookla overestimates with a download speed of 27Mbit/s while Akamai under-estimates at 10Mbit/s.

However, speed *rankings* from the two sources are highly correlated (corr. 0.86) meaning that in practice some credence can be given to the rank, if not the precise download speed recorded. France is one country however, for which rankings differ significantly.

Figure 6: Ranking comparisons – Ooka vs Akamai



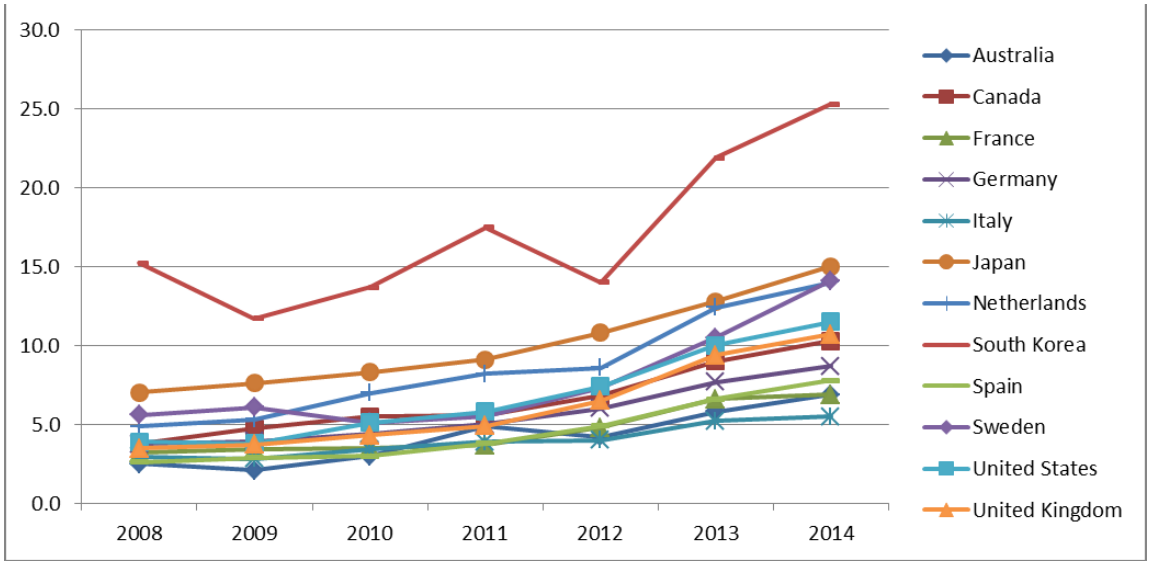
Looking at speed trends (see Figure 7), South Korea and Japan consistently score top speeds, the UK compares with the US in mid-table, while Australia and Italy have the slowest connections.

Both datasets suggest a gradual increase in actual speeds with a steeper increase in many countries from 2012 (although not Italy).

35 The different measurements may be affected by the point in the network at which speeds are measured, and the extent to which bandwidth has been subject to contention at the point of measurement

36 UK fixed-line broadband performance May 2014 – Samknows for Ofcom http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/broadband-speeds/broadband-speeds-may2014/

Figure 7: Average download speeds (Mbit/s) – Akamai



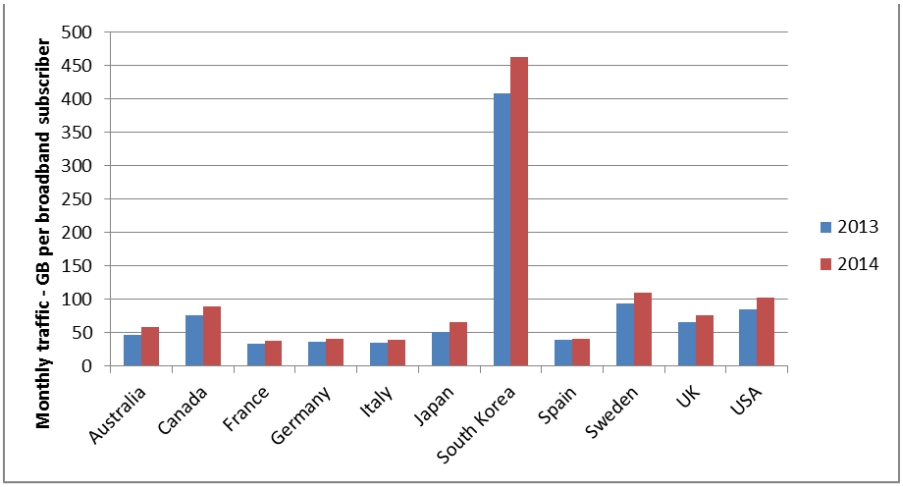
An interesting observation is that the speed 'premium' observed between countries with primarily FTTH/B deployment such as South Korea and Sweden compared with FTTC/VDSL countries such as the UK is less significant than one might expect, especially taking into account that a higher proportion of customers in South Korea and Sweden subscribe to NGA than in the UK.

2.5 Usage

An important observation (see also WIK/TNO/RAND (2013)[37]) is that speed may, but does not necessarily equate to usage.

37 WIK/TNO/RAND Europe for EP (2013) Entertainment X.0 to boost broadband deployment http://www.europarl.europa.eu/document/activities/cont/201310/20131017ATT72946/20131017ATT72946EN.pdf

Figure 8: Fixed data usage per broadband subscriber



Source: WIK-Consult, based on CISCO, VNI Forecase Widget

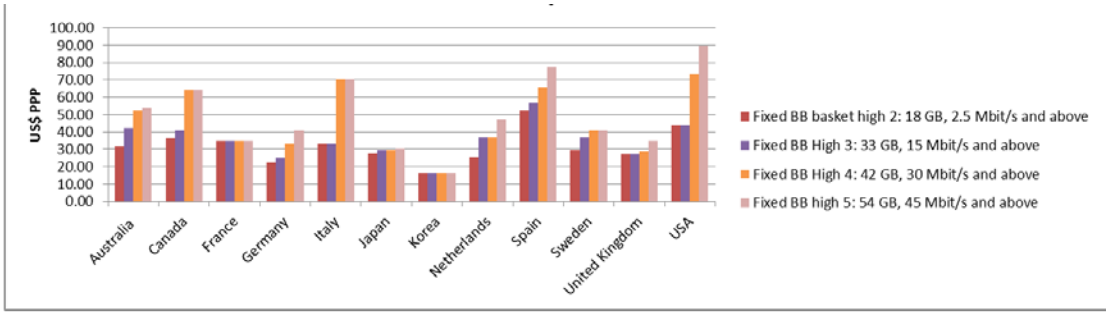
South Korean consumers make significant use of their high speed connections. However, Japanese consumers use less bandwidth than those in the UK and US despite having apparently higher broadband speeds.

Meanwhile data usage in France, Germany and Spain has been consistently low (and well below that of the UK) despite reasonable delivered speeds, while Australian usage is higher than would be expected given repatively low speeds and NGA diffusion.

However, with the exception of Japan, usage does seem to be associated with NGA take-up, which may have implications for the significance of the demand-side in stimulating uptake of fast broadband (see section 3.3.1).

2.6 Prices

Figure 9: Fixed broadband price baskets 2012



Source: WIK based on OECD Communications Outlook 2013

An analysis of pricing shows different strategies by country resulting in wide variations in pricing for fast broadband speeds of 30Mbit/s and above.

Tiered pricing (where operators charge substantially more for higher speeds) is prevalent in US, Spain, Italy, Canada and Australia, also Netherlands and Germany to a lesser extent.

In contrast, relatively flat pricing is offered in France, Japan, Korea, Sweden and UK, meaning that there is little or no price ‘premium’ for NGA.

Table 4: Rankings for fixed broadband price baskets[38] 2012[39]

	Fixed BB basket high 2: 18 GB, 2.5 Mbit/s and above	Fixed BB Low 3: 11 GB, 15 Mbit/s and above	Fixed BB High 3: 33 GB, 15 Mbit/s and above	Fixed BB Low 4: 14 GB, 30 Mbit/s and above	Average rank
Australia	7	10	8	8	**8**
Canada	10	9	9	9	**10**
France	9	6	5	4	**6**
Germany	2	2	4	6	**4**
Italy	8	5	11	10	**9**
Japan	5	4	3	2	**4**
Korea	1	1	1	1	**1**
Netherlands	3	7	6	7	**5**
Spain	12	12	10	11	**11**
Sweden	6	8	7	5	**7**
United Kingdom	4	3	2	3	**2**
USA	11	11	12	12	**12**

Source: WIK based on OECD Communications Outlook 2013 data

Ranking the speed baskets shows that for speeds >30Mbit/s customers in Korea, Japan and the UK had access to the lowest prices (2012) and the UK had the lowest prices amongst EU benchmarks. Conversely – prices in the US, Canada, Italy and Spain were relatively high.

Economic theory would normally suggest that low prices in absolute terms – or indeed the absence of a price premium for fast broadband - should translate to higher take-up[40]. However, the relationship between the two may in practice be more complex, and it is also possible that consumers may not always place significant value on higher speeds – over-and-above their existing broadband connections, exihibiting a low 'willingness to pay'.

France suffers low take-up of fast broadband despite having no price premium, while US and Canadian customers appear willing to pay a high premium. As discussed in section 3.3.1, other demand-related factors such as the popularity of online video may

38 A detailed description of the price baskets used for broadband by the OECD is given in the OECD Communications Outlook 2013 (page 2010) onwards. The references to 'high' and 'low' refer to the bandwidth usage profile – given in GB. Low and high usage profiles are distinguished because broadband bandwidths in several countries are subject to a usage cap for a given price. The speed represents the advertised download speed.

39 The average rank consistens of a ranking of the simple average of rankings for different baskets. Each observation is given equal weight. Using different weights would result in different outcomes, but the choice of weightings might be difficult to justify objectively.

40 If a service is 'price elastic' – a lower price should result in higher take-up

be at play – both in inhibiting take-up in countries such as France, and encouraging take-up in the US.

2.7 Summary of consumer outcomes

A summary of the five core consumer metrics is shown in Table 5.

Table 5: Summary of rankings for consumer outcomes[41]

	NGA coverage (IDATE 2014)	NGA take-up (IDATE 2014)	Speeds Mbps (Akamai 2014)	Usage GB per sub (Cisco 2014)	Prices - high basket >30Mbits (OECD 2012)	International ranking	EU ranking
Australia	12	11	10	7	8	11	
Canada	4	5	7	4	10	7	
France	10	9	10	11	6	10	6
Germany	7	10	8	8	4	8	4
Italy	11	12	12	10	9	12	7
Japan	3	3	2	6	4	2	
Korea	2	1	1	1	1	1	
Netherlands*	1	8	4	N/A	5	3	1
Spain	8	7	9	9	11	9	5
Sweden	9	2	3	2	7	4	2
UK	6	6	6	5	2	5	3
US	4	4	5	3	12	6	

Based on ranking of averaged rankings (NL over 4 observations)

2.8 Observations

The UK is the best-placed amongst the 'big 5' in Europe across a range of fast broadband outcomes. However, Sweden and the Netherlands have stronger outcomes as regards the diffusion of NGA. Their strength today may stem in part from the fact that deployments started significantly earlier than in the UK. While starting relatively late, the UK has however followed a swift adoption path.

The UK is not in general falling behind the US in terms of fast broadband. UK fast broadband prices are significantly lower and speeds received are comparable to those received by US customers. However, NGA coverage, take-up and data usage are higher in the US than in the UK.

41 The average rank consistens of a ranking of the simple average of rankings for different metrics. Each observation is given equal weight. Using different weights would result in different outcomes, but the choice of weightings might be difficult to justify objectively.

Fast broadband outcomes in Korea and Japan are world-leading in many respects. It is noteworthy however that fast broadband availability in Japan does not appear to have translated into greater data usage by customers.

High NGA take-up does seem to be linked to higher speeds, but does not necessarily result in the kind of 'step change' in speed that might be expected. For example, according to Akamai, average customers in Sweden and Japan receive speeds which are around 50% higher than those in the UK. This is significant, but not as high as might be expected given that Sweden and Japan benefit from FTTH technology (whereas the UK is largely served with Docsis 3.0 and FTTC/VDSL) and that take-up of superfast broadband in Sweden and Japan is considerably higher. It could be that the full capabilities of the technology are not being offered or demanded by customers, or alternatively customers may not be receiving advertised speeds in all cases.

3 What explains fast broadband outcomes?

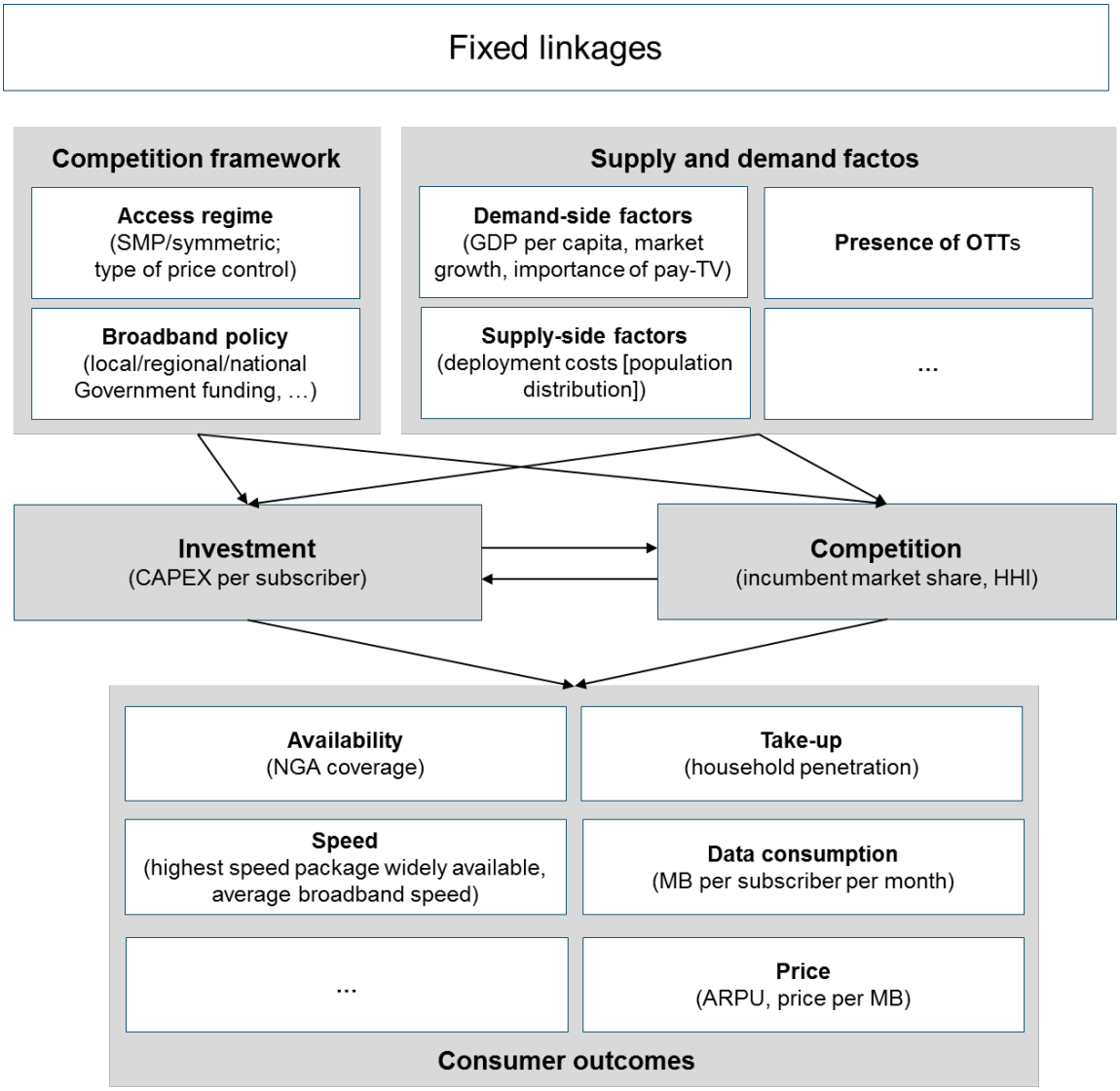
Differing consumer outcomes could be due to a wide range of factors, some of which may be systemic and others of which may be very specific to national markets. In this chapter we seek to understand what may be the role of different drivers in influencing NGA outcomes, and in particular what might be the respective role of policy and regulation as compared with market-based or demographic factors.

The main factors we consider are:

- The role of market structure and especially infrastructure-based competition in providing a 'stimulus' to invest
- Cost-drivers such as population density and technological choices which may reduce the costs of deployment NGA (and therefore expand potential reach)
- Demand-drivers with a focus on the role of online content and tied content (eg pay TV)
- Direct subsidies or other policy interventions such as those via state aid; and
- The approach to economic regulation – and especially the focus given to intermodal (own infrastructure) vs intramodal (access-based) competition

A schematic diagram indicating some of the potential linkages is shown in Figure 10.

Figure 10: Potential factors affecting fixed NGA consumer outcomes



3.1 Infrastructure competition

One of the main reasons for the extensive liberalisation of European telecoms markets which accelerated from the 1990s was the idea that competition could provide an important driver for consumer welfare – stimulating improved service quality, prices and efficient investment[42].

42 See Erkki Liikanen (EU Commissioner for information society) speech/01/356 'European Union Telecommunications Policy' July 2001 *ec.europa.**eu**/competition/speeches/text/sp1999_010_en.html*

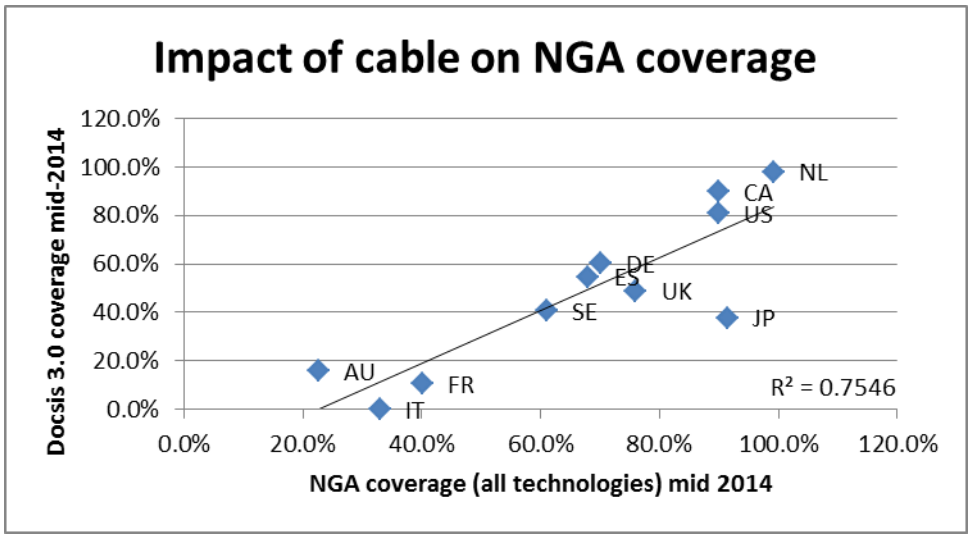
In principle (in cases where it is economically viable), end-to-end infrastructure-based competition in which competitors do not rely on any aspect of the incumbent network is likely to offer the most prospect for competitive investment and innovation – since all aspects of the value chain are contested.

Academic literature has indeed found consistently that infrastructure-based competition for example via cable has had positive effects on broadband deployment[43]. We also find from an examination of the drivers of NGA deployment in the countries considered, that cable or other forms of infrastructure-based competition have played a pivotal role.

3.1.1 Cable

One of the single most important factors in explaining NGA coverage is the pre-existence of cable, which can be upgraded to DOCSIS 3.0 at low cost. Figure 11 shows the important role that DOCSIS 3.0 has played in affecting overall NGA coverage. Comparing data on overall cable coverage with DOCSIS 3.0[44] also reveals a very high correlation highlighting the high degree of conversion to the newer technology.

Figure 11: Impact of cable on NGA coverage



Source: WIK based on IDATE

43 The empirical evidence suggests a positive impact of inter-platform competition on broadband diffusion (see, e.g., Cava-Ferreruela and Alabau-Munoz, 2006, Distaso, Lupi and Maneti, 2006, Höffler, 2007, Denni and Gruber, 2007, Bouckaert, van Dijk and Verboven, 2010, and, most recently, Nardetto, Valletti and Verboven, 2013). Briglauer, Ecker and Gugler (2013) as well as Briglauer (2013) have found a non-linear relationship between inter-network competition and broadband diffusion, Only Calzada (2013) and Gruber (2013) have both found no evidence for inter-platform competition accelerating broadband diffusion.

44 A correlation co-efficient of 98% is seen when comparing Cable Docsis 3.0 coverage (IDATE 2014) with cable coverage (IHS for EC (2012), OECD (2008) for non-EU countries)

In turn, high coverage of DOCSIS 3.0 technologies (>80% households) is a particularly significant factor explaining high NGA coverage outcomes in the US, Canada and the Netherlands. Deployments by (state-owned) cable operators also triggered the initial NGA roll-out in South Korea[45].

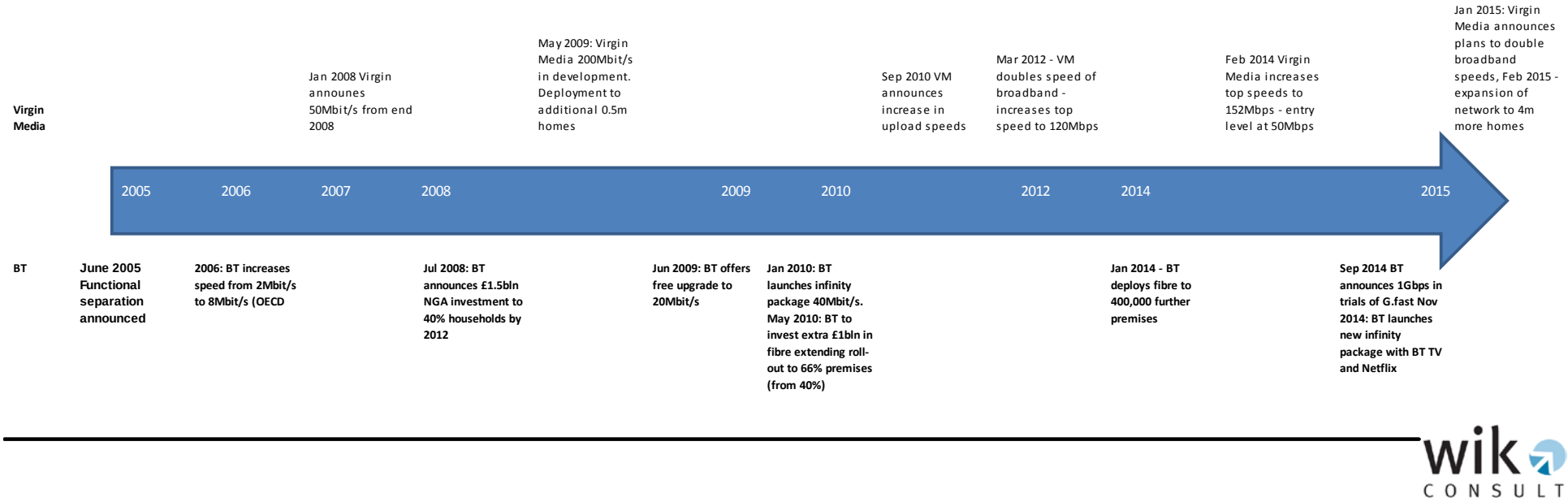
In this context, it may not be a coincidence that countries with the lowest coverage (Australia, Italy and France) also have limited cable.

An example of the interaction between cable and the incumbent in stimulating technological upgrades in the UK can be seen in Figure 12, where announcements made by BT concerning NGA investments appear to have followed announcements by Virgin Media concerning increased speeds available on the cable network. This pattern of competitive trigger and response mirrors the introduction of standard broadband in the UK, which was first introduced by cable operators in 2000, and closely followed by BT with the upgrade of its network to ADSL[46].

45 Ovum Consulting report for the World Bank "Broadband Policy Development in the Republic of Korea", October 2009

46 Oftel's Nov 2001 ADSL factsheet shows the early phase of ADSL deployment by BT and Kingston http://www.ofcom.org.uk/static/archive/oftel/publications/local_loop/adslsheet/adsl1101.pdf, which followed trials and the subsequent introduction of cable broadband by companies such as Telewest (March 2000 BBC news report http://news.bbc.co.uk/2/hi/business/687899.stm) in 2000

Figure 12: Interaction between cable and the incumbent in stimulating technological upgrades



Source: WIK based on media releases from BT and Virgin Media

3.1.2 FTTH investors

Where cable exists and has a significant presence, it has usually played a strong role in stimulating NGA deployment. The response from incumbents has in most cases been to deploy FTTC/VDSL as has occurred in Belgium, the UK, Germany and elsewhere – with progressive further technological investments and deployment of fibre towards the end-user (for example through VDSL vectoring, and G.fast).

The stimulus to move straight to FTTH on the other hand, has in several cases been stimulated by the initiation of FTTH deployments by alternative fibre investors and/or municipalities.

Data from IDATE for ETNO (2013 annual economic report[47]) suggests that in Sweden, where 47% households were served by FTTH/B in 2012, 56% of the deployment was from non-incumbent operators, including organisations such as Stokab, which at 2013 claimed to cover 90% of households and 100% of businesses in the Stockholm area[48].

In a similar manner, FTTH deployment in Denmark (35% coverage 2012) has been primarily driven by local utilities (although TDC later acquired fibre investors such as DONG[49]), while utilities also played a role in FTTH deployment in Japan[50].

FTTH deployment in the Netherlands (32% coverage 2014) was since 2005 driven by the formerly independent investor Reggefiber (originally owned by a private investment vehicle Reggeborgh)[51]. Reggefiber was later acquired by the Dutch incumbent KPN[52].

Alternative operators, which started from a broadband customer-base based on local loop unbundling, have also been active in stimulating FTTH investments in some countries including France (Iliad), and Portugal (Optimus/Sonaecom).

As discussed in section 3.2 below, competitive stimulus is unlikely to be the only reason for the decision to install FTTH (as opposed to FTTC). Cost and network architectures are also likely to have played a role. However, deployment by alternative investors has

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47 ETNO (2013) Annual Economic Report https://www.etno.eu/datas/publications/economic-reports/ETNO_Financial_Report_2013_Def-Lands.pdf

48 FTTH Council Stokab Webinar http://www.ftthcouncil.eu/documents/Webinars/2013/Webinar_16October2013.pdf

49 For discussion, see WIK (2014), Analysis of market structures in the Danish broadband market – study for DBA http://prodstoragehoeringspo.blob.core.windows.net/8564694b-f758-4823-b400-ec2c2b9a6c6f/Bilag%20-%20Analysis%20of%20market%20structures%20in%20the%20Danish%20broadband%20markets%20-%20august%202014%20-%20WIK.pdf

50 WIK/TNO/RAND (2013) for European Parliament 'Entertainment X.0 to boost broadband deployment) notes that at 2013 power companies had a market share of around 9% in FTTB/H in Japan

51 Reggefiber company information http://www.eindelijkglasvezel.nl/corporate/over-reggefiber/?sc_lang=en

52 KPN gradually increased its stake in Reggefiber – acquiring 51% of the company in Nov 2012 https://www.telegeography.com/products/commsupdate/articles/2014/01/06/kpn-to-increase-reggefiber-stake-to-60/, and later taking full ownership following the approval of the acquisition by the competition authority ACM in 2014 https://www.acm.nl/nl/publicaties/publicatie/13492/KPN-mag-volledige-zeggenschap-in-Reggefiber-krijgen-concentratiebesluit/

often seemingly provided a ‘trigger’ for the initiation of FTTH deployment, potentially affecting the chosen technological response by the incumbent.

3.1.3 Effect of local loop unbundling on NGA deployment

In addition to the speed competition driven by cable operators, broadband speed increases announced by BT in 2006 and 2009 may also have been stimulated by speed competition via local loop unbundling, a form of partial infrastructure-based competition, which accelerated following regulatory and structural reforms in 2005[53], and enabled competitors to upgrade copper lines to broadband and compete on speed.

It is also possible that competition from LLU-based operators may have provided an additional stimulus to BT to invest in NGA beyond those areas covered by cable. Speed competition from LLU may have facilitated demand for NGA-based speeds. Additionally, BT might be incentivised to to deploy NGA if it considered that this strategy would improve its competitive position in relation to LLU-based competitors and/or increase returns compared with broadband based on copper technologies.

On the other hand, the presence of cost-based LLU regulation creates mixed incentives for alternative operators concerning NGA investment. They may be disincentivised from investing in their own NGA access infrastructure or marketing NGA services, if higher returns can be made from offering basic broadband services on the basis of LLU. Equally, however, as seen in countries such as France and Spain, successful LLU-based deployment might enable alternative operators to gain the scale required to invest in their own fibre access infrastructure (see section 4.3.2).

3.1.4 Mobile ‘push’?

In the case of the other infrastructures described, infrastructure competition stimulates investment by creating a competitive advantage in higher speeds for the infrastructure-based competitor, which the incumbent then seeks to match, exceed, or acquire (as seen in several cases in continental Europe). This could be described as infrastructure competition ‘pull’.

In theory, another possible driver for investment in higher speed fixed infrastructure might also be developments in mobile broadband, if they increase mobile speeds sufficiently to threaten substitution for basic broadband. It is difficult to gauge the extent to which this may play a role, partly because LTE deployments in Europe are relatively recent (and therefore any effect may not yet be visible). Another complicating factor is that several of the countries in which mobile broadband has played a significant role,

53 Functional separation, alongside a price review of LLU, and the introduction of the Office of the Telecommunications Adjudicator (OTA)

including Austria, as well as the US, also have significant cable coverage, which we know to be an important factor in driving NGA in its own right.

One indication might be the extent to which NGA deployment by incumbent operators has exceeded cable coverage in markets in which mobile broadband is extensively used. In Austria, a country in which mobile broadband was found by the NRA to substitute for standard fixed broadband, it is interesting to note that the FTTC/VDSL coverage of the incumbent TA had exceeded cable coverage by 2012, reaching 50% compared with 35% coverage of housholds[54]. Meanwhile in Finland, which has the highest mobile broadband penetration rates in Europe at 131 per 100 inhabitants as of 2014[55], FTTH/VDSL coverage exceeds DOCSIS coverage by around 20 percentage points. These cases might be compatible with a 'push' from mobile influencing NGA deployment. However, it is difficult to reach wider conclusions based on these two cases alone, and it is notable that incumbent NGA deployment has also overtaken cable deployment in other countries such as the UK, where mobile broadband has not been considered a substitute for basic fixed broadband.

3.2 Factors affecting cost

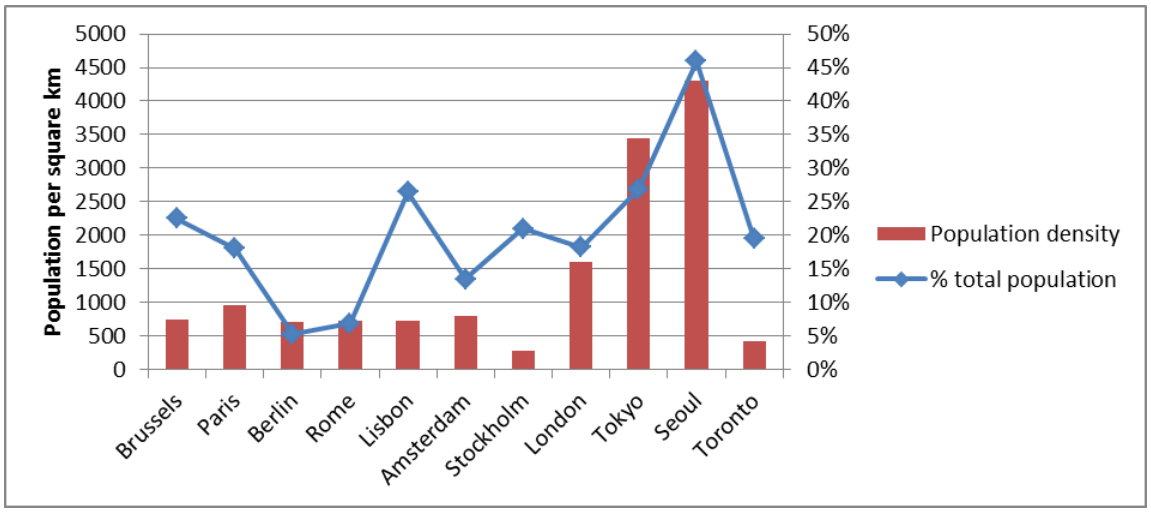
Another important factor that can affect the degree to which NGA deployment is viable is the cost of reaching each household, which can be affected both by demographic factors and the choice of technology.

3.2.1 Population density

Certain countries with high FTTH/B coverage including South Korea and Japan benefit from high population density with a large proportion of the population living in urban centres. This reduces the cost of FTTH relative to other more dispersed populations.

54 IHS for EC broadband coverage 2012
55 Digital Agenda Scoreboard

Figure 13: Population density and proportion population residing in major urban centres



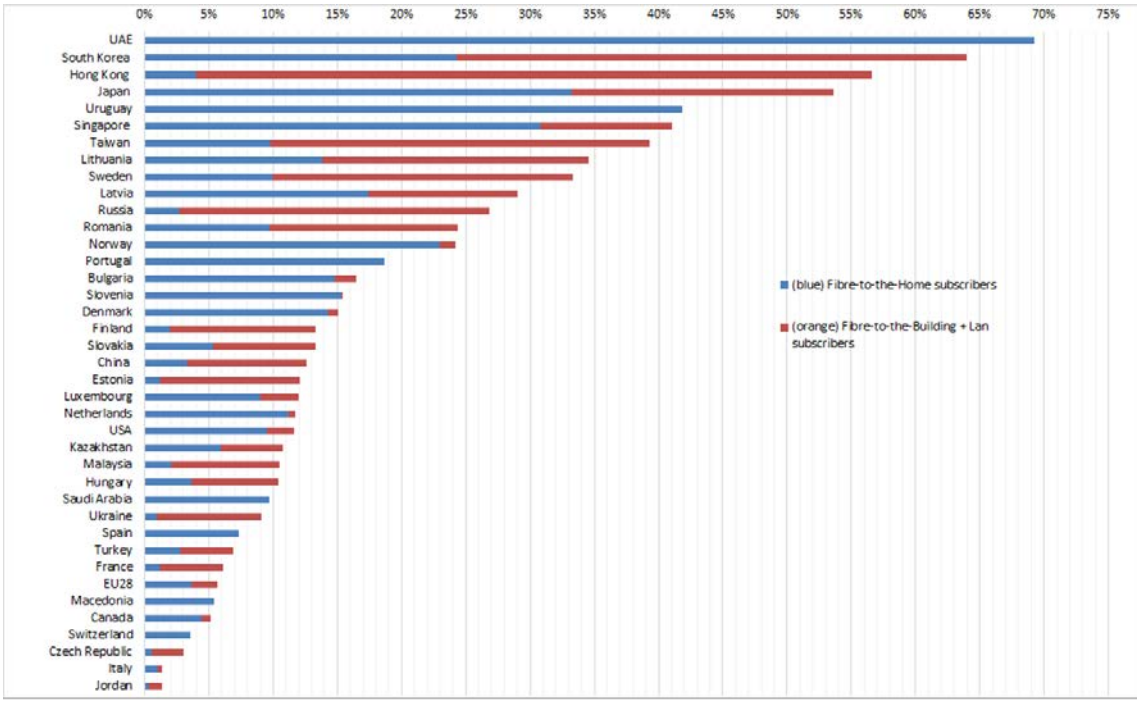
Source: WIK based on OECD dataset metropolitan areas. Dates as of 2008.

The predominance of Multi-dwelling Units (MDUs) in such countries can also facilitate FTTB deployment, which substantially lowers costs compared with single-dwelling FTTH[56].

However, FTTB also implies that bandwidth is shared amongst residents of an MDU, which might go some way to explaining why there is not as much of a 'step change' in speeds as might be expected.

56 Analysys Mason (May 2013) FTTx coverage and emerging technologies Webinar estimates average capex costs of around $400 FTTB/VDSL ($300 FTTB/LAN) per premise passed compared with $600 for FTTH/GPON.

Figure 14: Penetration of FTTH and FTTB by country



Source: IDATEfor FTTH Council Europe – presentation February 2015

Out of the countries studied for this report, it is notable that the FTTH/B deployment in France is reported as being currently largely on the basis of FTTB, which may represent coverage in the Paris area, which also benefited from cost-effective access to sewers as a means to support competitive fibre deployment. Sweden is also shown as having a high proportion of FTTB.

On the other hand, deployment in the US, Canada and Spain is suggested to be largely on the basis of the higher cost FTTH architecture.

3.2.2 Implications of technologies on coverage

In addition to population distributions, the potential to achieve high NGA coverage also depends on the cost of prevalent NGA technologies. In a European Investment Bank (EIB) paper[57], Hatonen found that the total incremental cost of fulfilling the Digital Agenda broadband targets was significantly affected by the choice of technologies – and specifically whether cable was included or excluded from the calculation, and

57 Hatonen (2011) EIB report http://www.eib.org/attachments/efs/eibpapers/eibpapers_2011_v16_n02_en.pdf

whether the targets were considered to necessitate the deployment of FTTP rather than cheaper FTTx technologies[58].

In similar vein, research by WIK[59] and Analysys Mason[60] has found that capex requirements for FTTC are around 4-5 times lower than those required for FTTH – thereby enabling wider viable coverage

In turn, we understand that certain historic factors such as loop/subloop lengths have influenced technological choices.

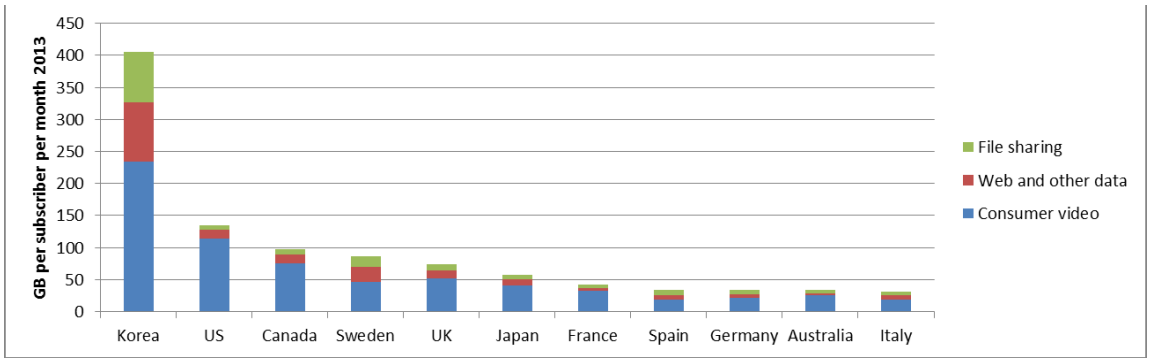
Long subloops in France (of around 750m) reduce the incremental speed advantages of FTTC as compared with standard BB, and therefore may have supported the case for deeper fibre investment – while conversely short subloop lengths in some other countries result in high FTTC/VDSL speed performance[61].

3.3 Demand drivers

From section 2.6 on pricing, it seems that customers in some countries such as the US are prepared to pay a premium for fast broadband, while in others such as France there is limited uptake despite the absence of a premium. One of the explanations might lie on the demand side, and especially the value customers place in bandwidth-intensive applications such as video.

3.3.1 Online video

Figure 15: Usage of online video from fixed connections



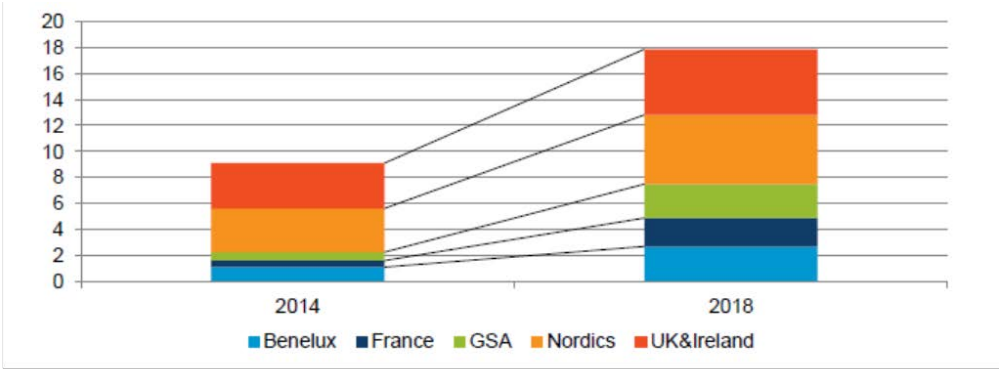
Source: WIK based on Cisco VNI (data as of 2013)

58 See figure 8 'The economic impact of fixed and mobile high-speed networks' Hatonen for EIB (20110)
59 WIK (2008) Economics of Next Generation Access
60 Analysys Mason (May 2013) FTTx coverage and emerging technologies Webinar
61 For reference to subloop lengths see WIK (2008) Economics of NGA

In turn, demand for and usage of high speeds may be affected by the availability of online video such as Netflix or national content such as that made available by the BBC iPlayer or other broadcasters.

High demand for consumer video accounts for a large portion of data usage in Korea, US and Canada, and may in turn support the case for take-up of NGA in those countries. Within Europe, the UK and Sweden have the highest usage of online video, potentially supported by wide available of English language video sources. The popularity of Netflix in the UK and Sweden can for example be seen in Figure 16.

Figure 16: Western Europe: Netflix subscribers (m)



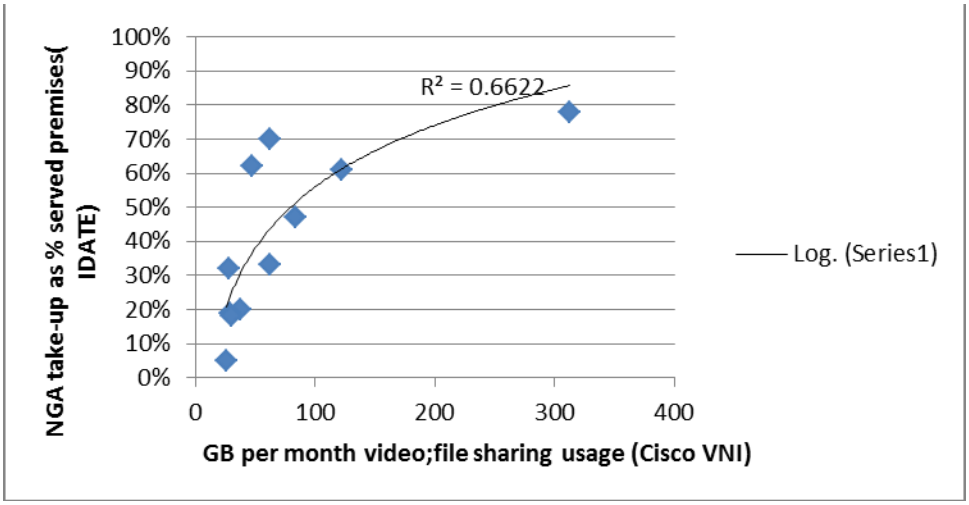
Source: IHS for EBU – the future of television in Europe 2014

Meanwhile, Australia, which had not in 2014 experienced the launch of Netflix, had lower online video usage than other English-speaking countries. It will be interesting to see whether Netflix's Australian launch in March 2015 affects future usage patterns.

Figure 17 suggests that there may be a link between online video usage and NGA take-up[62] although Japan is a notable exception – which may indicate a role for the demand-side such as availability of attractive content in supporting NGA diffusion.

62 The correlation co-efficient for this relationship according to data available was 0.68.

Figure 17: Video usage and NGA take-up 2014



Source: WIK based on data from Cisco VNI (usage) and NGA take-up (IDATE)

3.3.2 Pay-TV and fast broadband

Another 'demand-side' factor which may affect fast broadband take-up is the practice of bundling fast broadband with pay TV. The effects of such bundling may however play in both directions.

For customers where pay TV may be the primary factor behind the choice of supplier, fast broadband may be adopted as an adjunct to a wider triple-play bundle. For example:

- In the UK, Virgin Media has on several occasions automatically upgraded the BB speeds of its triple-play customers[63] while the inclusion of free BT Sport may have been one driver of take-up of BT's Infinity broadband offer[64]
- Customers taking cable TV in the US, Canada and the Netherlands may have benefited from bundled fast broadband offers

However, an alternative chilling effect on fast broadband may be seen if customers' satisfaction with pay-TV services diminishes their demand for fast broadband as a means of watching online-delivered content. This may especially be the case where there is limited local language content provided via online video.

63 Virgin Media doubled broadband speeds http://www.broadbandchoices.co.uk/providers/virgin-media/virgin-media-doubling-broadband-speed-whats-the-score

64 Telegraph April 2015 BT profits boosted by fibre and football http://www.telegraph.co.uk/finance/newsbysector/mediatechnologyandtelecoms/telecoms/11002949/BT-profits-boosted-by-fibre-and-football.html

For example, in France there is high take-up of IPTV in France as part of triple-play offers[65]. However, migration to FTTH has been slow despite the absence of any price premium. It is possible that customers are satisfied with existing TV services and would not gain significant additional content benefit from fast broadband, especially if French-language content is not widely available via online video. Moreover, IHS reports that pay-TV growth was above the EU average not only in France, but also in Germany and Spain, countries in which NGA take-up has been limited, potentially reflecting a lack of local online video[66].

Conversely, IHS observes that the US (and increasingly many Eastern European and Nordic countries, as well as Benelux) have experienced declines in pay-TV subscription, which may have been explained in part by 'cord-cutting' amongst customers for whom relevant online video content may have been accessible (and where language barriers may be less).

In practice, there appears to be some relationship between pay TV take-up and NGA take-up[67], which might be partly associated with the practice of cable operators 'upgrading' customers, including bundled customers, to fast speeds[68]. Within our dataset, there was also a positive relationship between online video usage and payTV take-up[69], which suggests that on average thus far there has been more complementarity than 'cord cutting'.

3.4 Summary of market supply and demand factors

A summary of supply (including market structure) and demand factors potentially affecting NGA outcomes is shown inTable 6.

65 In 2013 50% of households owning a TV in France subscribed to IPTV – source European Digital Agenda Scoreboard, and 76% of those with a TV subscribed to payTV (Ofcom ICMR 2014)
66 Cord-cutting takes hold in Europe – report on IHS research http://tbivision.com/news/2014/08/cord-cutting-takes-hold-europe/311722/
67 Correlation co-efficient 0.61
68 There is also a correlation between DOCSIS 3.0 take-up and payTV take-up
69 Correlation co-efficient 0.63

Table 6: Supply and demand factors potentially affecting NGA outcomes

	Infrastructure competition		Cost drivers		Demand drivers		NGA outcomes	
	Cable (docsis 3.0) coverage (IDATE/*OECD)	Independent FTTH	% population urban (OECD)	Predominant FTTx technology choice (IDATE)	Video/file sharing usage (GB/month /sub Cisco VNI)	PayTV relevance (Ofcom 2014 ICMR)	NGA coverage (IDATE)	NGA take-up % served area (IDATE)
France	10%	Iliad, SFR	35%	FTTH/B	38	76%	40%	20%
Germany	60%	Locally	57%	FTTC	29	57%	70%	19%
Italy	0%	FTTC (FW)	53%	FTTC	26	33%	33%	5%
NL	98%	Reggefiber	85%	FTTH and FTTC		98%	99%	27%
Spain	55%	VF, Orange, Jazztel	48%	FTTH	28	22%	68%	32%
Sweden	41%	Stokab/others	22%	FTTH	63	84%	61%	70%
UK	49%		70%	FTTC	62	53%	76%	33%
0.9797943	57%*		70%	FTTH/B	313	94%	96%	78%
Japan	38%	Utilities	56%	FTTH/B	48	70%	91%	62%
US	81%	Except some local	42%	FTTH and FTTC	122	84%	90%	61%
Canada	90%		56%	FTTC	84		90%	47%
Australia	16%		58%	FTTH	30	29%	23%	18%
	Green >70% Yellow 40-70% Red <40%	Green - strong Orangin some areas Red little/none	Green= 70%+, yellow=50-70%, red=<50%	Green - use of lower cost technologies	Green >100GB per month yellow 50-100GB Red <50GB	Green - 70%+ TV households, yellow 40-70%, red <40%	Green >80% Yellow 50-80% Red <50%	Green >50% Yellow 25-50% Red <25%

Source: WIK based on data sources as shown

Many country-specific factors cloud the picture. However, as discussed above, there appears to be a relatively strong association between countries which have either cable coverage or a relatively strong presence of infrastructure-based competitors and overall coverage of NGA networks. The role of infrastructure-based competition in strong and/or near-ubiquitous in the US, Canada, Korea and the Netherlands. Infrastructure-based competition in some areas has also supported NGA coverage in the UK, Sweden, Spain and Germany. Countries with a low degree of infrastructure-based competition such as Italy and Australia have also been amongst the most limited in terms of NGA deployment.

The prevalence of FTTH (as opposed to FTTC) as a technological choice seems to depend in part on whether independent FTTH investors played a role in stimulating NGA deployment – triggering a similar technological response by the incumbent. High population densities have also supported FTTH deployment in Korea, Japan and the Netherlands by reducing unit costs.

There appears to be some links between online video usage and NGA take-up. Taking into account that there are several countries in Europe including France and Germany with low NGA take-up despite low or no price premiums (potentially indicating low willingness to pay), we hypothesize that popularity of online video – driven by the availability of attractive online content – may be a driver of NGA take-up.

4 Policy and regulatory approaches to NGA

As discussed in the previous chapter, many of the factors affecting NGA deployment are market-based and depend on nationally specific factors, demand-side preferences, and/or the character and business plans of nationally focused suppliers (such as utilities, alternative operators and municipalities acting as private investors).

However, intiuitively, it seems also likely that policy may play a role in influencing certain aspects of supply, demand and associated consumer outcomes. Policy may be distinguished between 'public policy', which includes target-setting, public sector technological adoption, financial incentives for deployment or take-up, state aid and universal service obligations – and 'economic regulation', which concerns the rules applied to promote competition and efficient investment as a means to achieve benefits for conusmers.

In this section we review the range of approaches towards policy and regulation and describe through brief case studies how these have been applied in the twelve countries studied.

4.1 Public policy

Public policy may take various forms, but we focus in particular on aspects which may directly affect NGA outcomes. Prime amongst these are fast broadband targets and state aid.

4.1.1 Broadband targets

Setting targets for fast broadband coverage and adoption has become increasingly widespread. The Digital Agenda for Europe[70] sets an EU-wide target of universal availability of 30Mbit/s by 2020 (and 50% take-up of 100Mbit/s by the same date)[71].

As regards national broadband plans the UK has set a target of 95% coverage for next generation access (interpreted as speeds of 24Mbit/s or above) by 2017[72] while Sweden and France have set targets of near-universal availability of 100Mbit/s by 2022, with intermediate targets of 40% coverage of 100Mbit/s by 2015 and 50% by 2017 respectively.

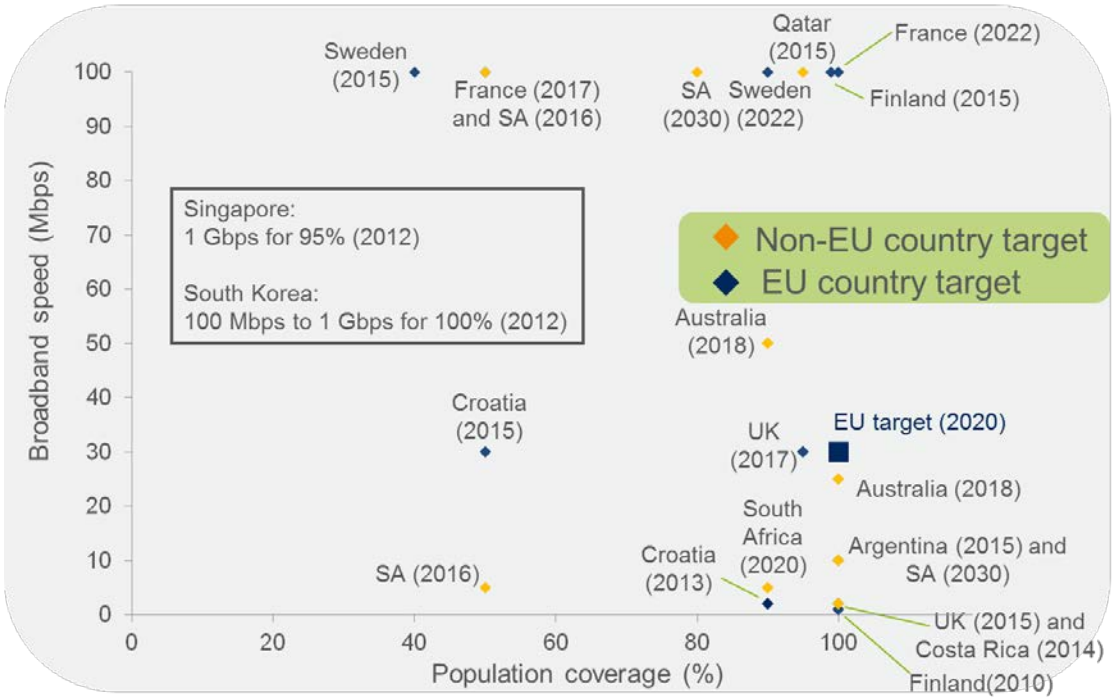
70 The European Commission Digital Agenda for Europe (2010) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC0245&from=EN

71 For further discussion and benchmarks of broadband targets see discussion in WIK/TNO/RAND Europe for EP (2013) http://www.europarl.europa.eu/document/activities/cont/201310/20131017ATT72946/20131017ATT72946EN.pdf

72 House of commons library March 2015 Fixed broadband: policy and speeds – note SN06643

These targets are significantly less amibitious than the target of achieving universal availability of 100Mbit/s-1Gbit/s in South Korea by 2012 – which has largely already been achieved (see Figure 4).

Figure 18: Fast broadband targets



Source: Cullen for Ericsson Nov 2014

On first sight, targets seem to reflect outcomes in the various countries to some degree. Countries with higher bandwidth targets have focused on FTTH deployment, while many of those with widespread coverage targets have achieved such coverage including the UK.

This may be in part because targets have been set to reflect developments already under way (such as the extensive prior roll-out in South Korea). However, in some cases targets may be linked specific actions Governments plan to take such as the subsidies for NGA coverage managed by BDUK in the UK[73], or the detailed policy and regulatory framework for the deployment of FTTH in France[74].

73 Broadband Delivery UK https://www.gov.uk/broadband-delivery-uk
74 Summary of the national broadband strategy for France and associated measures https://ec.europa.eu/digital-agenda/en/country-information-france

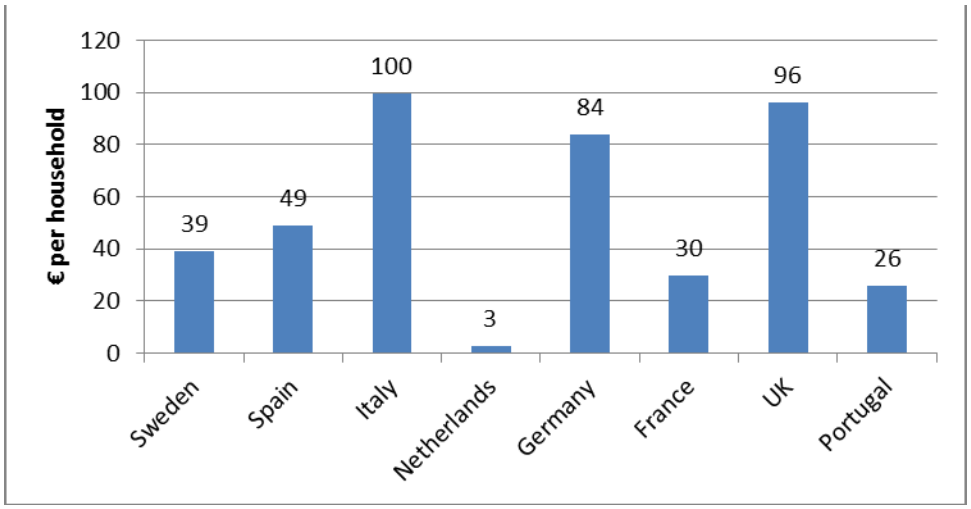
4.1.2 State aid

State aid is a clear example where a direct financial contribution has been made to support deployment of NGA infrastructure or subsidise retail offers. At one end of the scale, targeted state aid has been used in some cases to supplement private investments, favouring the lowest cost technology to achieve the most widespread reach in areas that would otherwise be uneconomic to serve ('gap' financing). This is the approach largely adopted in the UK for which £530m was budgeted to reach a target coverage of 95%[75] or approximately £20 per household (€28[76]).

At the other end of the scale, extensive state aid programmes have been used to nationalise, consolidate and fund specific nationwide infrastructure deployments in countries such as Australia, which has estimated the net cost of subsidising deployment (vs a scenario of unsubsidised commercial deployment) at AUS$6bln (approx. AUS$790 (€560) per household). Meanwhile, the Italian Government has recently announced plans to invest €6bln in supporting fast broadband deployment (approx. €270 per household).

Looking over a historic period (2003-2013) total state aid for broadband per household is shown for selected EU countries in Figure 19.

Figure 19: State aid per household (2003-2013)



Source: WIK based on data from DG Competition, European Commission

It is clear from these figures that the degree of state support for NGA in Australia (and that planned for Italy) far outstrips those in the considered countries (and most likely others in Europe).

75 House of Commons March 2015 note SN06643
76 GBP1=€1.39

Apart from that, few conclusions can be drawn from the variations, because they may be the result of nationally specific characteristics such as differences in the scope of 'white' areas and costs for addressing these.

4.1.3 Demand-side measures

Many countries have pursued demand-side measures as an adjunct to supporting or incentivising supply. The most common focus is on the use of technology in the public sector and education. However, certain countries have also pursued iniatives to support ICT in the context of culture, teleworking and energy efficiency.

Figure 20: Demand-side measures to support broadband adoption

Source: Cullen for Ericsson Nov 2014

The idea of demand-side initiatives may be particularly relevant in cases where infrastructure is present, but suffers from low take-up. If the absence of relevant content (eg local language) affects demand for fast broadband, it is also conceivable that policies which foster online transmission of regionalised content might have an impact on demand for NGA. The use of technology by Government can also act as a catalyst to spur technological advances within private sector businesses.

4.2 Economic regulation

As regards economic regulation, significant focus has been given to the impact that access regulation may have on investment incentives for NGA. There are different theories both on how the degree of competition affects investment and on what role, if any, regulation should play in supporting competition.

4.2.1 The relationship between competition and investment

At one end of the spectrum, the neo-classical view holds that competitive market structures are the most effective drivers of innovation, investment and consumer welfare[77]. In this context regulatory intervention to support what are viewed to be competitive market structures is considered to be welfare-enhancing.

A much more sceptical view is presented by Schumpeter, which holds that investment incentives are greater in concentrated markets because firms with market power face a lower risk that profits will be eroded by competition. Proponents of this theory accept that 'static' short-term benefits may be gained from intervening to promote competition (such as lower prices), but claim this may be at the expense of longer term 'dynamic' benefits achieved in a free – largely unregulated – market.

In the context of mobile markets, these conflicting theories on competition and investment influence debates around merger policy and whether spectrum should be reserved for new mobile network operators[78]. In the context of fixed markets, because economies of scale naturally tend to limit the number of parallel access networks to one or two in most cases, debates tend to centre on whether regulation should be used as a tool to create intra-modal competition (competition on a network – typically that of the incumbent), whether such competition is sustainable and whether it undermines investment incentives.

4.2.2 The ladder of investment

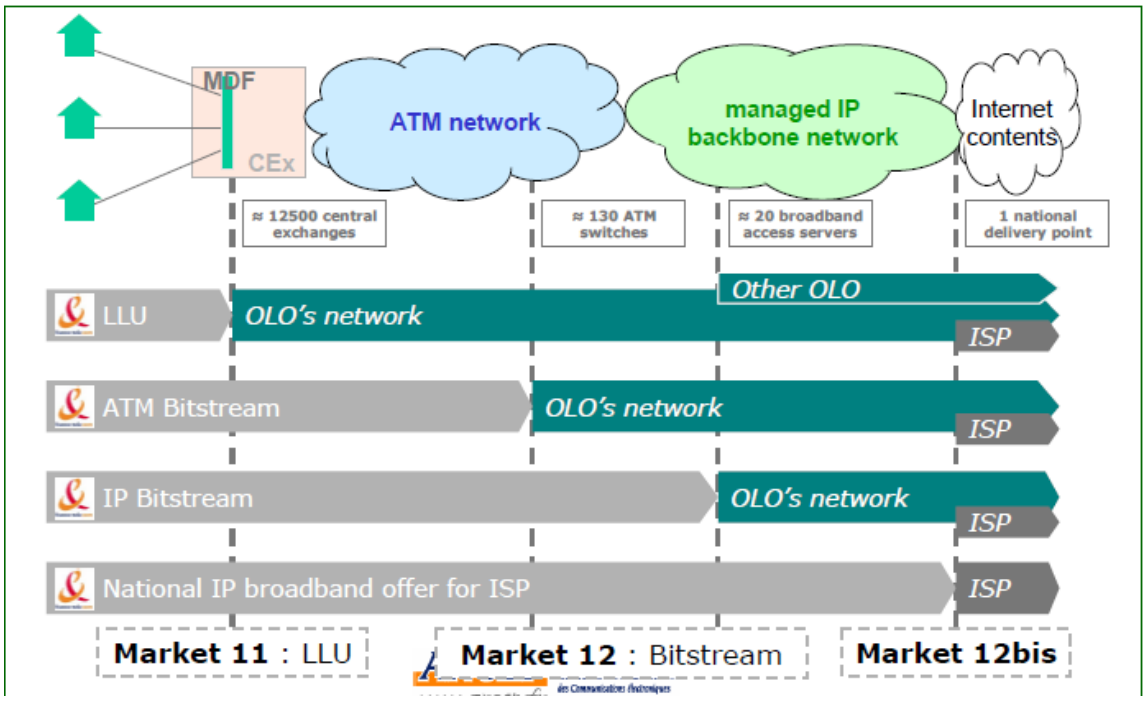
Within Europe, a view historically held by the European Commission and NRAs[79] has been that one or two fixed access networks are not typically sufficient to ensure effective competition in retail services, and therefore access regulation is often considered to be warranted in order to ensure sufficient choice for end-users.

77 See for example the 'structure-conduct-performance' paradigm Barin (1956)
78 For a discussion, see WIK 2015 study on competition and investment in mobile markets
79 See OPTA Economic Policy Note no 6, September 2006 "Is Two enough?"

The approach towards access regulation within Europe, which has been supported in successive iterations of the Recommendation on Relevant Markets susceptible to ex ante regulation[80], is to pursue a strategy known as the 'ladder of investment',

Originally elaborated by Martin Cave in a series of papers[81], the theory of the ladder of investment is to promote end-to-end infrastructure-based competition by providing a series of access product 'rungs' which new entrants are expected to 'climb' until they have built out their own networks and are no longer reliant on access. The rungs of the original broadband ladder – from resale (national IP broadband offer) through bitstream and LLU, can be most clearly seen in the regulatory approach originally taken to broadband by the French NRA ARCEP (see Figure 21).

Figure 21: The broadband ladder of investment in practice – France



Source: Presentation by Jerome Bezzina ARCEP "Implementing the ladder of investment regulation: The case of broadband in France" June 2007 at the ITU Forum on Telecommunication Regulation in Africa. Market numbers refer to relevant markets identified in the original (2003) EC Recommendation on Relevant Markets

Although the original theory envisaged the removal of rungs – including the final rung on the ladder after an initial period, in practice, the removal of regulation has happened

80 See for example the relationship between markets 3a and 3b Commission Recommensation on relevant markets (2014) http://ec.europa.eu/digital-agenda/en/news/commission-recommendation-relevant-product-and-service-markets-within-electronic-communications

81 See for instance Cave, M. (2006), *Encouraging infrastructure competition via the ladder of investment*, *Telecommunications Policy* 30, 223-237

more gradually and more partially within Europe for standard broadband than theory suggested. For example, although regulation of bitstream access (market 3b of the 2014 EC Recommendation) has been removed entirely or across the majority of the territory in several countries[82], LLU remains as a nationwide remedy in most EU countries. Moreover, for standard broadband, European NRAs have tended to wait until evidence of a progression up the ladder of investment to LLU, before removing downstream wholesale broadband access rungs, in contrast with some suggestions that the rungs should be removed at a predetermined time in order to provide investment incentives[83].

With the move towards NGA, a more diverse set of regulatory approaches based on the ladder of investment has been pursued within Europe, providing some scope to see the results of regulatory 'experimentation'.

- Remaining on the ladder: Some countries including the UK, Ireland, Netherlands and Sweden have maintained existing rungs on the ladder, but adapted these for NGA – for example by introducing fibre unbundling or VULA as NGA successors to standard broadband remedies.

- Climbing up the ladder: Other countries such as France, Spain and Portugal, have abandoned current rungs of the ladder of investment for NGA and focused on offering only higher rungs on the ladder of investment, such as duct access, sometimes with forms of subloop unbundling. This strategy essentially compels access seekers to invest in order to compete on NGA.

- Full ladder: Further countries including Germany and Italy have offered a combination of options, adding higher rungs while maintaining the option of 'local access' on NGA networks.

International comparisons offer further scenarios at either extreme in their approach to regulatory intervention. The US, Canada and Korea practice forbearance as regards NGA access, although there may be some degree of duct access, while Australia has pursued an approach in which a single structurally separated access network provides NGA access through regional bitstream offers – essentially focusing on service-based rather than infrastructure competition.

Countries pursuing forbearance may justify this in terms of the perceived detrimental effects of regulation on investment and/or on the basis that infrastructure-based competition exists (for example taking account widespread cable and potential constraints from mobile broadband) or could develop in the absence of regulation. The

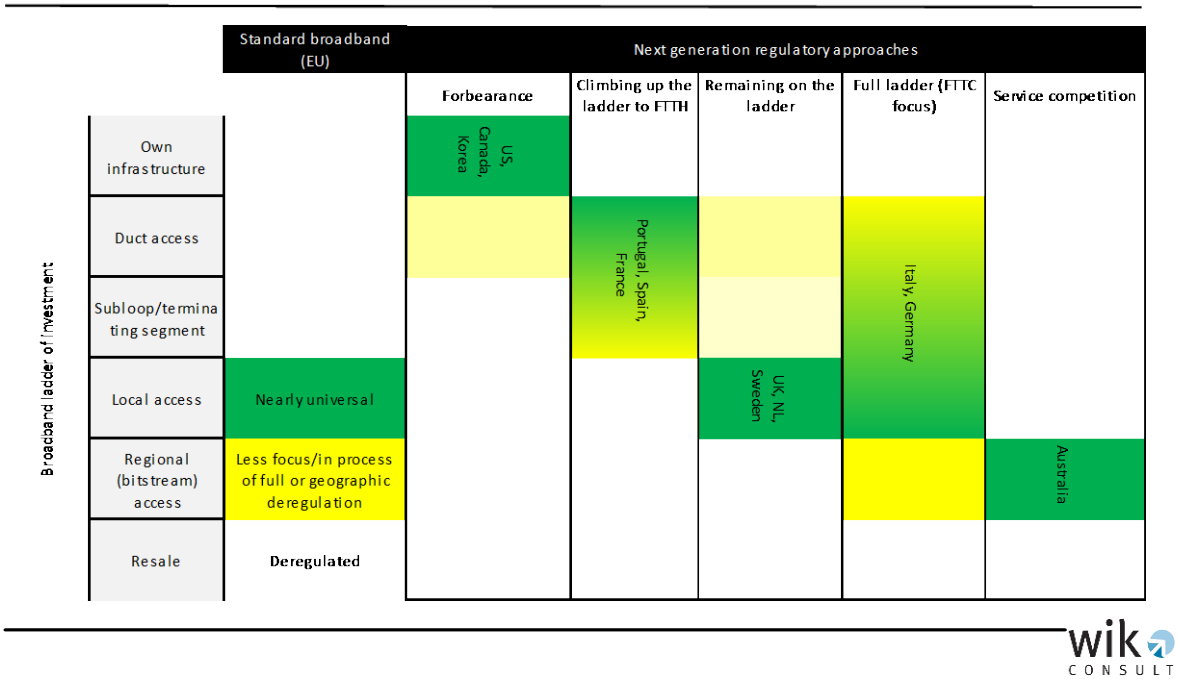
82 Bitstream access regulation has been withdrawn across the majority of the UK on the basis of a geographic market segmentation, and (for mass-market services) across the whole of the Netherlands. Sweden has announced the withdrawal of bitstream regulation.

83 See for example Bourreau, Dogan et al 2010 http://dash.harvard.edu/bitstream/handle/1/4777447/Dogan-Acriticalreview.pdf?sequence=1

approach taken in Australia seems to presume on the other hand that the fixed access network has features of a natural monopoly and will require ongoing regulation.

Figure 22 summarises the regulatory approaches taken towards NGA in Europe and internationally, and shows how these approaches relate to a notional 'ladder of investment' for broadband.

Figure 22: Approaches to NGA regulation – a view along the ladder of investment



Source: WIK

A further variation in regulatory approaches can be seen in the strategies pursued in the regulation of wholesale charges for NGA access, in countries where regulated access is available. Some of the first EU countries to deploy NGA networks on a widespread basis including the Netherlands, Belgium and Sweden, set wholesale charges on the basis of cost-orientation with a risk-adjustment, as was envisaged in the 2010 EC Recommendation on Next Generation Access[84]. Meanwhile others including the UK and Germany mandated access on the basis of non-discrimination, but with flexible pricing, subject to an ex post check or margin squeeze test. This latter approach, which is consistent with the 2013 EC Recommendation on cost orientation and non-discrimination[85], is now becoming more prevalent, as the Netherlands[86] and Sweden have adapted their regulatory strategies towards a more flexible model.

84 EC TRecommendation (2010) on regulated access to Next Generation Access networks http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32010H0572

85 EC Recommendation (2013) on consistent non-discrimination obligations and costing methodologies. http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32010H0572

86 The Dutch regulator has proposed to set prices for VULA only if market participants cannot reach a mutual agreement

4.3 Case studies in NGA policy and regulation

In this section, we provide further detail as regards the regulatory approaches taken in different countries, with a focus on approaches to economic regulation of NGA networks, and describe how these may have affected outcomes. The countries have been described in order according to the degree of intervention they take as regards regulation of NGA networks. South Korea and Japan are described at the end, as the approaches in these countries have also been influenced by public policy measures.

4.3.1 Forbearance – the US and Canada

Certain countries such as the US and Canada decided from the outset against regulatory intervention on NGA on the basis that the market (including potential stimulus from mobile), is best-placed to deliver investment in higher speeds benefiting consumers. The focus is thus on competition between end-to-end infrastructures (sometimes called inter-modal competition).

The US and Canada both benefit from extensive cable coverage.

Regulatory developments

In February 2015, the US FCC reclassified broadband to make it subject to 'Title II' of the US Communications Act[87], which could in theory enable the service to be subject to access regulation. However, the FCC has confirmed that the main purpose of the reclassification was to apply rules relating to 'Net Neutrality'. Statements from the FCC Chairman suggest that there are no plans to use the reclassification to mandate access to the NGA networks of the cable companies or incumbent telecommunication providers, noting that the "modernised regulatory approach [of forbearing from access regulation]… has already been demonstrated to work". The reclassification is currently subject to appeals proceedings.

Canada has thus far pursued the same path of regulatory forebearance as in the US as far as access to NGA networks is concerned[88]. However, the Canadian NRA CRTC is in the process of undertaking a review of wholesale wireline services which will consider inter alia whether currently unregulated services such as NGA access should be subject to regulation. The CRTC Chairman Jean-Pierre Blais noted at a public hearing in November 2014[89] that the agency will "consider the current state of deployment of fibre-optic facilities… and the required network investments. This will help us decide whether independent Internet service providers should have mandated access to these

87 https://www.fcc.gov/blog/good-news-consumers-innovators-and-financial-markets
88 Unlike the US, access obligations do apply to ASDL-based wholesale services, based on the principle of 'speed matching' to the incumbent retail services http://crtc.gc.ca/eng/archive/2010/2010-632.htm. However, they do not apply currently to NGA
89 CRTC Chairman remarks at public hearing on the review of wholesale wireline services http://news.gc.ca/web/article-en.do?nid=907109. Also http://crtc.gc.ca/eng/archive/2013/2013-551.htm

facilities." The review will also include an analysis of whether current policies strike an appropriate balance between sustainable competition and sufficient incentives to invest in networks by both the incumbents and competitors.

Outcomes

Table 7: Market structures and outcomes in countries with regulatory forbearance on NGA

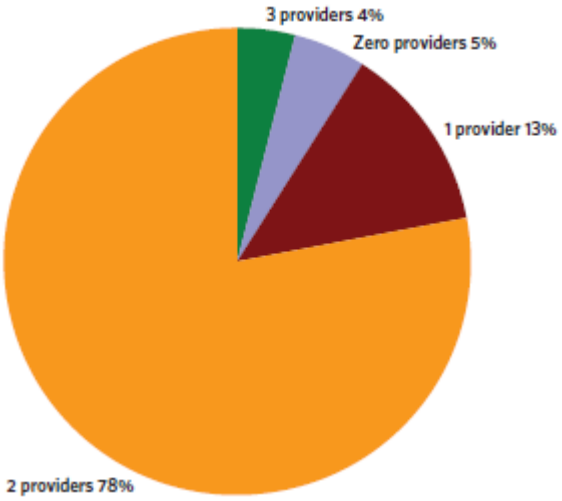
	NGA coverage	NGA take-up	Demand (usage)	Speeds	Price	Cable (DOCSIS)	% pop. urban	Choice (no. NGA offers)	HHI
Canada	90%	47%	Medium	10.3	$64	90%	56%	Limited	49%
US	90%	61%	High	11.5	$73	81%	42%	Limited	45%

Source: WIK based on various sources as described earlier – 2014 except price (2012), choice – based on estimates

Canada and the US both benefit from high NGA coverage and take-up. However, cable coverage accounts for the majority of the NGA coverage and prices for fast broadband in both countries are amongst the highest of those assessed.

Data provided by the FCC and in a recent speed by the FCC Chairman also suggests that the degree of choice of broadband supplier is limited. For basic broadband (with at least 4 Mbps downstream capacity and 1 Mbps upstream capacity), 75% of Americans have at least two choices of broadband provider, and 15% have a choice of three or more); however, for moderately fast broadband (with at least 25 Mbps downstream capacity and 3 Mbps upstream capacity), only 25% quarter of Americans have at least two choices of broadband provider, and only 2% have a choice of three or more.

Figure 23: Share of housing units in US census tracts with 0, 1, 2, or more fixed network operators.



Source: FCC, National Broadband Plan, March 2010.

Limited choice is also reflected in the high concentration levels in these countries as measured by the HHI.

Notwithstanding high prices and limited choice, take-up and usage of broadband in the US is very high and moderate in Canada. Usage may be explained by the volumes of online video consumed respectively by US and Canadian households, and may be supported by the ready availability of local content, for example from Netflix and iTunes.

Observations

It is not clear that regulatory forbearance was the main driver behind high NGA coverage rates or take-up in the US and Canada. With more than 80% of Docsis 3.0 coverage in both countries, little of the NGA deployment (none in Canada) has been in areas beyond the reach of cable. It is probable that – as in Europe – cable provided the trigger for NGA upgrades, which are relatively cost-effective on the cable platform, while the incumbents' deployment may have been a competitive response.

A possible explanation for high take-up might be that the US and Canada both have significant demand-driving factors for broadband – including the availability and populatity of 'home grown' online content which drives usage, such as Netflix (see Figure 15). This may contribute to high demand, and potentially high willingness to pay for broadband, notwithstanding high prices. Although overall coverage and take-up outcomes in North America are certainly not poor compared with Europe, if high prices are in part the result of a lack of effective competition, and if lower prices would have

stimulated higher take-up (in the presence of evident demand), the outcome does not appear optimal from an economic or social perspective.

The comparatively high coverage of cable in the US and Canada ensures a greater degree of choice for North American consumers than would be the case in most European markets in the absence of regulation – most customers have at least two infrastructure-based options. It is interesting that, notwithstanding this advantage, the degree of choice in *fast* broadband in the US appears to be limited and actual speeds received are average, and not significantly faster than those available to customers in the UK. This might indicate that the maximum speed capabilities of networks in the US are not always exploited in offers to customers, which could be another effect resulting from limited competition in fast broadband.

4.3.2 Climbing the ladder - Deep passive access approaches

A number of EU countries have sought to promote infrastructure-based competition through strong regulatory intervention in upstream passive access (such as ducts, in-building wiring and terminating segments), combined with no mandated downstream active access to NGA networks. This is intented to enable and encourage other players to duplicate access infrastructure to some degree – by stimulating them to 'climb the ladder of investment' for NGA..

France and Spain are two countries which have adopted this approach (alongside Portugal, which not covered in this study), but with important differences.

4.3.2.1 Spain

Spain is characterised by cable networks covering more than half of the population and significant broadband competition on the basis of local loop unbundling.

Regulation

Spanish NRA CNMC has stated that its main objective in its regulatory approach to NGA has been to promote multiple competing infrastructures and investment in NGA[90]. In practice, in the absence of demand for SLU[91], passive access regulation has been focused on fostering competing FTTH networks through duct access[92] (as an SMP

90 Questionnaire completed by CNMC March 2014

91 CNMC states that the lack of demand for SLU, which would have been used for FTTC renders a reference offer unnecessary – questionnaire March 2014

92 Resolution sobre la revision de la Oferta Mayorista de Acceso a Registros y Conductos de Telefonica (MTZ 2011/1477) http://telecos.cnmc.es:8080/c/document_library/get_file?uuid=971a9660-9b89-450b-85ed-b2cbcb5fe714&groupId=10138

remedy) and sharing of in-building wiring[93], on the basis of symmetric regulation in accordance with article 12 EU Framework Directive[94]. Both obligations were first implemented in 2009. The symmetrical obligation for in-building wiring requires that the first operator to deploy fibre in a building must provide access to in-building fibre wiring at the distribution point inside the building.

After reviewing the outcomes of this approach, in December 2014 CNMC issued a consultation concerning its market review of markets 3a and 3b in which it proposed to maintain forbearance on NGA active access in 9 major cities[95] where infrastructure-based competition (considered to be at least 3 parallel networks including cable) is established[96]. However, outside these areas, CNMC proposes to require the provision of VULA on the basis of SMP regulation on the incumbent, Telefonica.

Outcomes

As regards outcomes, there has been a very significant expansion in FTTH coverage in Spain, growing from just 3.1% of households in mid 2011 to 58% of households in mid 2014[97]. A large portion of this coverage is by the incumbent Telefonica. Telefonica reports that as of end March 2015 it had covered 4.3m households[98] while CNMC reported that Telefonica aimed to achieve coverage of 9m by end 2015, representing approximately half of all households[99]. However, alternative operators have also been active in FTTH construction. For example, Vodafone Spain and Orange announced an agreement to jointly build 3m FTTH lines by September 2015, increasing their joint footprint from 800,000 premises as of July 2014[100]. Meanwhile, Jazztel has also been deploying FTTH. The planned acquisition of Jazztel by Orange Spain threatened to reduce the degree of infrastructure competition in FTTH. However, Orange Spain has committed to divest 700,000-800,000 FTTH lines covering 13 urban districts as a condition for approval of the acquisition by the European Commission, with the aim of supporting entry by a further infrastructure-based player[101].

Take-up of FTTH is also growing in Spain and stood at 947,3000 in mid 2014[102], although figures suggest that take-up is not keeping pace with the swift deployment rate

93 Symmetrical obligations concerning the sharing of in-building wiring in Spain - http://www.cmt.es/c/document_library/get_file?uuid=5c140e07-8830-44a8-ab01-df7317942bce&groupId=10138
94 EU Directive 2002/21/EC as amended by Directive 2009/140/EC
95 Representing around 19% of the Spanish population
96 CNMC press statement and consultation http://www.cnmc.es/CNMC/Prensa/TabId/254/ArtMID/6629/ArticleID/1044/La-CNMC-lanza-una-consulta-p250blica-sobre-la-regulaci243n-mayorista-de-los-mercados-de-banda-ancha.aspx
97 Source: IDATE FTTx watch
98 Telefonica shareholder presentation http://www.telefonica.com/en/shareholders-investors/pdf/rdos15t1-pres.pdf
99 CNMC questionnaire March 2014. However, more recent (2015) reports suggest that Telefonica has downgraded these plans following the NRA's proposal to mandate VULA access outside dense city areas
100 http://www.vodafone.com/content/index/about/about-us/policy/news-releases/vodafone-spain-orange-spain-fibre-sharing-agreement.html
101 EC clears acquisition of Jazztel by Oranga http://europa.eu/rapid/press-release_IP-15-4997_en.htm
102 IDATE

– falling to 9% of the served area in this period. As in the UK (see Figure 12), there is evidence of the Spanish incumbent Movistar responding to speed upgrades from cable and other infrastructure-based providers. For example, in March 2014, Vodafone announced that it would be providing a 200Mbit/s fibre service to Spanish customers via its cable network (ONO) and fibre arrangement with Orange[103]. Subsequently in March 2015, Telefonica (Movistar) announced that it would spontaneously and free of charge upgrade existing customers taking 10Mbit/s to 30Mbit/s, while customers taking 100Mbit/s would be upgraded to 300Mbit/s[104].

4.3.2.2 France

France is characterised by limited cable coverage and significant broadband competition on the basis of local loop unbundling.

Regulation

French NRA ARCEP's strategy has been to foster FTTP deployment and infrastructure competition, with the aim of ultimately achieving lighter asymmetric regulation[105]. In France the regulatory approach to NGA is focused on duct access (mandated under SMP obligations) and symmetric access to the fibre 'terminating segment' (the portion of wiring from the customer site to the first distribution point). Duct access was imposed on FT-Orange for the deployment of fibre local loops in July 2008[106]. The legislation governing symmetric access was approved in 2008-2009[107], and was elaborated in Decisions by the NRA in 2009-2010[108]. In a June 2014 Decision, ARCEP confirmed that it would maintain its previous strategy of not applying unbundling or active remedies to FT-Orange (the operator designated as having SMP in the market for wholesale physical network access), on the basis that duct access and the symmetric access regime were considered sufficient to address competitive issues during the review period[109].

As regards the passive access approach, an important difference between France and Spain is that, in France, the access point applying to symmetric obligations (referred to by ARCEP as the 'mutualisation' point for the 'terminating segment' of the fibre loop), is decided by ARCEP and can at the first distribution point *outside* the building.

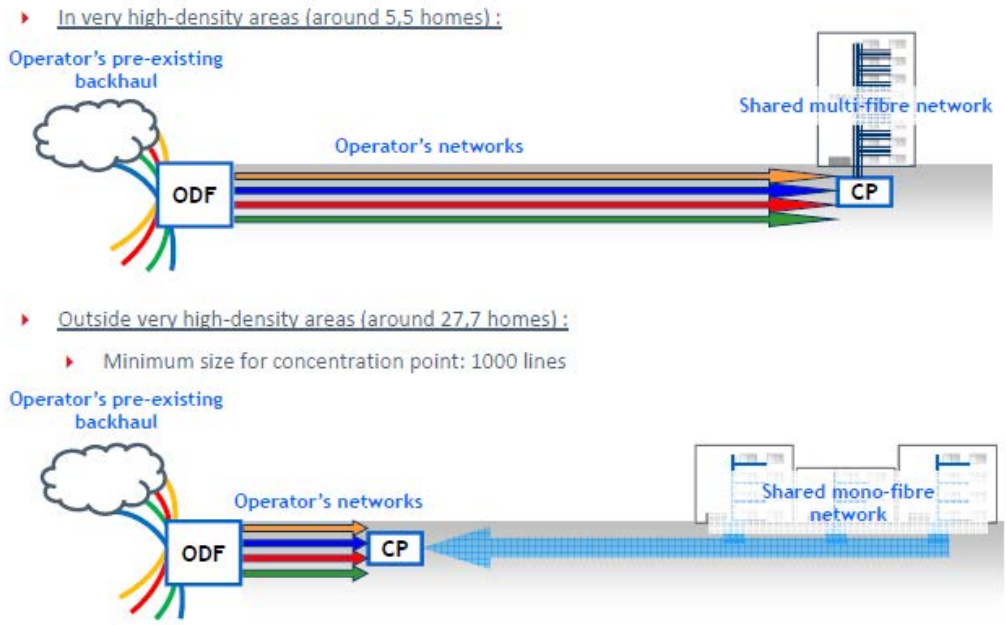
103 http://www.zdnet.com/article/vodafone-bringing-200mbps-fibre-service-to-spain-next-week/
104 Movistar upgrades broadband speeds http://www.adslzone.net/2015/03/23/telefonica-movistar-300-mbps-fibra-optica/
105 ARCEP response to questionnaire on behalf of Ofcom March 2014
106 ARCEP decision n ° 2008-0835 of 24 July 2008 ("GC BLO")
107 Law n ° 2008-776 of 4 August 2008 on the modernization of the economy Law n ° 2009-1572 of 17 December 2009 against the digital divide
108 Decisions of the Authority No. 2009-1106 and n ° 2010-1312 of 22 December 2009 and 14 December 2010 respectively, adopted pursuant to Article L. 34-8-3 CPCE
109 ARCEP decision http://www.arcep.fr/uploads/tx_gsavis/14-0733.pdf EC Article 7 letter C(2014) 4048 final

ARCEP decided on the location of the mutualisation point based on its 'ex ante' assessment as to the degree to which access infrastructure could be duplicated in different geographic areas. In this context ARCEP concluded that:

- In very dense areas[110], the mutualisation point could be at the base of the building (for multi-dwelling units housing more than 12 households or business premises), or at points aggregating a number of buildings for smaller buildings or individual households
- In areas characterised by ARCEP as 'less dense' the mutualisation point would be at a location aggregating at least 1,000 households – or 300 if additional backhaul is made available to aggregate 1,000 households

In this context, in less dense areas, symmetric obligations in France essentially require that construction of new fibre infrastructure includes a point to point fibre 'subloop', enabling physical access at that location (see Figure 23).

Figure 24: Access points to fibre terminating segment – France



Source: ARCEP – presentation April 2014 Pierre Oisel

Another innovation in the French case concerns pricing associated with the symmetric mutualisation regime, which features the concept of 'Indefeasible Rights of Use' (IRU) as a mechanism for 'co-financing' of fibre terminating segments. Although pricing

110 List of very dense areas according to ARCEP designation http://www.arcep.fr/fileadmin/reprise/dossiers/fibre/annexes-2013-1475-liste-communes-ztd.pdf

arrangements are agreed bilaterally between operators signing a mutualisation arrangement, ARCEP can resolve disputes between the parties, and in doing so, has aimed to ensure[111] that such arrangements include terms for:

- Co-financing at the beginning of the investment (ie before FTTH is deployed);
- Co-financing after the investment has been made; and
- An offer for rental of access

ARCEP indicates[112] that in very dense areas, where the mutualisation point is at the base of the building, financing of the in-building connection is equally divided amongst participating operators. Elsewhere, in less dense areas (with a few exceptions), co-financing is available in slices of 5% of lines.

In order to 'industrialise' a process which involves many public and private sector organisations, ARCEP has published guidelines both as regards pricing[113] and operational arrangements[114] for telecom providers operating under the mutualisation regime.

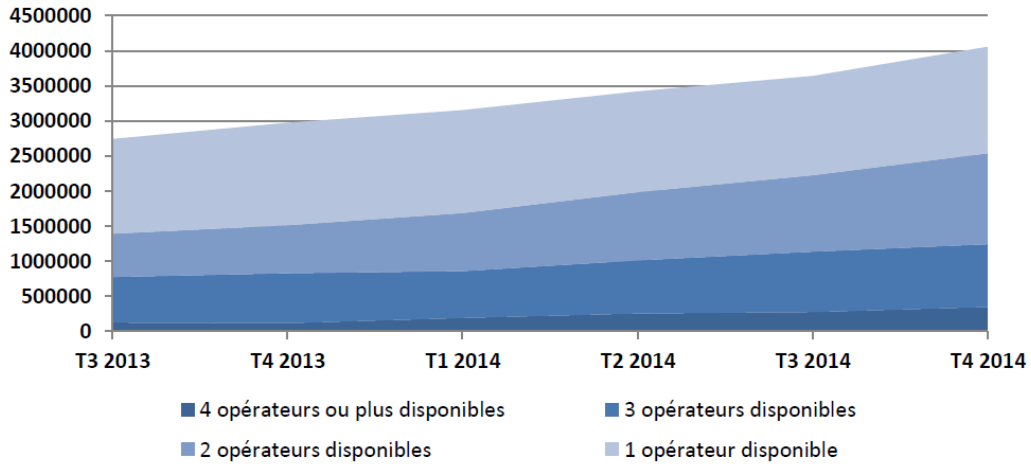
Outcomes

As regards outcomes, in France, coverage of FTTH/B networks had reached 25% of all households by mid 2014[115], higher than FTTH/B coverage levels in the UK, Italy and Germany, but lower than in Spain and Portugal, the other two countries focused on deep passive access remedies as means to stimulate a climb 'up the ladder' of investment. At 40% in mid-2014, overall NGA coverage was also significantly lower in France than in Germany, Spain and the UK. The regime cannot be considered therefore to have achieved a high degree of NGA coverage.

However, figures from ARCEP suggest that within areas served by FTTH there is a degree of FTTH-based infrastructure competition. Figure 25 shows that for around 60% of FTTH connections, customers have a choice of 2 or more FTTH providers on the basis of 'mutualisation' agreements. In some cases, customers would also have the option of a high speed cable connection.

111 Questionnaire/interview with ARCEP March 2014
112 Questionnaire/interview with ARCEP March 2014
113 ARCEP Dec 2014 consultation on pricing FTTH access http://www.arcep.fr/index.php?id=8571&tx_gsactualite_pi1%5Buid%5D=1716&tx_gsactualite_pi1%5Bannee%5D=&tx_gsactualite_pi1%5Btheme%5D=&tx_gsactualite_pi1%5Bmotscle%5D=&tx_gsactualite_pi1%5BbackID%5D=26&cHash=f9fa5b0791f1cc79bab5d97fc3e70d1f&L=1
114 ARCEP May 2015 notifies draft decision on operational process for accessing superfast networks to EC http://www.arcep.fr/index.php?id=8571&tx_gsactualite_pi1%5Buid%5D=1746&tx_gsactualite_pi1%5Bannee%5D=&tx_gsactualite_pi1%5Btheme%5D=&tx_gsactualite_pi1%5Bmotscle%5D=&tx_gsactualite_pi1%5BbackID%5D=26&cHash=2964568323fbf6cfa7d30cd284b0468a&L=1
115 IDATE

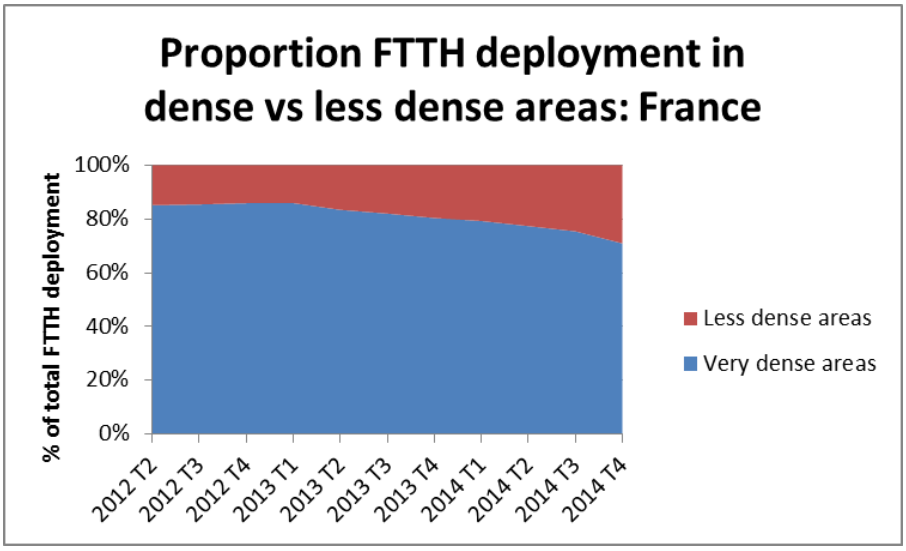
Figure 25: Premises served by FTTH: number of operators present via mutualisation of the terminating segment



Source: ARCEP – broadband observatory

Initially, FTTH deployment in France was mostly in the so-called 'dense' areas characterised by roll-out to the base of buildings (often MDUs) in the Paris area. However, more recently, ARCEP data suggests that deployment outside this zone has occurred on the basis of 'mutualisation' of the fibre terminating segment, reaching 29% at the end of 2014.

Figure 26: Proportion FTTH deployment in dense vs less dense areas: France



Source: WIK based on data from ARCEP – broadband observatory

The main private sector players involved in the provision of FTTH networks in France are Orange (with an estimated 4m FTTH/B lines), Iliad (operating under the 'Free' brand) and the recently merged SFR/Numerciable, which operates a combination of DOCSIS 3.0 and FTTH/B lines. It has been reported that SFR/Numericable continues to accelerate its FTTH/B deployment[116] with the aim of covering 9 cities by the end of 2016[117]. Meanwhile, fixed network challenger Bouygues Telecom, is also reported to be investing in FTTH with the aim of passing 2m homes under the 'mutualisation' regime by end 2015 compared with 1.4m today. It is however unclear whether the announced deployments would expand NGA coverage in France as opposed to introducing further competition in currently served areas.

Take-up of FTTH in France has remained relatively low reaching 20% of households served with NGA as of mid-2014. Bandwidth usage – and in particular usage of online video – also remains relatively low.

4.3.2.3 Observations

Table 8: Market structures and outcomes in countries with deep passive access (no active remedies)

	NGA coverage	NGA take-up	Demand (usage)	Speeds	Price	Cable (DOCSIS)	% pop. urban	Choice (no. offers)	HHI
France	40%	20%	Low	6.9	$35	10%	35%	3-4 (dense areas) 1-2 elsewhere	39%
Spain	68%	32%	Low	7.8	$66	55%	48%	3-4 (dense areas) 1-2 elsewhere	32%

Source: WIK based on various sources as described earlier – 2014 except price (2012), HHI (2013). Choice based on estimates

The approach of incentivising a move 'up the ladder' of investment in Spain and France by focusing on deep passive access without any downstream active access remedies, does appear to have achieved infrastructure-based competition amongst the incumbent, cable and alternative operators investing in FTTH/B. Data provided by ARCEP as well as the recent market analysis from CNMC shows that in particularly dense areas, customers may have a choice of three or more infrastructure-based FTTH providers. This represents more infrastructure-based choice than in countries such as the UK,

116 Data suggests that cable connections have also been converted to FTTB through the extension of fibre to the base of the buildings

117 ZDnet France http://www.zdnet.fr/actualites/fibre-bouygues-telecom-veut-egalement-accelerer-dans-le-ftth-39818974.htm

which have primarily focused on local access remedies (albeit with the option of duct access). However the geographic scope of this choice remains limited, with only 1 or 2 options for NGA beyond the dense urban areas. Compared with 'local access' countries, operators other than mass-market players with their own FTTH networks may also struggle to compete.

Both France and Spain have experienced a gap between dense urban areas, in which there is a degree of choice, and less dense areas, in which there is limited or no choice of fast broadband provider. However, they have chosen to pursue different regulatory approaches towards promoting competition in less dense areas. In Spain, the NRA has proposed to mandate an active remedy (VULA) on the basis of SMP remedies outside zones of infrastructure-based competition, while in France, the NRA is relying on passive access at a 'mutualisation' point aggregating 1,000 households, with access is offered either on the basis of IRU or rental. It remains to be seen how these respective approaches will fare.

Another point worth noting is that the regime of active access forbearance combined with deep passive access, does not seem in itself to explain the overall coverage levels of NGA.

Rather, cable seems to have been the primary driver of NGA coverage levels. To illustrate this point, it is interesting that in Spain FTTH coverage reached 58% of households by mid-2014 (with NGA coverage at 68%), compared with just 25% FTTH coverage in France (40% all NGA technologies). In Spain, coverage of the cable network exceeds 50% of households[118] whereas in France, cable coverage is relatively limited at 25% of households[119]. Another difference between the countries relates to cost. According to the OECD 48% of the Spanish population was classified as 'urban' compared with 35% in France.

4.3.3 Staying on the ladder – NGA regulation

Several countries have pursued a strategy for NGA regulation which assumes that existing access-based competitors may not 'climb the ladder' to a significant degree at least over the shorter-term. These countries therefore place a primary focus on 'local access' remedies although passive access may also be available. Countries pursuing this approach include the UK, Sweden and the Netherlands.

Although the regulatory approach is similar, the countries have different infrastructure starting points, with nearly ubiquitous cable in the Netherlands, and a history of independent FTTH investment in the Netherlands and Sweden. These factors contrast

118 IDATE reports DOCSIS 3.0 coverage in Spain at 55% mid-2014, while IHS estimates coverage of all cable technologies in Spain at 51% in 2012.
119 IHS 2012 all technologies

with the UK, which has partial cable coverage and limited independent NGA investment to date.

In all three countries, NGA regulation is based on asymmetric SMP obligations with a primary focus[120] on 'local' access to the network of the incumbent at or near the level of the Main Distribution Frame (the point at which LLU occurs today). The market review of the market for wholesale physical network infrastructure access[121], which led to the imposition of NGA-based access was concluded in 2009 in the Netherlands and in 2010 in the UK and Sweden[122].

4.3.3.1 Netherlands

The Netherlands is characterised by nearly ubiquitous cable networks and the deployment of FTTH networks by independent investors.

Regulation

The Netherlands experienced relatively early deployment of (point to point) FTTH as a result of the initiative of independent access investor Reggefiber (later acquired by incumbent KPN). As a result, the Netherlands is one of the first countries that introduced regulated access to NGA. In a 2009 Decision, the NRA OPTA (the predessor to ACM) required KPN/Reggefiber to meet reasonable requests for unbundled access to point to point fibre (ODF access) on the basis of cost-orientation. Costs were calculated using a Discounted Cash Flow (DCF) model based on the commercial business model for Reggefiber and included a risk-adjustment[123]. At the same time downstream 'low-quality' (mass-market) bitstream over fibre was left unregulated.

Following a recent market review and in view of the expansion of FTTC/VDSL by the incumbent (presumably as a geographic complement to FTTH), in March 2015, ACM notified the European Commission that it also proposed to introduce an obligation for VULA. In its market analysis[124], ACM provisionally found that, following a merger which created a nationwide cable operator, there was a risk of joint SMP between the cable operator and KPN in the retail market for fixed broadband, while at wholesale level, ACM excluded cable from the market on the basis that unbundled access and VULA could not be supplied via cable. ACM proposed to retain cost orientation as the price control method for fibre unbundling, and nominally also to mandate a price control for

120 Duct access and SLU are available in some countries such as the UK, but without an expectation of widespread usage
121 Former market 4 of the EC Recommendation on relevant markets
122 See article 7 cases NL/2010/1041, SE/2010/1061 and Ofcom WLA 2010 Statement http://stakeholders.ofcom.org.uk/consultations/wla/statement
123 Article 7 letter (2008)D/207845
124 ACM draft decision on wholesale local access https://www.acm.nl/nl/publicaties/publicatie/14110/ACM-biedt-ontwerp-marktanalysebesluit-ontbundelde-toegang-aan-bij-Europese-Commissie/

VULA based on the LLU 'safeguard cap' price with an uplift for the VULA increment. However, it signalled that the tariffs for VULA would be determined in a price decision which would apply only if an alternative operator requests such a decision, in the absence of a voluntary agreement between the incumbent KPN and other parties. ACM also noted that it considered that voluntary agreement was likely[125].

In April 2015, the European Commission challenged ACM's draft market analysis through a 'Phase II' proceeding under the 'Article 7' process[126]. In particular the Commission questioned whether cable should have been excluded from the wholesale market in view of the potential that virtual unbundling might be possible in future on cable networks. The Commission also questioned whether ACM's analysis would support a finding of (potentially joint) SMP in a wholesale market which included the cable network, noting inter alia the presence of commercial wholesale offers by KPN. On 12 June, ACM notified the European Commission that it had withdrawn the notified draft decision. A new draft Decision is expected in the coming months.

Outcomes

The Netherlands benefits from high NGA coverage of 99%, primarily due to its ubiquitous cable infrastructure and expanding FTTC/VDSL coverage, which reached 86% of households in mid 2014[127]. However, NGA take-up was reported as relatively low, at 26% of served households. Although there is intense infrastructure-based competition between the two nationwide infrastructures in the Netherlands (cable and incumbent), regulated NGA access plays a relatively small role. The number of unbundled fibre lines was reported by ACM to be less than 10,000 as of the end of 2014[128]. Voluntary wholesale NGA access is however thought to make up a further portion of lines.

4.3.3.2 Sweden

Sweden is characterised by the early deployment of point to point FTTH, led primarily by independent municipal organisations such as Stokab, serving the Stockholm area. Indeed Stokab reports[129] that around two third of municipalities in Sweden operate publicly owned city networks.

Regulation

Similarly to the Netherlands, in view of the prevailing point to point fibre architecture, in 2010 Swedish NRA PTS originally mandated cost-based unbundled fibre access on SMP operator Teliasonera as its primary remedy in the market for 'wholesale physical

125 See discussion in Case NL/2015/1727 Opening of phase II investigation by EC
126 Article 7 case NL/2015/1727
127 IDATE
128 Questionaire March 2015
129 FTTH Council webinar Stokab
http://www.ftthcouncil.eu/documents/Webinars/2013/Webinar_16October2013_QA_Session.pdf

access'[130]. All segments of the fibre network were subject to unbundling obligations, and the incumbent Teliasonera was also required to supply new fibre on demand if the requesting operator met the costs[131]. PTS also imposed NGA-based bitstream obligations on the basis of cost-orientation.

More recently, in 2015, Swedish NRA PTS issued a Decision[132] which significantly adapts the regulatory approach, taking into account the migration to NGA as well as competitive constraints from the municipal networks.

Firstly, PTS additionally introduced a VULA remedy to address circuimstances where unbundling was not feasible[133], for example where xDSL connections were falling due to increasing fibre roll-out or in the context of vectoring.

Secondly, PTS announced that it would be lifting the previous obligation of cost-orientation on NGA-based access from 1 December 2016 and would instead apply an economic replicability (margin squeeze) test – the details of which are specified in the Decision. The reasoning given was that prices for NGA-based access were sufficiently constrained by cost-oriented copper wholesale charges as well as competition from municipal fibre networks, which have a significant presence in Sweden.

At the same time, PTS deregulated the downstream market for 'Wholesale Central Access' (market 3b), which was previously included NGA-based access and was subject to cost-oriented access, leaving 'local access' as the remaining NGA remedy. The justification was given as constraints from competition in the wholesale local access market as well as retail constraints.

Outcomes

Sweden benefits from high historic FTTH deployment from independent organisations in addition to DOCSIS 3.0 coverage which reached 41% in 2014. Take-up of NGA is also high at 70% of served households, and Swedish customers are extensive users of bandwidth including online video.

Although there is infrastructure-based competition in NGA amongst the regional FTTH networks, cable and incumbent, as of 2013, NGA competition on the basis of regulated wholesale access was limited, and it is understood that a significant portion of the (still limited) NGA wholesale supply by the incumbent was based on commercial, rather than regulated offers[134]. At the same time, wholesale access is available in certain areas from alternative suppliers to the incumbent, with several of the municipal FTTH providers, such as Stokab, operating a wholesale-only model.

130 Article 7 Case SE/2010/1061 http://www.pts.se/upload/Beslut/Internet/2010/07-11757-beslut-nit-100524.pdf
131 In this case, the requesting operator would have a rigt of use of 20 years over the fibre
132 See Article 7 Case C(2015) 757 final
133 Article 7 case SE/2015/1688
134 March 2014 Interview with PTS

4.3.3.3 UK

The UK is characterised by high and expanding NGA coverage on the basis of FTTC/VDSL from the incumbent BT with infrastructure competition from cable across around half of the national territory.

Regulation

Faced the challenge of network architectures which were not readily unbundleable, in a 2010 market review of 'wholesale local access'[135], Ofcom defined and implemented the concept of Virtual Unbundled Local Access (VULA), which was intended to replicate as a far as possible the functionality of unbundling over an active access connection. VULA in the UK is supplied by the functionally separated Openreach unit[136] and was mandated on the basis of 'Equivalence of Inputs', a strong form of non-discrimination in which the same systems must be used to supply third parties as BT's downstream operations.

Wholesale pricing was kept flexible in order to provide adequate incentives for investment. Although BT remains free to set wholesale charges, in 2015, Ofcom adopted a decision aimed at protecting against margin squeeze in fast broadband[137].

Duct access is mandated in the UK in the context of the wholesale local access market for mass-market deployment (Physical Infrastructure Access – PIA)[138], and subloop unbundling SLU) is also available. However, on the expectation that these remedies would not be extensively used in practice, VULA has been the main focus of NGA regulation.

Outcomes

The UK has achieved a relatively high level of NGA coverage, mainly reflecting the widespread deployment of FTTC/VDSL by BT, which reached 75% in mid-2014.

Beyond the 50% of households served by cable for which an expansion has been announced[139], and some targeted areas served by rural specialists or used as the basis for FTTH trials, infrastructure-based NGA competition in the UK is relatively limited. On the other hand, competition on the basis of regulated access to BT's NGA network has been expanding. Data from BT shows increasing take-up of VULA which reached 27% of all lines on the Openreach FTTx platform in 2014 compared with 10% in 2012.

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135 Ofcom (2010) WLA statement http://stakeholders.ofcom.org.uk/binaries/consultations/wla/statement/WLA_statement.pdf
136 Functional separation was introduced in the UK on the basis of binding commitments in 2005
137 Ofcom (2015) approach to the VULA margin http://stakeholders.ofcom.org.uk/consultations/VULA-margin/statement/
138 Duct access cannot be used for selective business deployment
139 See Guardian Feb 2015 http://www.theguardian.com/media/2015/feb/13/virgin-media-bt-cable-network-project-lightning

4.3.3.4 Observations

Table 9: Market structures and outcomes in countries with local access focus

	NGA coverage	NGA take-up	Demand (usage)	Speeds	Price	Cable (DOCSIS)	% pop. urban	Choice (no. NGA offers)	HHI
NL	99%	27%		14	$37	98%	85%	3+ (but limited take-up)	35%
Sweden	61%	70%	Medium	14.1	$41	41%	22%	3+	27%
UK	76%	33%	Medium	10.7	$27	49%	70%	3+	29%

Source: WIK based on various sources as described earlier – 2014 except price (2012), HHI (2013). Choice based on estimates

These three countries provide interesting comparisons because they share a similar model for regulation (mainly although not exclusively focused on 'local access' to NGA networks), but have different starting points as regards infrastructure-based competition. This allows us to gauge what effects infrastructure competition may have had on the respective outcomes.

Sweden and the Netherlands' higher FTTH coverage is for example, largely the result of initiatives by independent investors and municipalities, which has been absent from the UK.

As regards NGA coverage, cable has clealy played a role in each of the countries. Population density and the consequences for cost may also have played a role. With just 22% of the population living in urban areas, Sweden presents the most challenging population distribution and also has the lowest NGA coverage of the three. On the other hand, urban areas account for 70% and 85% respectively of the population based in the UK and the Netherlands, making widespread coverage more cost-effective than in Sweden.

The strength of competition from the ubiquitous cable network in the Netherlands may also go some way to explaining why voluntary VULA price arrangements are considered possible by the NRA whereas in the UK, a Decision on the VULA margin has been applied, and there are ongoing disputes around the VULA price[140].

140 Case no. 1237/3/3/15 Competition Appeal Tribunal

Of the three countries examined, the UK and Sweden benefit from higher take-up amongst households served by NGA than the Netherlands. Online video is also widely used in the UK and Sweden, which may have supported demand for NGA. Comparable data is not available concerning online video usage in the Netherlands, and therefore it is not possible to gauge whether this factor may have affected demand in the Netherlands.

An analysis of these three countries provides an interesting illustration that market-based factors (cable, municipalities and demand) may be more significant than regulatory factors in explaining NGA (and FTTH) coverage and take-up outcomes. However, comparing these countries with those pursuing passive access in the absence of active remedies also highlights the effect of regulation on choice in retail fast broadband offers. There is at least a theoretical choice[141] of at least three providers of fast broadband in these countries across much of the served territory. This compares with a much more limited geographic scope of choice in France and Spain, which focused on passive access alone.

4.3.4 A full ladder – Germany and Italy

Some countries have focused on a strategy whereby focus has been given to several rungs of the ladder of investment with the expectation that they will be used by different operators and/or in different areas. We focus here on the examples of Germany and Italy.

4.3.4.1 Germany

Alongside the incumbent, which has a ubiquitous presence, Germany is characterised by regional cable operators as well as 'city-carriers' present in specific districts.

Regulation

In Germany, NGA bitstream is considered to be the primary remedy to support further competition in fast broadband services. However, SLU and duct access have also been applied[142] in order to support FTTC/VDSL deployment by alternative operators.

Bitstream obligations on DT's NGA network (all technologies) were mandated in 2010[143]. Ethernet bitstream is required "at appropriate handover points in the backhaul network" including local access, while IP bitstream is also required to be made available

141 Take-up of NGA access in the Netherlands is currently limited

142 Duct access is available only in the 'feeder' segment of the network between the street cabinet and MDF site

143 The obligation for bitstream was mandated in the context of the former market 5 Article 7 letter C(2010)6215) The obligation covers access to all FTTx technologies and requires layer 2 (Ethernet) bitstream at 'appropriate handover points in the backhaul network' as well as layer 3 (IP bitstream with downstream handover locations.

at regional access locations. Thus far however, only IP bitstream has been made available, as the specifications for Ethernet bitstream have not yet been agreed.

A key aspect of the bitstream remedy is that BNetzA imposed an 'ex-post' price control, whereby BNetzA would not set prices in advance, but rather would assess them after they had been proposed,by applying a 'strict margin squeeze test'". In addition, BNetzA noted that it was open to proposals for 'risk sharing' pricing structures whereby lower rental charges could be secured through the payment of higher up-front fees. In 2012, BNetzA approved a new pricing model for IP VDSL bitstream proposed by DT (called the bitstream 'contingent' model'), which illustrates how the principle of 'risk sharing' is applied in practice (see Table 10[144]).

Table 10: Original and 2nd contingent models IP VDSL bitstream - Germany

	Standard offer – monthly fee	1st Contingent model - monthly fee	1st Contingent model – incl. upfront payment	2nd Contingent model - monthly fee	2nd Contingent model – incl. upfront payment
VDSL - Classic	25.32 €	12.88 €	18.03 €	13.38 €	18.53 €
VDSL 50 Mbit/s	26.04 €	13.60 €	18.75 €	14.10 €	19.25 €

Source: European Commission

Subsequently, separate commercial wholesale agreements were reached between DT and the largest access-based operators in Germany, Telefonica Deutschland[145] and Vodafone Germany[146]. For example, in the agreement reached between Telefonica Deutschland (TF) and DT[147] TF commits to migrating its LLU-based customers to the DT platform network by 2019 on the basis of an (unspecified) risk-sharing model, while DT commits to reaching 65% VDSL coverage by 2016. Although these agreements were commercial rather than based on regulated offers, BnetzA scrutinised the deals in order to ensure that they did not create a margin squeeze against upstream LLU products or affect competition in the market.

At the same time as encouraging the take-up of NGA bitstream (on a regulated and commercial basis – and at local and regional handover points), BNetzA has pursued policies which foster a move 'up the ladder' to FTTC/VDSL by increasing the gap

144 Whereas the standard monthly fee for 50Mbit/s VDSL bitstream from DT is €26.04, under the contingent model, this monthly fee could be reduced to €14,10 on payment of an upfront fee of €19.25. This pricing structure is available where access seekers commit to volumes equivalent to 3% of total lines in the national market or in relevant regions in which the access-seeker operates.
145 https://www.telekom.com/media/company/185240
146 http://www.vodafone.com/content/index/media/vodafone-group-releases/2013/germany_nextgen.html
147 See EC article 7 case DE/2014/1566

between charges for SLU and LLU through adjustments to asset lifetimes[148]. BNetzA also adopted policies concerning VDSL vectoring[149] which give an effective monopoly over downstream active wholesale products to the first operator installing vectoring, which could be viewed as incentivising a 'race to invest'.

Outcomes

The main impetus for NGA in Germany has come from cable networks, which now serve 60% of households with DOCSIS 3.0. On the other hand, DT's FTTC/VDSL deployment has been slower, reaching 39% of households by mid 2014. Take-up of NGA remains relatively low in Germany at around 18% of served households. Usage of bandwidth including online video is similarly low compared with countries such as the UK and Sweden

As regards competition on NGA, according to figures from DT[150], at the end of 2014, wholesale (IP bitstream/resale) lines accounted for 28.5% of all lines on the DT FTTx platform.

There has been some take-up of SLU especially in relation to rural areas, estimated at around 300,000 lines in 2013[151]. However, this compares with some 2.5m active FTTx lines on the DT platform at end 2014[152], of which a significant proportion were wholesaled. It is clear in this context that thus far the active bitstream remedy has been the predominant wholesale solution in Germany.

4.3.4.2 Italy

Italy is characterised by the absence of cable, and the presence of strong LLU-based competition.

Regulation

In the context of this environment in which historic infrastructure-based competition is largely absent, the Italian NRA AGCOM has imposed remedies across the ladder of investment for NGA as well as symmetric obligations concerning in-building wiring.

AGCOM notified market analyses covering NGA technologies in 2009[153] and proposed remedies in 2011[154]. In the market for 'wholesale physical infrastructure access'

148 Decision BK3c-13-002 in 2013 increased asset lifetimes for ducts and copper terminating segments, while reducing asset lifetimes for copper cables in the feeder segment

149 Vectoring regulatory order published 29/08/2013 http://www.bundesnetzagentur.de/DE/Service-Funktionen/Beschlusskammern/1BK-Geschaeftszeichen-Datenbank/BK3-GZ/2012/2012_100bis199/BK3-12-131/BK3-12-131_Regulierungsverfuegung.pdf;jsessionid=0C95F16A369BAA76727F44B5895E758C?__blob=publicationFile&v=4 , Amtsbl. 17/2013, Mtlg. 340, also BK3g-13/056 Amtsbl. 5/2014, Mtlg. 127.

150 DT Q4 2014 financial report – presentation https://www.telekom.com/ar-2014

151 BNetzA

152 DT presentation https://www.telekom.com/ar-2014

153 Cases IT/2009/0988, IT/2009/0989

(former market 4 of the EC Recommendation on Relevant Markets), AGCOM imposed access to SLU and ducts as well as dark fibre segments. In the downstream market for wholesale broadband access (market 5 of the EC Recommendation), AGCOM mandated VULA as well as ethernet bitstream at the parent and distant node. IP bitstream is also mandated.

A cost-orientation obligation was applied for VULA and bitstream access at the parent and distant feeder. AGCOM also signalled at the time of the 2011 decision that 'at a later stage' the price control and cost accounting obligations for VULA would only apply in areas where there is no infrastructure competition over fibre networks or where this is not likely to develop in the near future. These areas would be consulted upon together with the BU-LRIC cost model. In these areas, prices would instead be monitored on the basis of the non-discrimination principle to ensure the replicability of TI's retail offer. TI's offer for VULA and NGA bitstream was approved and finalised in March 2013[155].

A significant focus has also been given to subloop unbundling in Italy (SLU), which has been priced at two thirds of the rate for LLU[156].

In view of the gap between Italy's current NGA deployment and the targets set in the Digital Agenda for Europe, in March 2015, the Government approved the "Strategy for Italian Broadband and Digital Growth 2014-2020'[157], which includes €6bln (drawn from European development aid) to modernize network infrastructure and expand connectivity to rural areas. The strategy aims to bring speeds of 100Mbit/s to 85% of the population by 2020 as well as universal coverage of 30Mbit/s, with tenders for public subsidies taking into account the speed of roll-out rather than just the cost.

Outcomes

Outcomes for NGA in Italy are poor compared with other EU countries with coverage of NGA at just 33% in mid-2014. Part of the coverage represents a historic FTTH/B network in the Milan area. VDSL coverage from the incumbent and alternative operators reached 23% of households in mid-2014. Take-up of NGA in Italy as a proportion of served households has failed to keep pace with the expanding networks, and bandwidth usage is low, indicating potentially low demand for high speed services. A consultation is currently underway[158] to assess the investment plans of operators in order to identify areas which may benefit from the programme.

As regards, competition, thus far, take-up of VULA has been limited, with 7,440 lines reported by AGCOM at end 2014. However, there have been some developments in FTTC/VDSL infrastructure competition via SLU. SLU take-up reached around 150,000

154 Article 7 letter C(2011) 4763
155 Telecom Italia VULA Q&A http://www.wholesale.telecomitalia.com/faq-bitstream-nga-and-vula_en#742
156 This approach was subject to a phase II investigation and 2013 Recommendation by the European Commission – see article 7 C(2013) 5418 C(2013) 8862
157 http://www.governo.it/GovernoInforma/Documenti/piano_crescita_digitale.pdf
158 http://www.infratelitalia.it/categoria/news/consultazione-2015/

in 2014. Fastweb, an access-based competitor announced its intention to cover 7.5m homes with its own NGA network (primarily based on FTTC/VDSL) by the end of 2016[159], while Vodafone Italy has also announced NGA deployments on the basis of FTTC/VDSL.

4.3.4.3 Observations

Table 11: Market structures and outcomes in countries with full ladder

	NGA coverage	NGA take-up	Demand (usage)	Speeds	Price	Cable (DOCSIS)	% pop. urban	Choice (no. NGA offers)	HHI
Italy	33%	5%	Low	5.5	$70	0%	53%		49%
Germany	70%	19%	Low	8.7	$33	60%	57%	3+	36%

Source: WIK based on various sources as described earlier – 2014 except price (2012), choice – based on estimates

Germany and Italy have both adopted strategies which aim to offer a number of potential solutions on the ladder of investment to access seekers. However, the countries differ significantly in the degree of historic infrastructure-based competition eg through cable. This in turn may have influenced both NGA outcomes (Germany's performance owes a lot to cable) and competitive developments in NGA (the use of SLU in urban areas in Italy may have been supported by the absence of pre-existing cable).

The conduct of the respective incumbents and DT's willingness to engage in commercial wholesale deals (vs a reticence on the part of TI), may also have affected the relative success of bitstream in Germany compared with a low take-up for VULA in Italy.

In the absence of an impetus from cable or other infrastructure players, Italy's plans to make significant use of state aid may provide incentives to expand the NGA network. However, demand for bandwidth in Italy is currently low, and this may continue to limit the take-up of NGA services.

Unlike in France and Spain, operators in Italy and Germany have not been forced to climb the ladder of investment to participate in providing NGA services. A safety net exists in terms of bitstream/VULA – at least in theory. In practice, certain players have nonetheless climbed the ladder of investment, but to FTTC/VDSL rather than FTTH,

159 http://company.fastweb.it/wp-content/uploads/2015/02/2015_02_12_CS_FASTWEB_NGN-upgrade_ENG.pdf

potentially supported by a focus in both countries on the conditions (such as pricing) for SLU. It is not possible to say what might have been the outcomes in these countries if active access options had not been made available and/or if the focus of incentivising infrastructure-based competition had been on FTTH rather than FTTC.

4.3.5 Structural separation and service-based competition

At the other extreme from the North American approach of 'forbearance', Australia has adopted an approach in which NGA access is deployed by a state-owned monopoly, thereby relying on service competition to offer choice in the market.

Australia is characterised by limited cable coverage and some broadband competition on the basis of Local Loop Unbundling.

Regulation

The fixed NGA regulatory regime in Australia involves

- Taking fixed infrastructure into state control in the form of a structurally separated wholesale only Government-owned 'National Broadband Network' (NBN Co) including through the acquisition of existing HFC networks; and
- Migrating customers from other parallel access networks onto the NBN Co thereby creating a monopoly access network; and
- The injection of a significant level of state funds in the form of equity into the NBN Co.

Access to the NBN Co network is by means of a layer 2 Ethernet bitstream wholesale product offered with regional handover. Pricing and non-price terms and conditions for access to the NBN Co is set on the basis of a 'Special Access Undertaking' (SAU)[160], which was initiated in December 2013 and is set to expire in 2040. The aim of this approach is to provide long-term certainty from an investment perspective. However, certain aspects have shorter timeframes. For example, the initial 'NBN offers' and methods of adapting prices run until June 2023. During this period prices are based on actual costs (set at levels similar to current prices for copper and HFC services) and annual price increases are limited to CPI minus 1.5%. Thereafter, costs may be based on forecast costs.

Although originally, the Government's strategy was to favour a FTTP deployment (with wireless technologies in the hardest to reach areas). After a change of Government in 2013, the strategy shifted towards an optimised 'multi-technology mix' with the policy

160 NBN Co Special Access Undertaking Dec 2013 https://www.accc.gov.au/system/files/ACCC%20Final%20Decision%20on%20the%20Special%20Access%20Undertaking%20lodged%20by%20NBN%20Co%20on%2019%20November%202013.pdf

objective of offering at least 25Mbit/s to all permises and at least 50Mbit/s to 90% of fixed line premises as soon as possible[161]. The current target is for the NBN Co to pass around 12m homes and businesses by 2020[162].

In support of its decision to opt for a technology mix, the Government commissioned a cost benefit analysis[163], which concluded that this scenario (including roll-out of FTTP to 15% premises) had a net cost of AUS$6bln relative to unsubsidised roll-out – largely reflecting the net costs of delivering higher speeds to otherwise uneconomic rural and remote areas via fixed wireless and satellite. By comparison, FTTP was considered to have a relative net cost of AUS$22bln compared with unsubsidised roll-out.

In December 2014, the NBN Co reached agreements with Optus and Telstra to take ownership of many parts of their copper and HFC cable networks and use this infrastructure in the NBN[164], as part of the multi-technology strategy. These arrangements replaced previous plans to shut down legacy networks with a migration to FTTP.

Outcomes and observations

Table 12: Market structures and outcomes in countries with structural separation

	NGA coverage	NGA take-up	Demand (usage)	Speeds	Price	Cable (DOCSIS)	% pop. urban	Choice (no. NGA offers)	HHI
Australia	23%	18%	Low	6.9	$52	16%	58%	3+	48%

Source: WIK based on various sources as described earlier – 2014 except price (2012), HHI (2013). Choice based on estimates

As of end 2014, 718,000 households had been passed while the number of households and businesses with active service based on the NBN Co network was 309,000 (43% of

161 Statement of Government expectations http://www.communications.gov.au/__data/assets/pdf_file/0014/221162/SOE_Shareholder_Minister_letter.pdf April 2014

162 Government press release Dec 2014 http://www.minister.communications.gov.au/malcolm_turnbull/news/nbn_co_and_telstra_sign_revised_definitive_agreements#.VUN342ccTIU

163 NBN Co model cost benefit analysis http://www.communications.gov.au/__data/assets/pdf_file/0003/243039/Cost-Benefit_Analysis_-_FINAL_-_For_Publication.pdf

164 Government press release http://www.minister.communications.gov.au/malcolm_turnbull/news/nbn_co_and_telstra_sign_revised_definitive_agreements#.VUN342ccTIU http://www.minister.communications.gov.au/malcolm_turnbull/news/nbn_co_and_optus_strike_deal_for_faster_nbn_rollout#.VUN5lWccTIU

served premises)[165]. However, as the Government Regulation supporting migration to the NBN Co was approved only in January 2015, coverage and take-up figures for the NBN at the end of 2014 do not yet reflect the consolidated results.

It is notable that, thus far, NGA outcomes in Australia have not compared well with other countries. NGA coverage overall stood at just 23% households at mid-2014[166]. The majority (16%) of these connections came from the yet-to-be-consolidated commercial cable network, while data from the OECD (2008) suggests that a further 8% of cable connections had not been converted to DOCSIS 3.0, potentially as a result of uncertainty during the transition to the NBNCo. Take-up of NGA services was also low overall at 18% of served households.

That said, given that decisions on the final form of the NBN Co, regulatory conditions and migration agreements are recent, it is not clear whether this picture will change when these arrangements are fully implemented.

A further question concerns the level of NGA coverage that might have been expected in the absence of this action, given low levels of cable and other infrastructure-based competition. Australia also suffers from poor demand-side conditions, which further reduces the NGA business case (although it is to be seen how this might be affected by the Netflix launch).

4.3.6 Korea[167]

The development of broadband in South Korea took a different path from that in most of the other countries considered, with a strong focus on public initiatives and targets from the very earliest phase of deployment.

Policy initiatives

Ahn (2012)[168] reports that as early as 1994, the Korean Government decided that "a national fibre optic network was crucial for economic growth. It therefore supported a pilot project with US$1bln in grants to build a backbone to connect government and public facilities." Subsequently, the Korea Information Infrastructure (KII) fibre optic networking plan stimulated public and private actors to deploy broadband and NGA

165 Government press release http://www.minister.communications.gov.au/malcolm_turnbull/news/nbn_co_and_telstra_sign_revised_definitive_agreements#.VUN6iGccTIU

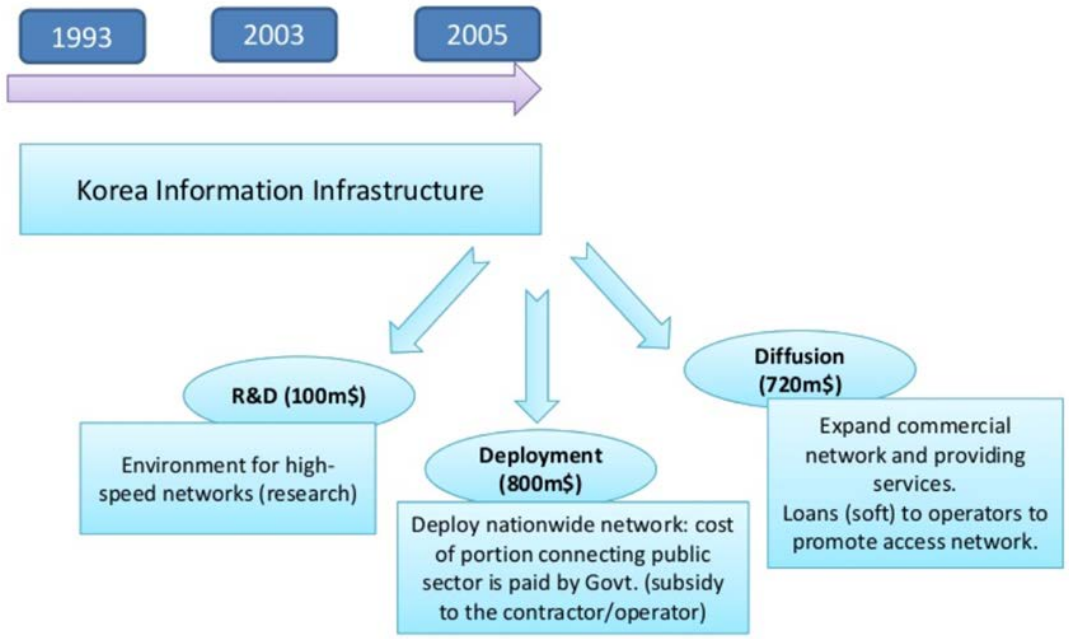
166 IDATE FTTx watch

167 This summary draws on information and data from the Ovum Consulting report for the World Bank "Broadband Policy Development in the Republic of Korea", October 2009, the report on Korea by ANACOM http://www.anacom.pt/render.jsp?categoryId=340674#.VUE1iSGqqkp, and WIK/TNO/RAND (2013) study for the European Parliament Entertainment X.0 to boost broadband development .

168 Ahn, J.J. (2012a): Broadband Policy in South Korea - The Effect of Government Regulation on Internet; slide presentation at PTC 2012; available at: http://www.ptc.org/ptc12/images/papers/upload/PTC12_Broadband%20Policy%20Wkshop_Jamie%20Ahn.pdf.

infrastructure more widely including through soft loans to support deployment in the access network[169].

Figure 27: Korea Information Infrastructure



Source: Scorca (2012)

The Government also focused on ubiquitous access in its e-Korea (2002-2006), u-Korea (2006-2010) and Smart Korea (2010-2014) IT Plans, promoting the the establishment of Internet take-up, e-education at schools, and the provisioning of free internet access at community centers in low income areas and in remote areas.

In 2009, the Korean government established the 'Plan for Developing and Promoting Giga-Internet' to improve communications infrastructure (Giga Korea plan (2013-2020)). This plan aimed at upgrading bandwidth to 10 Gbps for the fixed network and 1Gbps for the mobile network.[170] Meanwhile, the Giga Internet pilot project aimed to bring gigabit Internet connection to households by 2013 by leveraging state support to generate private sector investments.[171]

169 Scorca, L. (2012): The Korean strategy to promote NGAN: Any lesson for Europe?, presentation at Create-Net and EAI; Riva del Garda; October 4; available at: http://de.slideshare.net/scorecard/korean-strategy-to-foster-broadband-ngan.

170 Park (2013).

171 The government plans to replace 70% of the circuit-switched network with an IP network by 2013 by providing 1.3 trillion Korean won on the project and plans to generate around 32.1 trillion won from the private sector in investment (Ahn (2012b)).

NGA deployment history

Broadband was initially deployed on cable networks by the state-owned companies Powercom[172] and KT[173], which were initially prohibited from offering retail services.

DSL was subsequently introduced both by the incumbent KT and by competitors in a competitive market largely based on leasing backhaul to large apartment buildings within which services were provided on the basis of existing in-building copper wiring and DSLAM equipment. Whilst local loop unbundling was introduced in 2002, take-up has been minimal. The Government decided that fibre cables deployed after 2004 should not be subject to unbundling requirements in order to promote further investment in fibre[174]. NGA competition has therefore largely been on the basis of infrastructure competition.

VDSL was introduced at a relatively early stage in 2002, facilitated by dense housing and short copper loops which meant that it could be installed within relatively little additional investment.

Although customers benefited from significant infrastructure competition in the early 2000s, market developments suggest that the investments prior to that period may not have been economically sustainable. The third and fourth largest players, Thrunet[175] and Onse[176] both went into receivership in 2003, whilst second placed Hanaro[177] received an emergency cash injection, and the incumbent KT also reported a loss in Q4 2003.

Despite the crisis, a few years afterwards, a race towards fibre was triggered, with the offer of 100 Mbps speeds in 2005 by cable company Powercom. The incumbent KT responded with the launch of FTTH-based services, and SK Broadband (previously known as Hanaro), remained as a major infrastructure-based player in a consolidated market. In this environment of intense infrastructure-based competition, competition on speeds has continued to flourish with the showcase in 2014 by SK Broadband of 10GBit/s broadband services[178], paving the way to achieve the Government's Giga-Internet targets.

Observations

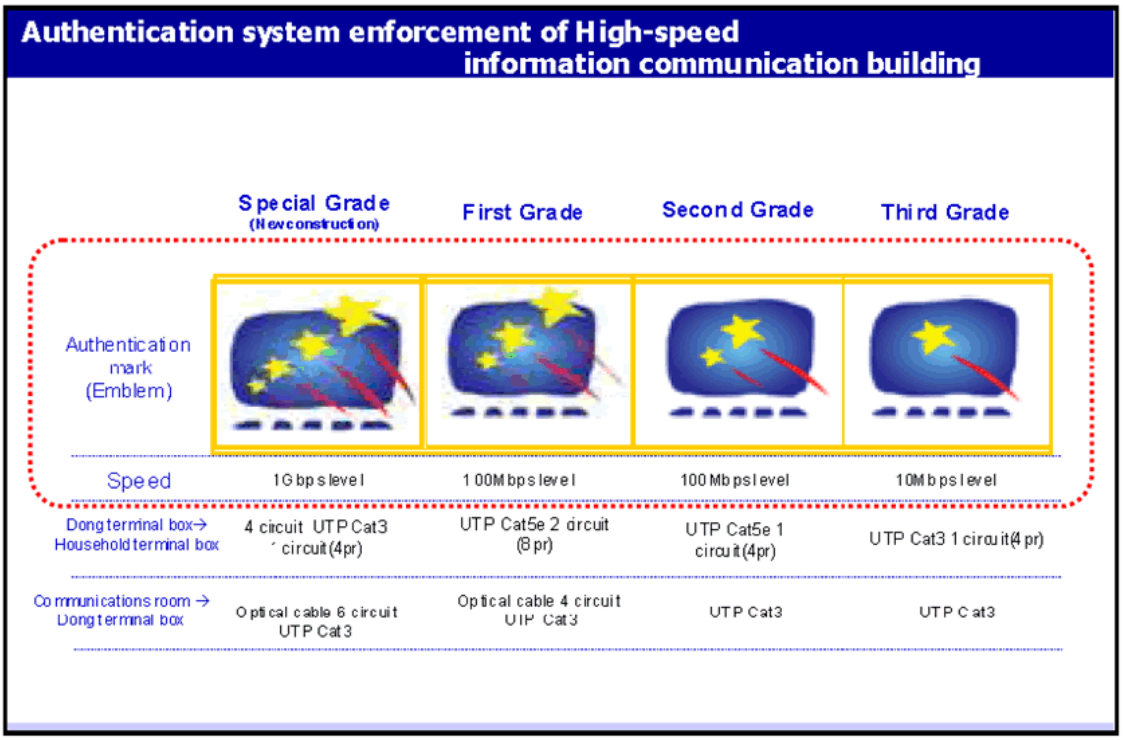
The positive outcomes in Korea, which benefits from a high coverage, use and take-up of NGA alongside low prices appear largely to have been the result of a combination of positive supply and demand-side factors, supported by state interventions.

172 LG Powercom Corporation
173 KT http://www.kt.com/eng/main.jsp
174 OECD Review of Regulatory Reform – Korea 2007 https://books.google.co.uk/books?id=gcPVAgAAQBAJ&pg=PA146&lpg=PA146&dq=Korea+fibre+unbundling&source=bl&ots=J5dbm7DeGQ&sig=0o8TqbJ0iw_rScuNq3bu_LvLfsE&hl=en&sa=X&ei=_7hlVZSeBsHBUqWVgPAO&ved=0CDcQ6AEwAw#v=onepage&q=Korea%20fibre%20unbundling&f=false
175 Korea Thrunet Co, Ltd
176 Onse Telecom Corporation Korea
177 Hanaro Korea http://hanaro.kaeri.re.kr/main.html
178 SK Broadband to Offer 10Gbps Internet http://www.businesskorea.co.kr/article/6789/100x-faster-internet-sk-broadband-offer-10-gbps-internet

Positive supply-side aspects include intense infrastructure-based competition, supported by a favourable environment of dense housing. Since 2009, KT was also obliged to grant duct access, which may have further supported infrastructure-based competition. Meanwhile, state interventions including pilot projects, financing and investments by state-owned companies may have helped to 'derisk' investments in fast infrastructure, compared with countries which did not pursue these policies.

On the demand-side, a bandwidth-related certification system for large residential and commercial buildings has existed since 1999[179], which gave visibility to end-users of the availability of high bandwidth connectivity. In a presentation by Corning, a supplier of fibre-option infrastructure, they state that 'Korean builders have been using fibre technology as a selling tool in consumer real estate marketing for some time[180].

Figure 28: Certification system for buildings in South Korea



Source: ONA (2009)

In addition, and importantly, South Korea has by some measure the highest usage of bandwidth per subscriber, and was an early adopter of bandwidth-intensive peer-to-peer file sharing as well as online gaming. In this context 'positive' NGA outcomes may

179 The Korean Cyber Building Certificate System"
180 http://www.corning.com/docs/opticalfiber/r9575.pdf

not always have been economically and socially beneficial. For example, various sources cite 'gaming addiction' as a challenge in South Korea[181].

4.3.7 Japan

Policy and regulation

Japan has a history of both very early FTTH deployment (from the incumbent and utilities), and relatively stringent unbundling regulation on the incumbent, which however was little used in the initial phase potentially due to the network architecture and design of the obligation which effectively required unbundling 8 lines at once[182].

An early stimulus for FTTH deployment was given through financial and tax benefits intended to promote fibre deployment between 1991-2006[183] entailing a reduction of local and corporation taxes for operators investing in advanced network facilities[184]. As a result, coverage had already reached 10% of the access network in 1994 – and is now near-ubiquitous today. Alongside the incumbent NTT's deployment, infrastructure-based competition may have been supported by the availability of access to sewers in Tokyo[185]. Access to ducts from buidlings to the nearest manhole as well as to utility poles are also apparently required[186]. However, it is unclear the extent to which this has been used in practice.

Local Loop Unbundling regulation was applied on incumbent NTT East and West since 1997 and from 2001 was applied to fibre network operators whose market share was above 50%[187]. Subsequently in 2011, the Government mandated a form of functional separation on NTT East and West, "in order to ensure fair competition between telecommunications carriers installing 'category 1' designated telecommunications facilities and other telecommunications carriers"[188]

Outcomes

181 See for example Jungmihn Jamie Ahn http://www.ptc.org/ptc12/images/papers/upload/PTC12_Broadband%20Policy%20Wkshop_Jamie%20Ahn.pdf - presentation to Pacific Telecommunications Council

182 Katagiri, Y. (2008), 'Recent Regulatory Reform in Japanese Telecommunications'; slide presentation at the International WIK Conference 'Review of the European Framework for Electronic Communications', Bonn, Germany; April 24 – 25; Taniwaki, Y. (2008): "Broadband Competition Policy in Japan", presentation by Ministry of Internal Affairs & Communications (MIC), March; .

183 Provisional Measures Law for Telecommunications Infrastructure Improvement電気通信基盤充実臨時措置法

184 Presentation to ITS Conference in Beijing 13/06/2006 – Evolution of IP Network and Convergence in Japan – impact of hard law and soft law – members of the Research Institute of Telecommunications and Economics, Keio University, Obirin University

185 OECD 2008 – Public rights of way for fibre deployment to the home http://www.oecd.org/internet/ieconomy/40390753.pdf

186 Outline of the Rules for co-location in Japan Asia-Pacific Economic Co-operation council submission April 2013 http://mddb.apec.org/Documents/2013/TEL/TEL47-LSG/13_tel47_lsg_014.pdf

187 Presentation to ITS Conference in Beijing 13/06/2006 – Evolution of IP Network and Convergence in Japan – impact of hard law and soft law

188 Revised Telecommunications Business Act and the Act on Nippon Telegraph and Telephone Corporation

The Japanese Ministry responsible for Communications reported that at the end of March 2014, NTT East and West held approximately 71% share of FTTH retail lines, with the other FTTH-based services provided by the affiliates of power companies, KDDI, UCOM and others. NTT East/West also maintained a 78% share of subscriptions on its platform as a whole, implying that around 7% of connections were on the basis of wholesale access at that time[189].

Japan performs strongly on a range of NGA outcome measures, which is unsurprising given its long history of FTTH deployment. In addition to tax-breaks, supporting factors may have been aerial deployment, a dense urban population, sewer access in Tokyo (all of which reduce costs) and the resulting infrastructure-based competition from utility companies. However, interestingly, demand-side drivers in Japan are considerably weaker than might be expected, with bandwidth usage falling far below that of Korea. This may also be reflected in the fact that, notwithstanding the long-standing availability of fibre, as of mid-2014, 62% of served households in Japan subscribed to NGA broadband compared with a very high 78% in South Korea.

4.4 Summary of policy and regulatory approaches

A summary of policy and regulatory approaches is shown in Table 13. It reveals that regulatory intervention on NGA appears to have been lightest in the US, Canada and Korea, while public financial incentives from an early stage played a role in stimulating early NGA deployments in Korea as well as Japan. On the other end of the scale, the regime in Australia is by far the most interventionist, both in terms of public support and the level of regulation. Approaches within Europe to NGA feature regulation which lies somewhere between the extremes, but vary as regards which rungs of the broadband ladder of investment receive most focus. France and Spain have focused on deep passive access remedies to encourage new entrants to move 'up the ladder' to invest in their own FTTH/B infrastructure. Meanwhile in the Netherlands, Sweden and the UK, remedies have focused on NGA regulation at a 'local access' level, broadly equivalent to competition via local loop unbundling. Italy and Germany meanwhile have focused remedies for NGA at various levels of the ladder of investment from SLU through to regional bitstream. Although initially the Netherlands and Sweden adopted cost-oriented price controls on NGA access, there has been a trend towards more flexible pricing approaches to NGA access across Europe. Australia is the only country studied which has implemented full structural separation of the main provider of NGA access. Functional separation, a separation arrangement which falls short of structural separation, has been implemented through binding obligations and/or commitments in the UK (in 2005) and in Japan (2011). A weaker form of operational separation exists in Italy, while voluntary separated processes exist in Sweden and the Netherlands.

189 Source: October 2014 presentation 'Telecommunications Policy in Japan' by Koichi Fujiname, Japanese Ministry of Internal Affairs and Communications http://www.dekyo.or.jp/soudan/antispam/PDF/LAP10_Japan_MIC01.pdf. The main users of wholesale access are Softbank and KDDI

Examining a range of outcomes (including price, usage, speed and choice alongside NGA coverage and take-up) according to the regulatory approaches adopted, highlights that the best outcomes on average have been seen in countries with early public interventions (Japan and Korea), and those focusing on 'local access' regulatory strategies (Sweden, Netherlands and UK), while the worst outcomes are seen in the passive access regimes (France and Spain) and Australia which has pursued a system focused on structural separation and service competition. The countries in which regulatory forbearance have been pursued (Canada and the US) are relatively strong on coverage and take-up, but weak in other respects. It would be premature to draw conclusions from this picture as regards the impact regulation has had on consumer outcomes. Our earlier analysis suggests that other factors such as cable, urban density and demand factors may play a greater role. However, regulatory regimes are likely to have played a significant role in the degree of choice available and the geographic scope of that choice. It remains to be seen how choice may impact market outcomes as NGA competition becomes more established.

Table 13: Summary of policy and regulatory approaches

	Public Policy			Economic regulation and infrastructure access		
	NGA availability targets	State aid (since 2003)	Tax breaks/other financial incentives	Deep passive access focus (duct, in-building wiring, SLU, terminating segment)	Wholesale access to NGA (current conditions)	Separation
France	Near universal 100M 2022	30		Duct access + mutualisation terminating segment	No regulation of wholesale fibre access under SMP rules	
Germany		84		SLU focus, duct access in feeder segment (for FTTC/VDSL)	Mandated (layer 2 and 3 bitstream), but only IP effective - ex post price controls	
Italy		100 to 2014 (€6bln planned)		SLU, SMP duct access obligations	Cost-oriented VULA, except where infrastructure competition emerges	A form of operational separation - less detailed than UK
Netherlands		3		Cables directly buried	Historically cost-based fibre unbundling, VULA commercial agreement possible	Reggefiber historically offer access on a quasi-separated basis
Spain		49		Duct access obligations, in-buidling wiring	No wholesale regulation of speeds >30Mbit/s, but proposals to change outside urban areas	
Sweden	Near universal 100M 2022	39		No priority - under symmetric measures	Historically cost-oriented fibre unbundling - price forebearance from Dec 2016	Voluntary operational separation by incumbent - not recognised as 'FS' by PTS
UK	Near-universal 24M 2017	96		Duct access available for mass-market, not extensively used	Pricing Flexibility for VULA subject to margin squeeze test	Functional separation on the basis of legally binding 'commitments'
South Korea	>100M 2012			Duct access obligation 2009, usage not known	None significant	
Japan	90% ultraspeed FTTH coverage by 2011			Duct access obligation, usage not known	Fibre unbundling mandated, some but not widespread usage	Functional separation 2011
US	~85% homes 100M by 2020			Mandated but no ref offer usage not known	None	
Canada	Universal 5M by 2016			Long-standing reference offer - also access to utility infrastructure	None currently	
Australia	90% at least 50M asap			Long-standing with reference offer (Telstra)	Cost-oriented ethernet bitstream	Structural separation

Source: WIK

Table 14: Comparing regulation with market structures and outcomes

	NGA HH coverage (IDATE 2014)	NGA take-up % HH (IDATE 2014)	Demand (usage) Cisco VNI (2014)	Ave. download Speeds Akamai (2014)	Price (High 30M basket OECD (2012))	Cable (DOCSIS) % HH IDATE (2014)	% pop. Urban (OECD)	Choice (no. NGA offers)	BB HHI (EC, estimates)
NGA regulatory forbearance									
Canada	90%	47%	Medium	10.3	$64	90%	56%	Limited	49%
US	90%	61%	High	11.5	$73	81%	42%	Limited	45%
Deep passive access (no active access)									
France	40%	20%	Low	6.9	$35	10%	35%	3-4 (dense areas)	39%
Spain	68%	32%	Low	7.8	$66	55%	48%	3-4 (dense areas)	32%
Local access NGA focus									
NL	99%	27%		14	$37	98%	85%	3+	35%
Sweden	61%	70%	Medium	14.1	$41	41%	22%	3+	27%
UK	76%	33%	Medium	10.7	$27	49%	70%	3+	29%
Full ladder (passive + active) for NGA									
Italy	33%	5%	Low	5.5	$70	0%	53%		49%
Germany	70%	19%	Low	8.7	$33	60%	57%	3+	36%
Structural separation									
Australia	23%	18%	Low	6.9	$52	16%	58%	3+	48%
	As previous	As previous	As previous	Colours based on ranking top 4=green etc	Colours based on ranking top 4=green etc	As previous		Light green tentative (geographic limitation?)	

Source: WIK based on various sources

5 Does regulation impede investment?

It has been argued in the context of several studies and academic papers that investment in fixed broadband – and in particular upgrades to next generation access networks - could be deterred through regulated access, especially if at cost-oriented rates. The US, Canada and Korea are often cited as examples of countries in which regulatory forebearance has contributed to positive NGA outcomes[190]. There is also an extensive literature on the effect of copper unbundling policies on broadband outcomes and investment, yielding mixed perspectives[191].

In this section, we examine whether there is a clear link between regulatory approaches (and in particular forbeance) and nationwide investment and revenues.

5.1 Methodology

In order to test this theory, we examined whether there was any clear relationship between two measures of 'investment' and various measures of regulation and market structure.

Period for the analysis

Our analysis uses data over a 10 year period up to 2011. The period for analysis was limited by the availability of consistent per country financial data for fixed revenues and capex. Such data can be derived from the OECD Communications Outlook. However, the last available edition was published in August 2013, covering financial data up to 2011.

The benefit of using the OECD time series is that it covers an extensive period and reflects revenues and investments across the whole market, rather than those of specific operators. The period in question was also a time during which standard broadband evolved, LLU regulation was introduced and became operational[192], and subsequently NGA was introduced under different regulatory models. The period from

190 For example, BCG (2013) Reforming Europe's Telecoms Regulation to Enable the Digital Single market https://www.etno.eu/datas/publications/studies/BCG_ETNO_REPORT_2013.pdf (for ETNO) notes that "while Europe was once a leader in the technologies that comprise the backbone of the digital economy, many markets in Asia and America now enjoy fiber access penetration that is up to 20 times higher and LTE penetration that is as much as 35 times greater than Europe's." In order to recover Europe's position, the study advocates a move from sector-specific regulated to a harmonised and substantially reduced pan-European regulatory approach, relying mostly on established competition law".

191 Lee, Marcu and Lee (2011) have found unbundling and service-based competition to foster broadband uptake, Denni and Gruber (2007), Distaso, Lupi and Maneti (2006), Cava-Ferreruela and Alabau-Munoz (2006) and Höffler (2007) found only small or insignificant effects. Wallsten and Hausladen (2009), Bouckaert, van Dijk and Verboven (2010) and Briglauer, Ecker and Gugler (2013) have found that facilitating intra-network competition through access regulation negatively affects broadband penetration as it reduces incentives for broadband investment.

192 For example, LLU implementation in Europe accelerated following the adoption of the EU ULL Regulation of 2000

2002-2011 therefore reflects a period of technological and regulatory 'change', allowing an analysis as to the reasons for variations between countries, and the implications of unbundling policy in particular, which was well-established during this period.

A disadvantage associated with the lack of more recent data, is that we are not able to analyse at this stage the longer term effects on fixed investment of NGA regulation, which was introduced in many European countries around 2010, and is yet to be fully implemented in several cases. Because many (although not all) of the early NGA deployments were associated with cable, we may also not be able to gauge the full effect of LLU regulation (which sets an expectation as regards regulatory approach) and NGA regulation on investments in FTTx made by regulated operators.

A further edition of the Communications Oulook is expected later in 2015 and will cover data up to 2013. An update to the analysis could be performed at this stage, which should enable these points to be addressed.

Measures of investment

As one measure of investment we took fixed capex as a proportion of fixed revenues, based on time series data from 1997-2011 gathered by the OECD[193]. We assessed firstly average capex levels between 2002-2011 (excluding prior years to avoid impact from the 'dot com boom and bust'), and capex levels in 2011. The main reason for taking an average value was to reflect capex cycles and the tendency for investments in NGA to ramp up over time. We used nationwide capex and revenue data in order to capture the collective impact of competitive and regulatory factors on investments by all parties in the market. We calculated fixed capex and revenues wherever a data split was available. However, for four countries[194] capex splits were not available, and total capex/revenue figures are therefore used (including mobile). We also took fixed capex per capita (average 2002-2011), as an absolute capex indicator in order to assess whether capex was influenced by revenues – and whether in turn revenues were affected by regulation. For the four countries where capex splits were not available, we took a ratio for capex reflecting the level of fixed revenues as a proportion of the total.

As another – more consumer-oriented - measure which is perceived to be linked to investment, we looked at NGA coverage (all technologies enabling speeds >30Mbit/s) as well as FTTH/B coverage (typically enabling speeds of 100Mbit/s or above) in 2011 as assessed by IDATE.

Measures of regulation

As a proxy for the relative strength of regulation, we took LLU as % fixed broadband lines on the one hand and the strength of NGA access regulation on the other.

193 OECD (2013) Communications Outlook
194 Netherlands, Japan, Australia and France

In the absence of significant take-up of NGA-based access (and comprehensive consistent data across the surveyed countries), we have based the assessment of NGA regulation on a qualitative assessment as to whether NGA access regulation was mandated, and if so, whether at cost-oriented charges (see summary table in section 4.4). In this context, forebearance from NGA regulation is marked as a 0, while full cost-oriented regulation of NGA at the time of assessment (2011) is marked as a 1. NGA local or regional access with flexible pricing (subject to margin squeeze tests) is scored at 0.5, while the mutualisation of the terminating segment (roughly equivalent to a subloop) in France is assessed at 0.25.

In time, once comprehensive data is made available on NGA-based wholesale access take-up, this could be used as an alternative measure of the strength of NGA-based regulation in practice.

Measures of competition

As measures of competition, we looked at two measures relating to the strength of cable as a competitive force – cable coverage, and cable lines as proportion of broadband connections. Lastly we looked at broadband HHI as a measure of market structure. Inherently, this measure would include both infrastructure-based and access-based competition. The OECD was used for cable data, whilst the main source of the HHI data was the European Commission Digital Agenda Scoreboard, complemented by direct calculations based on published market shares.

5.2 Results

The resulting data is shown in Table 15.

Table 15: Data on investment and potential influencing factors (competition and regulation)[195]

	Investment			NGA outcomes		Revenues	Regulation		Infrastructure competition		Market structure
	Fixed* Capex % revenues OECD 2011	Fixed* capex % rev (2002-2011) OECD average	Fixed capex per capita (2002-2011) OECD average	NGA coverage IDATE (2011)	FTTH/B coverage IDATE (2011)	Fixed revenues per population (2002-2011) OECD average	LLU (% broadband connections) OECD 2011	Strength NGA access regulation	Cable coverage - OECD (2008**)	Cable % broadband lines OECD (2012)	Broadband HHI (2013) EC***
Canada	30%	23%	133	58%	3%	587	2%	0	93%	56%	49%
Germany	11%	10%	63	61%	2%	632	12%	0.5	58%	14%	36%
Italy	18%	17%	78	11%	11%	454	37%	0.75	0%	0%	49%
Korea	11%	13%	61	93%	93%	457	0%	0	57%	28%	29%
Spain	16%	12%	90	42%	3%	729	25%	0	60%	18%	32%
Sweden	17%	22%	94	53%	36%	437	20%	1	37%	19%	27%
United Kingdom	16%	14%	99	58%	0%	707	38%	0.5	49%	20%	29%
United States	15%	15%	148	78%	18%	984	8%	0	96%	57%	45%
Netherlands	21%	18%	124	97%	10%	688	11%	1	92%	44%	35%
Japan	11%	15%	47	89%	89%	323	0%	0.5	38%	17%	38%
Australia	17%	18%	124	14%	1%	706	20%	1	24%	16%	48%
France	16%	13%	74	23%	18%	570	45%	0.25	28%	6%	39%

Source: WIK based on various sources as described

The resulting relationships are shown in Table 16. Cells highlighted in yellow show weak correlation coefficients of (+-)0.5 or above, while strong correlation coefficients greater than (+-)0.7 are marked in green.

Table 16: Relationships between fixed investment, competition and regulation

	NGA coverage 2011 (IDATE)	FTTH/B covergae 2011 (IDATE)	Ave rev per cap (2002-2011)	LLU (% broadband connections) OECD 2011	Strength NGA access regulation	Cable coverage - OECD (2008**)	Cable % broadband lines OECD (2012)	Broadband HHI (2013) EC***
Ave. capex % rev	-0.07	-0.11	-0.16	-0.17	0.34	0.12	0.39	0.30
2011 capex % rev	-0.16	-0.49	0.14	-0.02	0.01	0.35	0.50	0.46
Ave. cap per cap	-0.02	-0.57	0.74	-0.09	0.02			0.41
Ave. rev per cap				0.08	-0.24			0.20
NGA coverage		0.54	-0.01	-0.73	-0.21	0.68	0.59	-0.42
FTTH/B coverage			-0.61	-0.50	-0.17	-0.10	-0.05	-0.33
Cable coverage		-0.10	0.55	-0.55	-0.49		0.92	-0.04
Cable take-up			0.50	-0.63	-0.35	0.92		0.17

. Source: WIK based on various sources as described

5.3 Observations

A first observation is that – at least across the countries observed, there are few clear-cut linkages suggesting that regulation, cable or other forms of competition affect capex. An exception is a weak positive link between cable broadband lines and 2011 capex. It would be interesting to observe later data, once available from the OECD, to see if this

195 * Capex and revenues for NL, Japan, Australia and France are not split between fixed and mobile
** except France, US, Netherlands (2007) and Korea (2003), Japan (2014 - IDATE)
*** except Canada, US, Australia, where estimates made based on squared market share of 2011 LLU, cable and incumbent - on the assumption of platform duopoly, Japan (calculated on basis of 2012 NTT data http://www.slideshare.net/ieeesa/case-studies-from-japan), Korea on the basis of market shares Point Topic Q4 2013 http://point-topic.com/free-analysis/south-korea-broadband-overview/

weak link might signal the start – at least in some countries – of an impetus to invest in FTTx, potentially supported by cable competition. In both the average and single year measure, the effect on capex of the proportion of cable broadband lines (a measure of the retail strength of cable) is greater than HHI overall.

It is surprising to note that there does not seem to be a straightforward link between fixed capex and NGA coverage. Moreover, surprisingly, FTTH/B coverage is even weakly associated with less capex. One hypothesis might be that at 2011, a high proportion of NGA coverage (even more so than today) was due to cable upgrades to Docsis 3.0, which is a particularly cost-effective means to supply fast broadband, as noted in Hatonen (2011) for the EIB[196]. Later data during a period of more significant FTTx (including FTTH/B) deployment might help to reveal if this is a reason. Another possible reason for the absence of a clear link might be that investors expect companies to remain within a given capex ratio, and therefore NGA investments might – for a period – replace other investments that would otherwise have taken place.

Looking to potential drivers of NGA coverage, as expected (and as noted in section 3.1.1) cable coverage is a clear positive factor. However, it is striking to see that there is a strong negative correlation between the proportion of LLU lines (as % broadband) and NGA coverage. On first sight this might seem to raise the potential that LLU regulation may have undermined NGA deployment.

However, an explanation can be seen in that cable coverage and penetration – which are a clear drivers of NGA coverage (as well as FTTH/B coverage) – are negatively associated with LLU. Intuitively this makes sense in a number of ways. In countries with high – or even ubiquitous cable coverage and strong cable take-up, as is the case in the US, Canada and the Netherlands, there may be less economic space to allow the success of LLU-based competitors. Therefore, even when regulation is mandated in these cases, often the take-up of LLU is more limited. Furthermore the presence of ubiquitous cable might affect the regulator's approach towards access-based competition, resulting in a less interventionist approach (eg as seen in the US and Canada) than in cases where there is little or no pre-existing infrastructure-based competition, as is the case in France, Australia and Italy – all of which have low or no cable and low NGA coverage. Another reason may be that as standard broadband migrates to NGA (including FTTH), the number of access lines based on standard broadband technology (LLU) would naturally be expected to fall.

We therefore cannot definitely conclude on the basis of this analysis that unbundling itself affects NGA deployment, but rather that unbundling may be especially strong in cases where other forms of (infrastructure) competition are weak or non-existent and/or where widespread migration from standard broadband to NGA has not yet occured. In

196 http://www.eib.org/attachments/efs/eibpapers/eibpapers_2011_v16_n02_en.pdf. See also WIK (2012) Rethinking the Digital Agenda for Europe: a richer choice of technologies http://www.libertyglobal.com/PDF/public-policy/LGI-report-Re-thinking-the-Digital-Agenda-for-Europe.pdf

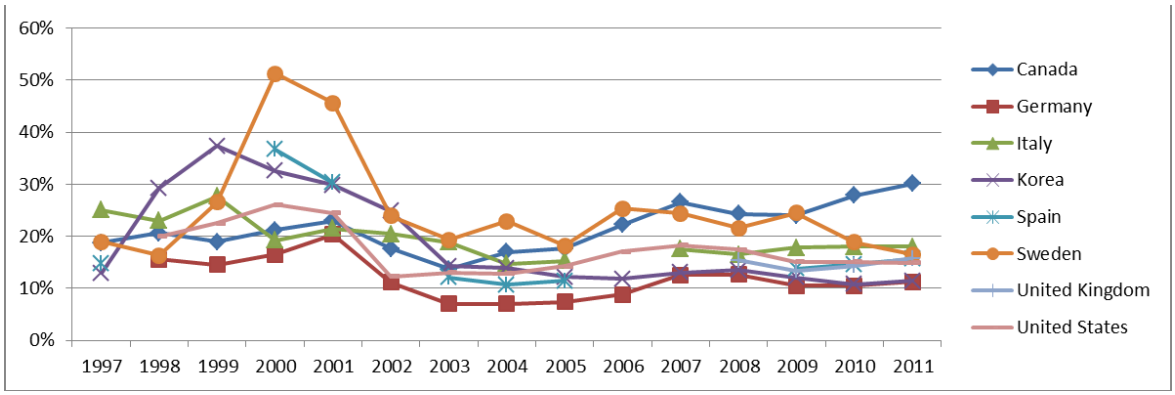
turn, one could conclude that, although in theory access-based competition might support take-up[197], LLU does not replace the role of infrastructure-based competitors such as cable or other independent investors in driving NGA deployment.

It is interesting to note that the strength of NGA access regulation does not seem to directly affect investment or NGA coverage. However, there seems to be some (albeit weak) negative relationship between the strength of NGA access regulation and cable coverage. Again this makes intuitive sense on the basis that regulation of the incumbent's NGA network might be weaker in cases where there are competitive constraints from cable. Analysis based on more recent data sets should help to confirm whether NGA regulation has had any effects over time.

5.4 Is Europe falling behind on investment?

The data on investment also allows us to make some observations concerning the UK and Europe's position relative to the US and Asia. Figure 29 shows trends in capex as a proportion of revenues for those countries for which fixed data could be isolated.

Figure 29: Fixed capex % revenues



Source: WIK based on OECD Communications Outlook 2013

It can be seen from the data that capex follows trends over time, and can be affected by external circumstances such as the dot com boom and bust in the financial markets around the turn of the century.

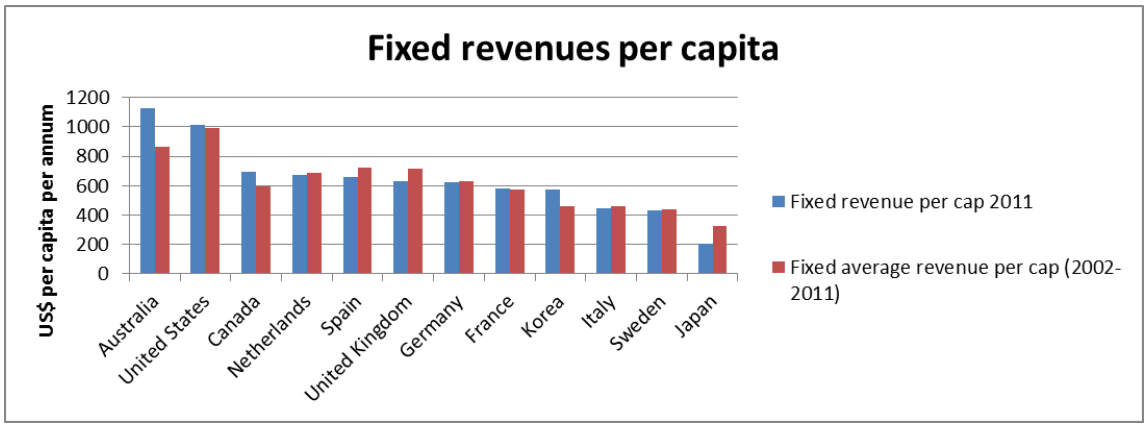
Excluding this period, there is no evidence to suggest that the UK, which pursued a more stringent approach to regulation experienced less investment as a proportion of revenues than the US, Japan or Korea. Rather, the impression is that – with certain

197 Access-based competition might support take-up through service innovation, pricing and marketing. Unbundling might also support technological upgrades in equipment.

variations and excluding the boom and bust, capex has tended to lie for all countries within a range of 10-20% of revenues, and that the relative positioning of countries has changed during the period.

An expectation of a standard 'efficient' capex ratio might give some credence to those arguing for reduced regulation if reducing economic regulation allowed higher prices and revenues (due to consolidation) which in turn spurred investment. However, as can be seen from Figure 30, it is far from clear that this chain of reasoning can be proven.

Figure 30: Fixed evenues per capita



Source: WIK based on OECD Communications Outlook 2013

Approaches to regulation seem unrelated to fixed revenues. For example, there are high fixed revenues in the US and Canada, which are examples of countries which have pursued forebearance. However, equally revenues are low in Korea. In the same way countries with a high regulatory intensity such as Australia and Sweden appear at opposite ends of the spectrum. This qualitative assessment is also mirrored in Table 16, which shows a strong relationship between revenues and capex per capita, but not clear statistical links between regulatory approaches and either revenues or capex.

Furthermore, even if as seems the case, higher revenues may be linked to higher capex, there does not appear to be a straightforward link between higher capex and positive outcomes for NGA coverage. As previously noted, this could potentially be due to the role that capex-efficient NGA technologies such as cable and FTTC/VDSL have played in several countries.

We conclude that there is no clear-cut evidence that regulatory forbearance of the type seen in the US, Canada and Korea would necessarily lead to more capex or revenues if deployed in the UK or more widely in Europe, nor that they would necessarily deliver greater NGA coverage. There may be specific features of those markets – including strong infrastructure-based competition and high demand – which enable positive

results in the absence of regulation. Moreover, cost factors (such as relatively low urban density in the US and high density in Korea) may also be influencing outcomes in those markets in a way which would not necessarily apply in European markets with different characteristics.

6 Summary and conclusions

In this section, we bring together our analysis of market-driven and regulatory factors, in order to see whether conclusions can be drawn around the relative importance of different factors in determining NGA outcomes.

6.1 Potential factors influencing NGA outcomes

In Table 17, we have summarised the results of our analysis by showing on the one hand NGA outcomes – and on the other – candidate drivers including market supply, policy and demand-side factors.

NGA outcomes are shown both in terms of the overall rank including 5 metrics (coverage, take-up, speed, usage and price), and for NGA coverage and take-up, which are metrics for which targets have been set within the Digital Agenda for Europe[198]. These two metrics have also been extracted from the wider NGA ranking because they may be influenced by or drivers of the other three consumer outcome measures.

For market supply-side factors, we have listed (i) infrastructure-based competition, based on cable coverage together with an estimate of coverage of other independent NGA infrastructures; and (ii) % population within urban areas as a proxy for cost.

Under policy factors we have highlighted (i) the degree to which there is regulatory forebearance on NGA, which has been suggested as a factor which may affect NGA deployment and (ii) the degree to which public initiatives including tax incentives, soft loans and state aid have been offered by the national Government.

On the demand-side we have highlighted video usage, which may be linked to NGA take-up, and NGA price, which may influence take-up in the presence of demand.

For easier comparison, we distinguish between four groups of countries based on the degree of coverage and take-up of fixed NGA (>30Mbit/s).

198 EC DAE (2010)

Table 17: Summary table: NGA outcomes –candidate drivers

	Outcome measures			Market supply-side factors		Policy supply-side factors		Demand-side factors	
	NGA outcome average rank	NGA Coverage (>30MBit/s) % HH (IDATE)	NGA Take-up (% coverage) (IDATE)	Coverage infrastructure-based competition	% population in urban areas (OECD)	Financial incentives/state aid	NGA regulatory forebearance	Video usage/ file sharing (Cisco VNI)	NGA basket (>30M) price (OECD)
Korea	1								
Japan	2								
US	6								
NL	3								
Sweden	4								
Canada	7								
UK	5								
Germany	8								
Spain	9								
France	10								
Australia	11								
Italy	12								
		Green >80% Yellow 50-80% Red <50%	Green >50% Yellow 25-50% Red <25%	Estimates based on cable, independent FTTH - Green >70% HH Yellow 40-70% Red <40%	Green= 70%+, yellow=50-70%, red=<50%	Green=significant state financial initiatives or state aid. Red=minimal state aid/financial support	Green = complete NGA forebearance. Red= cost-based NGA regulation	Green >100GB per month yellow 50-100GB Red <50GB	By rank - 4 lowest cost = green etc

All data 2014 except price (2012)

Source: WIK based on various data sources as described

6.2 What is driving NGA outcomes?

We note in our analysis of market supply drivers (section 3) the positive relationship between infrastructure-based competition such as cable[199] and NGA coverage, as well as the potential linkage between video usage and NGA take-up. These two factors come through in the table as potential candidate drivers for NGA outcomes.

A further interesting observation is the lack of a clear pattern concerning regulatory forbearance and NGA outcomes and investment as examined in section 5. The 'top' group includes two countries in which access-based competition does not play a role. However, it does play some role (albeit limited) in Japan. Meanwhile, in the second group of countries there are two examples of countries which implemented cost-oriented regulation of NGA access which nonetheless experienced positive outcomes.

Meanwhile, in the lower two groups, there are two countries which pursued a policy of regulatory forbearance in order to support infrastructure-competition, with the support of duct access (and other measures in the case of France). However, this does not seem to have materially affected coverage and take-up rates.

Based on our analysis of 12 countries, we conclude that NGA access regulation is less likely to determine NGA coverage than widespread infrastructure-based competition (for example between the incumbent and cable provider), demand factors and other factors such as the technical solutions adopted (DOCSIS 3.0 and FTTC can be deployed at lower cost than FTTH) and demographics, such as the urban density and prevalence of multi-dwelling units, which also lowers the cost of deployment.

This does not mean that access-based competition plays no role. An analysis of regulatory approaches and outcomes for example highlights that the regulatory approach is likely to affect the degree to which there is choice in fast broadband providers (see Table 14). Choice is limited in the US, which has pursued forbearance, but is widely available in the UK based on wholesale inputs alongside cable. Infrastructure-based choice is available in countries which focused on deep passive remedies, but the geographic scope is limited mostly to dense urban areas.

As volumes of NGA wholesale products in many countries are still low, there is insufficient data at this stage to fully gauge what the effects of choice in fast broadband may be on consumer outcomes. We note however that retail prices for NGA in the countries with least choice – the US and Canada - are amongst the highest amongst the examined countries (see Table 14), while NGA prices are lower amongst those countries which focused on local access strategies for NGA. Previous experience with local loop unbundling in the UK suggests that local access put downward pressure on

199 HHI measures which also include access-based competition show a weaker relationship than cable alone

prices for higher speed services and accelerated the uptake of broadband in the early deployment phase[200].

It is possible that a later analysis may reveal more insights around the effect of NGA regulation on consumer outcomes including take-up, speeds and prices.

6.3 Implications for UK policy

From a UK perspective, the analysis suggests that:

- Policies which incentivise infrastructure-based competition are likely to continue to yield positive outcomes for NGA deployments today and in the future
- Consideration should be given to consumers' needs in shaping regulatory policy. Strategies which explicitly seek to favour FTTH may not necessarily match user requirements for bandwidth.
- There is no 'magic bullet' as regards regulatory approaches, as they are affected by national circumstances, and may differ between countries as well as within countries. For example, it cannot be concluded on the basis of the analysed countries that complete forbearance on NGA access or structural separation of the access network would necessarily improve NGA outcomes in the UK. The conditions which led to those approaches in the US, Canada, Korea and respectively Australia (for structural separation) are in many cases not applicable in the UK. Some outcomes in those markets – notably price in the US and Canada, and NGA coverage and take-up in Australia - are substantially worse than in the UK.
- Access regulation may play an important role in enabling choice where infrastructure competition alone would be insufficient to achieve this. Experience from basic broadband markets suggests that choice can be a driver of price and speed innovation, and support uptake in the early deployment phase of new technologies.
- The ladder of investment remains a relevant concept in which to consider approaches towards NGA regulation. It is possible that different aspects of the ladder may be relevant in different geographic areas. The degree (and geographic scope of) infrastructure-based competition in European countries which focused on competing NGA infrastructures, may provide some useful insights as to the potential as well as the limitations of passive approaches.

200 See Analysys Mason (2012) Disentangling unbundling: the impact of local loop unbundling on broadband take-up and quality and Nardotto, Valletti et al (2014) Unbundling the incumbent: evidence from UK broadband which finds acceleration of broadband in the early phase, but with diminished effects on market maturity

- On the basis that cost as well as demand factors (such as online video, publicity around high bandwidth connections) may affect NGA outcomes, there may be a case to focus NGA policy on areas beyond economic regulation.

6.4 Implications for the review of the EU framework for electronic communications

The EU framework for electronic communications currently requires national regulatory authorities to focus on three main priorities[201] – namely:

(iv) promoting competition in electronic networks and services; and

(v) contributing to the development of the internal market; and

(vi) promoting the interests of citizens

A significant focus in this context is currently placed on the role of ex ante SMP regulation, which is applied in case of market failure. Regulators are given significant flexibility in applying rules which reflect conditions specific to their markets.

Firstly, we are able to conclude that promoting competition (and in particular infrastructure-based competition) remains an important means to achieve positive consumer outcomes, and should remain as a core objective for European NRAs.

Notwithstanding the importance of the internal market, our analysis also suggests that national (or even local) conditions, such as the existence and potential for infrastructure-based competition, may affect market dynamics. In turn, these factors may affect the appropriate regulatory response in each case.

Lastly, an important conclusion is that a focus on ex ante SMP regulation as a primary regulatory tool may be too narrow in an environment in which factors other than access-based regulation play an important role in driving market outcomes. Industry-wide (symmetric) measures may be relevant in some cases, and NRAs should be given an appropriate set of tools in this area. Given the relevance of demand in supporting NGA outcomes, it may also be useful for NRAs to have an explicit role on the demand-side, for example through fostering the competitive provision and usage of innovative content, applications and services.

201 Article 8 Directive 2002/21/EC as amended by Directive 2009/140/EC

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