Fostering investment and competition in the broadband access markets of Europe

A report for ETNO

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Table of Contents

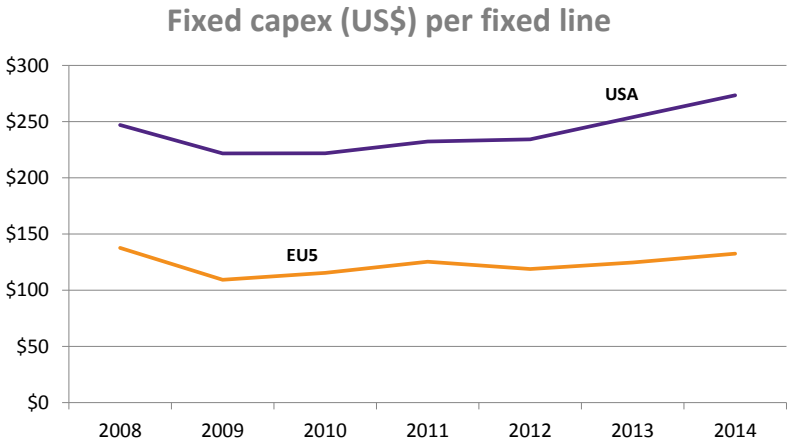
Executive Summary

S1 The investment challenge facing the EU

The EU needs high speed and ubiquitous broadband if it is to deliver additional economic and social benefits to its citizens through the Digital Single Market. This will require major investment in new technologies to upgrade Europe's telecommunications access networks.

Currently the EU faces a major challenge here. In particular when compared with the US there is a large investment gap[1]. The US invests more than twice as much per fixed line as the EU and this gap is, if anything, growing. Figure S1 illustrates. As a result Europe enjoys more limited availability of high-speed broadband, poorer download speeds, and uses less data per head than the US.

Figure S1: The investment gap between the EU and the US



Source: Communications Service Provider (CSP) Revenue & Capex Forecast: 2014–19, Ovum (Jan 2015)

Our research indicates that regulation of the telecommunication sector has played a significant role in creating this investment challenge for Europe:

- Reputable econometric studies indicate that regulation which supports service-based competition, the historic approach used in the EU, reduces infrastructure investment
- The relatively low level of regulated prices for unbundled copper loops has suppressed retail prices for both basic and high-speed broadband. This has meant lower fixed service revenues and lower levels of investment in fixed infrastructure
- The investment returns to regulated access providers in Europe are significantly lower than the returns to unregulated operators. This has created disincentives for investment by regulated access providers, which together make just under two thirds of investment in the fixed telecommunications sector of the EU

[1] There are also investment gaps when we compare the EU with Japan or South Korea

- Where access regulation has been relaxed recently we have seen significant increases in NGA investment in member states as diverse as Portugal, Spain, Sweden and the UK.

The revision of the regulatory framework for electronic communications creates an opportunity to deal with this investment challenge.

S2 The key factors influencing broadband investment and competition

How might the regulatory framework be modified to stimulate investment and competition in the supply of high-speed broadband access? In answering this question we need to take account of the following:

- The bulk of the investment required to meet policy objectives for the Digital Single Market will need to come from private investment in Europe's access networks
- This private investment is a continuous and incremental, rather than a one-off, process. Investment decisions are constrained by the annual cash flows generated by the businesses. They reflect market and regulatory risk and they take account of the fact that suppliers are constantly offering new technologies with substantially improved price-performance
- Infrastructure-based competition stimulates infrastructure investment. This form of competition has grown steadily in the EU over the past five years. But it is patchy. In a typical member state around 50% of households and businesses are in areas where there is infrastructure-based competition in the supply of broadband access
- The business case for infrastructure investment by an access provider is strongest where:
  - Regulation is simple and certain
  - The access provider is free to choose how, where and when to invest
  - The access provider has maximum pricing freedom at the wholesale and retail level
  - The access provider can close legacy services with the minimum of regulatory constraints
- Existing regulatory practices, originally designed to protect access seekers from a powerful regulated access provider, have started to raise sector costs, delay investment by regulated access providers, and weaken the competitive process in a significant number of cases.

With these factors in mind we make the following proposals for a revised regulatory framework. In combination the proposals are designed to stimulate investment and infrastructure-based competition, while preserving efficient service-based competition.

S3 Proposed principles for the revised framework

I *Regulate using a single objective for NRAs – maximising the long-term interest of end-users. In applying this principle to economic regulation, devise rules which optimise the combination of dynamic, productive and allocative efficiency to maximise (total) economic welfare.*

Changing objectives in this way should incentivise NRAs to consider the extent to which proposed regulations promote investment and innovation, promote infrastructure-based competition, and preserve efficient service-based competition. Establishing a single regulatory objective, rather than

the three in the current Framework Directive, should also lead to more harmonised regulation across the EU.

II *Preserve the principle of technology neutrality in developing regulation and do not regulate in a way which attempts to favour specific technologies.*

Market players are better placed to make efficient investment decisions[2] than NRAs or governments. They have far more information on both the incremental costs of deploying new technologies and the incremental revenues which might flow from investing. They also have stronger incentives to evaluate all technical options.

Attempting to favour technology choices that do not correspond to the assessments made by market players would be likely to drive investment to other world regions and industry sectors and prove counterproductive. In contrast preserving technology neutrality allows the market to make the greatest possible contribution to achieving broadband policy goals and minimises the need for public subsidy.

III *Restrict ex-ante regulation to the minimum required to deal with the competition problems identified.*

The existing framework already contains a number of relevant features which reflect the principle of minimum regulation - that markets which are effectively competitive should not be regulated; that remedies should be implemented at the wholesale rather than the retail level; and that remedies should be proportionate. These are important principles. But it is not clear that regulatory practice by NRAs always follows these principles.

IV *Focus on retail markets and wholesale remedies. Define and examine competitive conditions in retail markets, rather than notional wholesale markets, before developing wholesale remedies to deal with competition problems.*

This principle focuses regulation on the right regulatory objective - that is the long-term interests of end users who are concerned about choice in the retail market. It is already implied in the current framework, but regulatory practice does not always reflect this.

As part of the process of defining and assessing competitive conditions in retail markets it will be important for NRAs to consider the geographic scope of retail markets for broadband access. Infrastructure-based competition, especially from cable operators, is now substantial and growing steadily. But high levels of infrastructure-based competition, which result in effective competition in a retail market, only exist in around 50% of a typical member state. By defining sub-national geographic retail markets it should be possible to lift regulation in those markets where infrastructure base competition is strong and focus regulation on those where it is weak or non-existent.

V *Allow regulated access providers to close legacy networks and services with the minimum of constraints*

We propose that network operators should have the option, but not an obligation, to close legacy services and networks at short notice provided that end-users and access seekers can obtain a broadly similar service level at a similar price on the new technology network.

[2] Which maximise economic welfare gains

Allowing freedom to close legacy services and network elements without permission would lower overall sector costs and promote investment by access providers. In particular it would give greater incentives for infrastructure-based players to upgrade their networks so as to replace expensive legacy technologies with modern technologies which offer lower unit costs and higher levels of functionality to end users.

VI *Recognise and encourage use of voluntary commercial agreements*

Where infrastructure-based competition is strong the interests of the regulated access provider and access seekers are increasingly aligned. This has led to voluntary long-term agreements which are superior from a public interest perspective to ex-ante regulation. Voluntary agreements can increase investment incentives and infrastructure-based competition. As such they are an important innovation which should be encouraged and considered when reviewing the effectiveness of retail competition and when assessing the need for ex-ante regulation.

VII *Give access providers the maximum regulatory freedom consistent with Principle I*.

Where retail markets are not effectively competitive regulation may be required to preserve effective service-based competition. This regulation needs to be carefully crafted if the case for infrastructure investment, especially by the regulated access provider, is not to be undermined. There are two main ways to do this:

- By moving away from cost oriented price regulation regulators give access providers greater pricing freedom at the wholesale level, and hence strengthen the case for infrastructure investment. This is possible through a range of alternative measures which include investment friendly economic replicability tests; reliance on voluntary agreements between the access provider and access seekers; and application of the anchor product pricing principle
- By simplifying wholesale remedies. Regulation at multiple wholesale levels is complex, and discourages investment and innovation. We therefore propose that the revised regulatory framework should require an NRA to impose a **single** wholesale remedy to deal with the competition problem identified in a retail market which is not effectively competitive - unless it can provide strong public interest arguments as to why there is a need to impose more than one wholesale remedy.

VIII *Move from ex-ante to ex-post sector specific regulation where possible.*

It is now 15 years since EU telecommunications markets were opened to competition. As a result ex-ante measures which were designed to promote market entry have become increasingly irrelevant. Over the past five years in particular we have seen substantial consolidation between entrant market players and little new entry. At the same time it is clear that ex-ante regulatory measures have reduced infrastructure investment in the EU. In these circumstances it makes sense for NRAs to use ex-post regulation more and ex-ante regulation less.

S4 Proposals for a revised market review process

If adopted the principles set out above would lead to a revised market review process. We make proposals for this revised process below – in terms of market definition, assessment of competition,

and development of remedies. Some of the proposed changes are designed to ensure consistent regulatory practice at the Member State level; others are designed to make more fundamental changes to the regulatory framework.

Market definition

We propose that an NRA should start the market review process by defining retail (rather than wholesale) markets for fixed broadband access in terms of both the **product** and **geographic** scope. When defining the geographic scope of retail markets the assessment should be based on competition law practices to identify areas where "*the conditions of competition are similar or sufficiently homogeneous and which can be distinguished from neighbouring areas in which the prevailing conditions of competition are appreciably different"*

We might expect relatively few retail **product** markets – perhaps a mass market for broadband access and a market for dedicated, high quality, broadband access to meet the needs of businesses. But in terms of the **geographic scope** of the market the market definition process may lead to a substantial number of sub-national geographic markets.

This approach is superior to one in which NRAs focus primarily on wholesale markets in that:

- It focuses regulation on the right objective - that is the long-term interests of end users who are concerned about choice in the retail market - rather than on promoting competition alone
- It avoids the problem of regulating a weak infrastructure-based operator where it faces strong infrastructure-based competition from an unregulated rival. This outcome is a distinct possibility in an approach which ignores retail market conditions and defines wholesale markets narrowly.

It should also be possible, by defining sub-national geographic retail markets, to lift regulation in those areas where infrastructure base competition is strong and focus regulation on those where it is weak or non-existent.

Assessment of effective competition

The current regulatory framework is clear – if a market is effectively competitive then that market should not be regulated. This means that accurate assessment of competition is important if a market is not to be over-regulated. We maintain that changes to the framework would substantially contribute to a better assessment of effective competition. Specifically we propose that:

- The starting point for an assessment should change to one in which there is an assumption that a retail market is effectively competitive unless the NRA can demonstrate otherwise
- The NRA should take a more forward-looking approach to competition assessment.
- The NRA should in particular take account of the existence and prospects for infrastructure-based competition over the market review period in each retail market.

In making its assessment the NRA will need to judge whether the retail market would remain effectively competitive if existing ex-ante regulation were withdrawn. Here the NRA will need to take account of voluntary agreements between regulated access providers and access seekers. These would prevent foreclosure of the access seeker in supplying the retail market. The NRA will also need

to consider whether withdrawal of existing regulation would lead to the loss of access to bottleneck facilities which are strictly necessary for the retail market to be competitive.

In modifying the basis on which to assess whether a market is effectively competitive we propose that the revised framework should signal clearly to NRAs the damaging public interest consequences of pursuing either joint dominance or tight oligopoly regulation on an *ex-ante* basis. We note that the use of *ex-ante* rules to deal with tight oligopolies is likely to be especially damaging, given that it is even more challenging to reliably establish a tight oligopoly on a prospective basis than it is to establish prospective joint dominance.

Selection of remedies

With regard to retail markets which are not effectively competitive we propose the following changes. NRAs should:

- Simplify the wholesale remedies applied to deal with competition problems in a retail market. This would mean generally abandoning the historic ladder of investment concept and simplifying regulation so that there is only one wholesale remedy for each non-competitive retail market. The single remedy should be chosen so as to allow access to the input strictly necessary to compete in the relevant retail market. This would be determined in relation to the bottleneck identified during the competition assessment process
- Justify any proposed remedy by applying a cost benefit test. Do the incremental benefits of intervention clearly exceed the incremental costs? We note here that regulation will have costs in terms of foregone flexibility, reduced investment and the risk of regulatory error. This proposal is consistent with Principle 1
- Give voluntary agreements precedence over ex-ante rules to reflect the fact that voluntary agreements between access providers and access seekers are often superior to ex-ante regulation from a public interest perspective
- Choose remedies which maximise wholesale pricing freedom so as to strengthen the case for investment by the regulated access provider. They should move away from cost oriented price controls and rely instead on voluntary agreements, on application of anchor product pricing principles, or on application of an investment friendly economic replicability tests
- Make credible commitments to the regulated access provider to increase investment certainty as competitive conditions change. For example an NRA might:
  - Develop contingent remedies in which they commit in advance to lifting of regulation in the middle of market review periods if and when specific triggers are reached[3]
  - Once a market is deregulated, commitment not to reintroduce regulation in subsequent market reviews, provided that the market characteristics which justified deregulation do not deteriorate significantly in future.

[3] For example a voluntary agreement is signed or a specified level of infrastructure base competition is reached

S5 Conclusion

On their own each of our proposals for change is not revolutionary. A regulatory focus on maximising economic welfare; a shift away from the concept of regulating wholesale markets per se to one in which regulators examine competitive conditions in retail markets after taking account of geographic differences; recognition of the growing role of voluntary agreements; a simplification of wholesale remedies; and a move away from cost orientation where remedies are required - these are all logical incremental changes to the regulatory framework. But, taken together, we believe that they represent a fundamental and necessary change to the way fixed broadband access is regulated across the EU so as to create a major stimulus for NGA investment and infrastructure-based competition.

1 Introduction and context

1.1 The importance of the review

Broadband access, a key element of communications connectivity, now makes a major contribution to the economic and social welfare of the EU. History has made the central role of connectivity clear. In 1987 economist Robert Solow quipped that:

> *"You can see the computer age everywhere but in the productivity statistics".*

But by 2000, with the arrival of the internet and connectivity, we could see networked computing in the productivity statistics, as Alan Greenspan, then Chairman of the Federal Reserve Board, remarked:

> *"The full value of computing power could be realised only after ways had been devised to link computers into large-scale networks…"*

The benefits and innovations of the digital age therefore depend on ubiquitous, fit-for-purpose, connectivity. To ensure that this connectivity is delivered, two ingredients are required – investment and competition. Both stimulate innovation and lead to greater economic and social welfare. However where broadband access bottlenecks occur regulation may be required to limit the scope for market abuse. It is important to get the balance of this regulation right. Over regulation not only limits innovation and investment, but also weakens the competitive process.

The European Framework for Electronic Communications ("the framework") was last reviewed in 2009, arguably before the linkage between data connectivity, computing and wider economic and social benefits were clear. The role of connectivity is now clear. As Günther Oettinger puts it:[4]

> *"The availability of high-capacity and high-speed connections is a necessary condition – the condition sine qua non – to achieve better results for each and every citizen, for industry, for businesses…".*

Oettinger also remarked that the focus is now on:[5]

> *"lifting barriers to investment while keeping in mind that competition is the main driver of investment."*

1.2 The scope of our report

In this report we assess how regulation might change to address the challenge of high-speed and ubiquitous connectivity. We consider key market evidence in Section 2; the relationship between competition and investment in Section 3; and the nature of incentives for investment in Section 4. We then put forward specific recommendations for reform of the framework in Section 5.

[4] Günther Oettinger. 10 December 2015. http://ec.europa.eu/commission/2014-2019/oettinger/announcements/speech-berec-board-regulators-meeting-telecoms-review_en

[5] Günther Oettinger. 17 November 2015. http://ec.europa.eu/commission/2014-2019/oettinger/announcements/speech-ecta-regulatory-conference_en

The focus of our work is on:

- Facilitating investment and competition in broadband markets by narrowing the scope of *ex-ante* regulation to the extent possible while preserving efficient competition
- The regulation of ***access*** rather than ***services***, given the much greater barriers to entry in the access markets
- How best to regulate the supply of ***fixed*** broadband whilst recognising that ***mobile*** broadband services, which are considered effectively competitive in almost all member states, create significant competitive constraints on fixed broadband providers when they address key market segments
- Reviewing the objectives, principles and procedures for the implementation of *ex-ante* ***asymmetric*** remedies. We do not consider requirements for ***symmetric*** remedies, such as the sharing of in-building wiring or the measures proposed by the European Commission to lower the cost of NGA rollout by infrastructure operators in general
- Presenting EU institutions with specific and actionable proposals which they can consider as they review the framework.

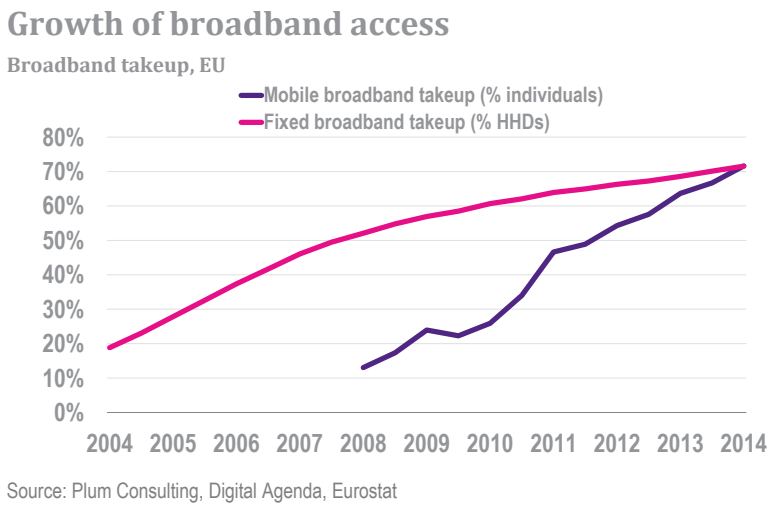
2 Market context

The delivery of communications services continues to change at a rapid pace. We set out below four aspects of this change which are especially relevant when considering how best to revise the regulatory framework.

2.1 Broadband access has emerged as central

Since the last review of the framework in 2009, broadband access has emerged as a key input to the digital economy. As illustrated in Figure 2-1 steady growth in household broadband adoption is now matched by individual mobile broadbnad adoption – predominately via smartphone adopiton.

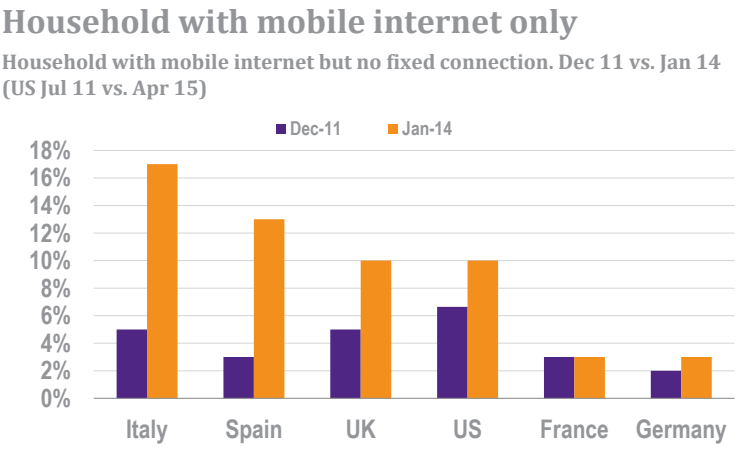
Figure 2-1



Source: Plum Consulting, Digital Agenda, Eurostat

Overall adoption of broadband is however higher than the above figure indicates, since a growing number of households are mobile only (Figure 2-2).

Figure 2-2



Source: Plum Consulting, Eurobarometer, Pew

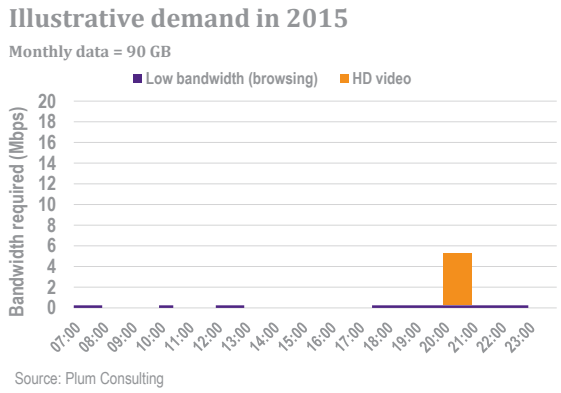
Fixed and mobile broadband connectivity underpins the digital economy, and mobile broadband access is a growing competitive constraint in the access market – at least for certain market segments such as households made up of young adults.

2.2 Peak bandwidth demand is not directly linked to data demand

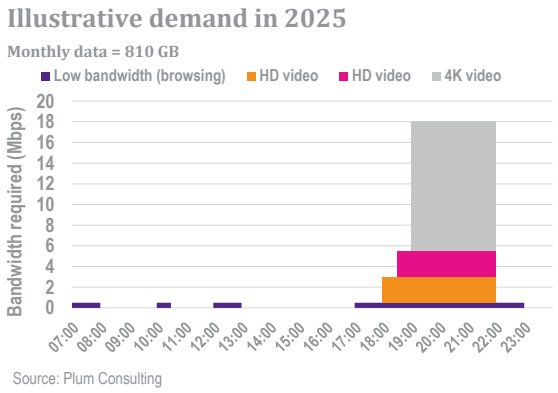
Whilst data consumption per user is growing, this does not require connection speeds to grow at the same rate. We consider two purely illustrative demand scenarios below to illustrate this point.

In the 2015 scenario there is a moderate amount of low intensity activity such as browsing coupled with an hour of online HD video consumption per day (Figure 2-3). We assume that this requires a peak connection speed of just over 5 Mbps and involves data consumption of 90 GB/month[6].

Figure 2-3: Requirements of a high demand user – 2015 vs 2025



Source: Plum Consulting



Source: Plum Consulting

[6] Compared with the 20 GB per month average for Western Europe. See Figure A9 of Appendix A

By 2025 we assume that there is simultaneous viewing of three video streams at peak time, and one of these is in 4K format. However, partially offsetting the growth in demand is a two-fold improvement in compression (following a transition from H.265 to HEVC compression).[7] This involves peak bandwidth demand of 18 Mbps and data consumption of 810 GB per month. Comparing the two time periods the increase in data consumption (roughly 8.6-fold) exceeds the growth in peak bandwidth required (roughly 3.4-fold).

A key factor here is that time spent online increases substantially as household occupants spend more time watching video. This means that data growth *per se* does not necessarily require higher access speeds, though growth in both is likely.

Core networks have kept pace with past traffic growth without a step change in investment. But raising access speeds beyond those available with copper based ADSL does require a step change in investment to extent fibre to the premise or cabinet.

2.3 Changes in competitive conditions

Over the past decade competitive conditions in the fixed telecommunications markets of the EU have changed substantially. In particular the retail market share of alternative operators in the EU broadband market has grown from just over 40% to just under 60%.

The nature of this challenge to ex-incumbent operators has also changed – with a significant shift from service-based to infrastructure-based competition. We are not aware of published data which would enable us to establish the full extent of the growth in infrastructure-based competition. But we can estimate, from published ITU data, that infrastructure-based cable operators have contributed virtually all of the growth in the challengers' market share since 2008. Moreover we estimate that, in the geographic areas where they have a footprint, cable operators have increased their share of the fixed broadband market from around 30% in 2008 to around 40% in 2014[8]. We consider in Sections 3, 4 and 5 how regulation might be modified to take advantage of this positive trend.

2.4 The investment problem facing Europe

The scale of the challenge

The EU invests less in ICT and less in the telecommunication sector than the US[9]. Figures 2-4 and 2-5 illustrate. We can see that:

- The gap is a serious one. In 2014 for example the US invested over twice as much per fixed line as the EU5[10] On current trends the gap is growing rather than shrinking

[7] Our assumed speed requirements for HD and 4K video approximates to those in: Kenny and Broughton (November 2013). "Domestic demand for bandwidth - an approach to forecasting requirements for the period 2013-2023." http://www.broadbanduk.org/wp-content/uploads/2013/11/BSG-Domestic-demand-for-bandwidth.pdf

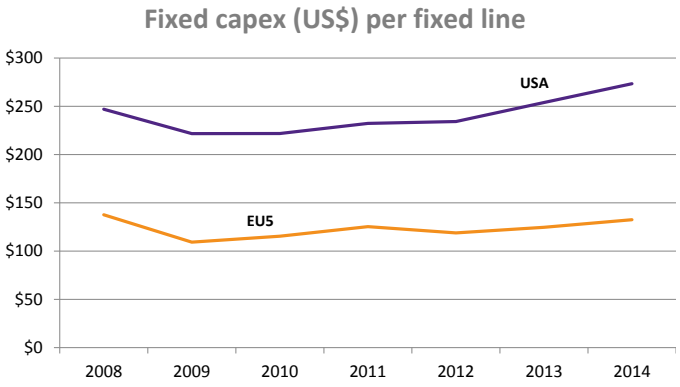
[8] For the EU15

[9] We find that there is also an investment gap when we compare the EU with Japan and South Korea. But this comparison is more difficult to interpret. It is difficult to compare industrial policies while the nature of telecommunications regulation is less transparent in these two countries than it is in the US.

- When measured in terms of percentage of GDP spent on ICT, the gap is very similar. The EU spent under 2% of its GDP on ICT in 2011 while the US spent close to 4%. Yet when measured across all sectors of the economy the EU allocated a significantly higher proportion of its GDP to investment.

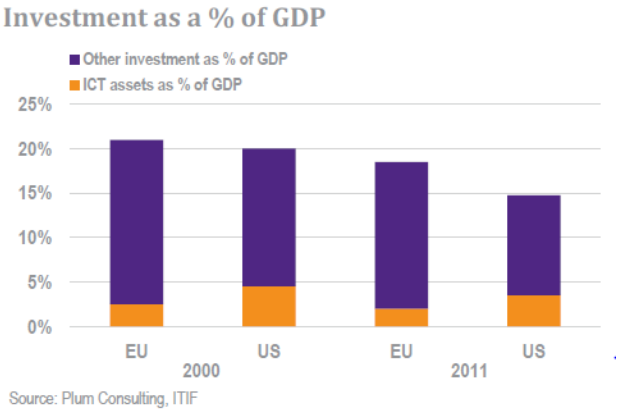
This lower level of investment is reflected in poorer high speed broadband availability, lower download speeds and lower levels of data use in the EU. Figure 2-6 illustrates the differences in data use between Europe and North America. Appendix A provides a more detailed analysis.

Figure 2-4: Investment per fixed fine – EU5 vs US



Source: Communications Service Provider (CSP) Revenue & Capex Forecast: 2014–19, Ovum (Jan 2015)

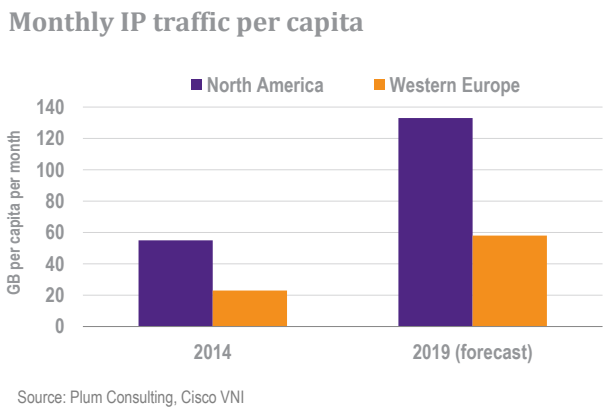
Figure 2-5: ICT investment as a % of GPD – EU vs US



Source: Plum Consulting, ITIF

[10] France, Germany, Italy, Spain and the UK - a group of large member states with a population almost the same as that of the US

Figure 2-6: Data use per head – Western Europe vs North America



Source: Plum Consulting, Cisco VNI

This investment challenge is also highlighted if we consider the investment which would be required for the EU to meet the Digital Agenda Europe connectivity targets. Here the Boston Consulting Group has estimated that €216 billion in investment would be required between 2015 and 2020, leaving a gap of €106, when the combined public and private investments currently planned is subtracted.[11]

These two pieces of evidence are broadly consistent. If the EU were to invest as much as the US per fixed line over the next five years, then this would increase fixed network investment in the EU by just over €140 billion[12].

The role of regulation

Meeting this investment challenge matters. High-capacity and ubiquitous connectivity is essential for Europe's economic and social development. A key question for this study is how much of the investment gap can be attributed to inappropriate *ex-ante* regulation. Our review of the evidence (set out in Appendix B) suggests that regulation has a significant impact on investment levels. For example we note that:

- There is a substantial body of reputable econometric studies which indicate that regulation which supports service-based competition has a negative impact on infrastructure-based competition and associated investment. Econometric studies also suggest that strong service-based competition has a negative impact on NGA coverage – even after controlling for the effect of cable coverage[13].
- There is good evidence that the relatively low level of regulated prices for copper loops has depressed retail prices for both basic and high-speed broadband in the EU[14]. This, in turn, means low revenues from fixed network services in the EU relative to the US – a problem which has worsened as broadband revenues have grown in importance relative to voice telephony revenues. These lower fixed revenues in the EU have led to lower levels of investment in fixed

[11] Boston Consulting Group. 2015. "Five priorities for achieving Europe's digital single market." http://media-publications.bcg.com/BCG-Telecommunications-Five-Priorities-Europes-Digital-Single-Market-Oct-2015.pdf

[12] [$270 less $130 per line] x 0.9$/€ x 225 million lines x 5 years

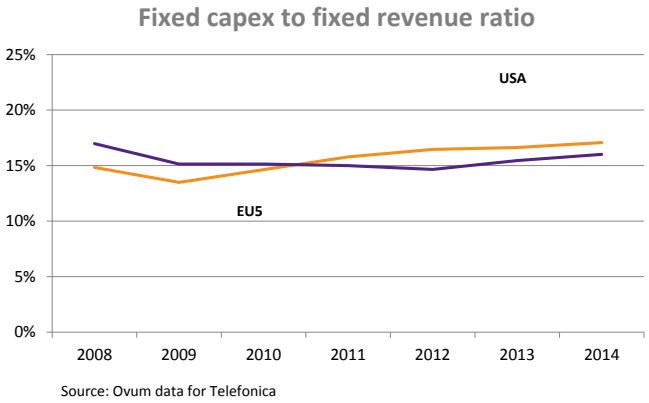
[13] High levels of which tend to stimulate NGA rollout

[14] Local loop unbundling is not required in the US

services. As Figure 2-7 shows EU operators are investing the same proportion of their fixed revenues in fixed services as their US counterparts[15]. But these fixed revenues are only half as large.

- The return on investment and cash flow generated by ETNO members[16] are substantially lower than those generated by other, unregulated, operators in the EU as Figure 2-8 illustrates. A major factor here is that regulation redistributes risk and returns between the access provider and the access seekers. These differences in investment incentives for regulated and unregulated operators have a substantial impact on overall investment levels. Over the past six years investment by regulated operators[17] in fixed networks has constituted between 60% and 65% of total investment in the fixed sector
- Qualitative case studies suggest that access regulation has a significant impact on investment by regulated access providers. We provide a number of illustrative examples below and, in more detail, in Appendix C.

Figure 2-7: Capex to revenue ratios – fixed services – EU5 vs US



Source: Ovum data for Telefonica

[15] Economic literature on the impact of cash flows on investment, which draws on both econometric analysis of outcomes (See for example *Financial Constraints, Investment, and the Value of Cash Holdings,* David J. Denis and Valeriy Sibilkov. December 2011, The Review of Financial Studies*, 23(1))* and surveys of chief financial officers (See for example *The real effects of financial constraints: evidence from a financial crisis,* Murillo Campello, John Graham and Campbell R Harvey, December 2009. NBER Working Paper 15552) finds that reduced revenues and reduced cash flows tend to reduce investment.

[16] Which form the bulk of regulated fixed access providers

[17] As measured by investment by ETNO members. See *Annual economic Report 2014,* IDATE for ETNO, December 2014

Figure 2-8: Financial indicators of investment incentives – regulated vs unregulated EU operators

Measure	ETNO members	Other operators	Source
Return on investment pa	9%	21%[18]	Boston Consulting Group
% EBITDA fixed	27%[19]	47%[20]	Analysis of company accounts
Change in fixed capex (€bn) between 2008 and 2013			
2008	17.8	8.5	IDATE Annual Economic Report to ETNO 2014[21]
2013	16.3	10.0	
Difference	-1.5	+1.5	

The impact of *ex-ante* regulation in practice

In the course of our work we have identified a number of examples of how *ex-ante* regulation can suppress or delay NGA investment in practice. For example:

- In the Netherlands regulation designed to give access seekers first mover advantage stopped KPN from investing further in fibre in business areas of the Netherlands
- Regulatory processes have delayed the introduction of higher speed broadband services (through use of vectoring) in Germany
- In France Orange slowed down its investments in FTTH between 2008 and 2011 while government and regulatory policies on NGA were uncertain
- Delays in regulatory decision-making in Malta delayed the deployment of FTTH by almost three years.

At the same time we have identified examples of how the relaxation of *ex-ante* regulation has led to greater investment in NGA:

- In Sweden and the UK, removal of cost oriented regulation and a move to economic replicability tests has led to increased investment in NGA broadband
- In Spain and Portugal the move to relatively light regulation of WBA products in return for open duct access has led to substantial deployment of FTTH. In Spain differentiation of regulation by bandwidth allowed relaxation of regulation while in Portugal differentiation by geography supported relaxation of regulation
- The use of symmetric regulation, which avoids cost oriented price controls, has led to strong infrastructure-based competition in the supply of next generation broadband in the urban areas of France.

[18] Access seekers only Cable operators are excluded

[19] EU5

[20] Liberty Global

[21] These data were not available in the 2015 report

Appendix C provides more details and further examples[22].

Further analysis

Given these findings we consider the relationship between investment and competition (in Section 3) and the nature of incentives for investment in fixed broadband (in Section 4) before making proposals for changing the regulatory framework (in Section 5).

[22] Furthermore, it is worth noting that a recent paper from the Bruegel Institute recently made a similar point. This paper points to the fact that Central and Eastern European member states have below average GDP per head and penetration of first generation broadband. But some, notably the three Baltic States, regulate without strict cost oriented obligations and enjoy high levels of NGA penetration (averaging 90% across the three states at the end of 2014 according to the DAE scorecard). Others, notably Hungary, Poland, Slovakia and Slovenia, use stricter fibre access regulation and enjoy significantly lower levels of NGA availability (averaging 68% across the four states at the end of 2014 according to the DAE scorecard). We also note that some of the recommendations made in this paper appear questionable.

3 The competition and investment challenge

3.1 The changing regulatory challenge

Existing regulation has supported service-based competition and protected consumers from abuse of market power. However, existing regulation was designed for an era in which copper was already for the most part present and could be upgraded at comparatively low cost to provide broadband.

We are now in an era of transition - from copper to fibre, and from service-based competition to increased infrastructure-based competition. With this transition comes a need for more substantial investment. The regulatory challenge is now different. The current regulatory approach discourages investment and infrastructure-based competition, whilst access seekers who have invested in local loop unbundling may be reluctant to transition to fibre. The prospect, or risk, of regulation which requires cost orientation for fibre may also delay and hinder investment.

3.2 The emergence of voluntary agreements

As consumer demand for higher speed access grows, the interests of access providers and access seekers will become better aligned, particularly in areas where there is infrastructure-based competition. In such areas both access seekers and the regulated access provider have an interest in competing more effectively with rival platforms. In some markets, recognising the constraints of uniform regulated access terms on their ability to compete effectively, they have reached long-term voluntary commercial arrangements. Under the right market conditions, infrastructure-based competition may also expand, as in the UK, where Virgin Media is planning to extend its footprint from just under 50% to around 65%.

3.3 Regulating to create a virtuous circle of infrastructure-based competition and investment

The challenge now is to adapt the regulatory framework and the approach of NRAs to regulation to acknowledge the greater alignment of interest between access seeker and access provider and differences in the balance of costs and benefits between *ex-ante* regulation and commercial agreements. By adapting this approach, competition and investment can become complements, in which investment delivers improved services for end users, while infrastructure-based competition drives up value for money to create a virtuous circle.

This dynamic process is not a one-off event, but a continuous process in which investment and competition complement one another. The aim is to support continuous investment, competition and innovation everywhere within each member state in a way which is responsive to, and anticipates end-user demand. Revising the regulatory framework in this way should make a substantial contribution to a successful digital single market.

3.4 Aligning the interests of access providers and access seekers

The transition to fibre, particularly in areas where infrastructure-based competition exists, also tends to align the interests of access providers and access seekers. Both co-investment and contracts involve risk sharing - notably via up-front financial commitments in return for lower prices per broadband connection. This increases the incentives for contracting access seekers to increase broadband take up and compete more aggressively with rival platforms. This alignment of interests has led to co-investment in Spain, France and Portugal and long-term voluntary contracts in the Netherlands[23] and Germany.

Historically, access regulation was focused on promoting entry by access seekers. But we are now entering a more mature phase of competition which requires a different approach to regulation and which enables commercially motivated market governance to flourish. The scope and extent of *ex-ante* regulation can then be reduced as commercial agreements develop, with the role of the regulator moving from a body which specifies access conditions to one which monitors and adjudicates.

There are precedents for such an approach. In the UK terrestrial broadcast transmission services provided by Arqiva are predominantly governed by long-term contracts with an independent adjudicator offering guidance and intervening in disputes as a last resort:[24]

> *"The adjudication process should be seen by Arqiva and its customers as a fall-back option; customers are expected to first undertake bilateral negotiations with Arqiva on a good faith basis with a view to entering into commercially negotiated contracts. Only where a satisfactory agreement cannot be reached should customers then turn to the dispute process. The Adjudicator has the right to resolve disputes only where it can be proven that reasonable attempts have been made, without success, to negotiate terms commercially."*

In a growing number of instances platform competition coupled with voluntary commitment to open access and potentially long-term contracts may be sufficient to ensure that the retail market is effectively competitive absent wholesale regulation. In other circumstances remedies might be relaxed, for example by shifting from an *ex-ante* economic replicability test to a complaints-driven regime[25]. Long-term voluntary arrangements not only allow *ex-ante* regulation to be removed or relaxed, but may be superior to *ex-ante* remedies in terms of their flexibility and incentive properties. These are discussed in Figure 3-1.

[23] Between KPN and the three main access seekers. See *KPN reaches agreement on fixed network access,* 20 July 2015. http://corporate.kpn.com/press/press-releases/kpn-reaches-agreement-on-fixed-network-access.htm

[24] http://www.adjudicator-bts.org.uk/

[25] See for example *Economic replicability tests for NGA services*, CRA for ETNO, March 2015

Figure 3-1: Potential advantages of voluntary long-term contracts versus *ex-ante* remedies

First, long-term contracts offer greater predictability and commitment to both access seekers and access providers. For example the agreements in the Netherlands agreements have seven year durations - considerably longer than the three year period between market reviews. Contracts may also include renewal clauses that make their effective length longer.

Second, long-term contracts may improve incentives for cost efficiency compared with short duration price controls. The opportunity for the network provider to more effectively benchmark the performance of its own retail arm against access seekers would also be expected to promote cost efficiency i.e. the vertically integrated access provider is in effect partially outsourcing its retail function via contracts.

Third, voluntary agreements require both parties to negotiate and seek an agreement of mutual benefit. Further agreements may include bespoke elements which suit the needs of different access seekers whilst preventing overall price discrimination in favour of the retail arm of the access provider. Contracts may also include terms that achieve non-discrimination to the satisfaction of access seekers but which are less costly to implement than across the board equivalence of input requirements.

Fourth, long-term contracts can include price structures and risk sharing arrangements that align the interests of access seeker and access provider in relation to investment, transition and competition with competing platforms. In practice we observe two part price structures with an element of up-front payment in return for reduced ongoing payments per customer connection. This not only introduces risk sharing and supports investment, but also allows greater pricing freedom in the retail market for access seekers and creates greater incentives for access seekers to increase broadband and superfast broadband adoption.

3.5 Changing regulation to strengthen the competitive process

Our research also suggests that the current form of regulation is starting to harm the competitive process by unduly handicapping the regulated access provider where it faces strong infrastructure-based competition from an unregulated rival. See Appendix C. OECD guidance also highlights practices which can have a negative impact on competition but which are commonly applied under *ex-ante* regulation. This includes a practice which "*Requires or encourages information on supplier outputs, prices, sales or costs to be published*" or a practice which *"Limits sellers' ability to set the prices for goods or services"*.[26]

[26] OECD. "Competition Assessment Toolkit". http://www.oecd.org/daf/competition/45544507.pdf

4 Incentives for investment

In this section we consider the factors which create incentives for investment in fixed access infrastructure and the role of regulation in strengthening or weakening these incentives. These incentives depend on the anticipated incremental revenues and incremental costs which investment will generate, after allowing for market and regulatory risk. Regulation impacts on both the incremental revenues from, and incremental costs of, investing. Investment incentives can be therefore be improved by:

- Allowing investors to capture more of the incremental value – which depends on freedom to determine the service enhancement and prices
- Allowing investors to minimise the net cost involved – which depends on freedom to choose an efficient technology mix and to close legacy services and infrastructure
- Commitment to a sound regulatory approach, thereby reducing regulatory risk
- Risk sharing between regulated access providers and access seekers

Investment incentives are also influenced by competition in two ways:

- Infrastructure platform competition may motivate investment to the extent that investment is required to attract or retain customers.
- Access based competition may motivate or discourage investment depending on the access terms and whether or not risk is shared between access provider and access seeker.

We also observe empirically that the level of overall investment is directly related to the revenues of the access provider, as discussed in Section 2.4. Increased revenues can therefore be thought of as a pre-condition for seeing significant increases in the level of investment.

Finally we note that financial investors - as opposed to operators - choose in which regions and sectors they invest in. The profitability of investments is of major importance for such decision-making. Too stringent regulation may lead investors to focus their investments on different industry sectors or world regions.

4.1 Regulatory incentives to choose specific technologies

The idea that a regulatory disincentive to invest in one technology will encourage investment in another is dubious.

A number of companies in Europe have embarked on fibre to the cabinet investment, triggered in part by the 2013 recommendation on costing and non-discrimination[27]. They are now considering possible future upgrades from VDSL to G.fast. Other companies in other member states have invested in FTTH while cable companies have invested in DOCSIS 3.0 upgrades and are now contemplating further upgrades to DOCSIS 3.1. In these circumstances can, and should, regulation influence the choice of NGA technologies?

There are strong arguments that regulation should remain *technology neutral*. These are discussed further in Sections 4.3 and 5.2. We also note that regulation which creates disincentives to invest in

[27] Or, in the case of the UK, adoption of a similar package of measures in 2010)

one technology will not necessarily mean more investment in rival technologies. Ultimately, investments are dictated by financial investors, as opposed to telecommunications operators, who choose which world regions and industry sectors they invest in. This means that regulatory disincentives to invest in an existing communications technology may drive investment funds entirely away from the telecoms sector in Europe. Moreover introducing a regulatory disincentive to invest in a technology for which a positive investment signal had previously been provided, would, almost certainly, reduce long-term investment incentives.

4.2 Capturing incremental value

There may be demand and willingness to pay for higher speed broadband which should lead to investment. But cost oriented prices do not take account of an end user's willingness to pay and this means that the investor may not be able to fully exploit willingness to pay. So cost oriented price controls weaken the investment case. Allowing pricing-flexibility and price-product differentiation to a regulated access provider deals with this problem[28].

In cases where there is no effective competition, allowing the greatest possible scope for service and price flexibility, consistent with constraining any abuse, should therefore be the aim. For example:

- Minimising the extent of price regulation, and avoiding reliance on cost oriented prices, can contribute to an alignment of investor and consumer interests in moving to new and more advanced forms of broadband access.
- Placing greater weight on voluntary commercial agreements, including co-investment and voluntary long-term contracts which allow for risk sharing, should also help. Such agreements increase the scope for service-price differentiation by ensuing that retailers contribute to up-front costs. The advantages of voluntary long-term contracts are summarised in Figure 3-1.

Allowing scope for service-price differentiation with next generation broadband is particularly important because (as discussed in Appendix D1):

- The high capacity and greater service consistency of NGA broadband service, when compared to copper ADSL based broadband, increases the scope for differentiation.
- Service-price differentiation allows market players to offer lower-price/lower-functionality[29] as well higher-price/higher-functionality packages. This promotes both investment and digital inclusion of end users.
- Service-price differentiation better aligns anticipated incremental costs with incremental willingness to pay for higher speed broadband thereby promoting an efficient technology mix.

Key aspects of service-price differentiation can be sustained in the retail market if it is mirrored in the wholesale market. Alternatively, market participants might face a cost structure with significant up-front pooled costs (through co-investment or long term contracts with two-part tariff structures). In contrast passive fibre unbundling at a single cost oriented price is likely to be incompatible with service-price differentiation (see Appendix D2).

[28] This point is discussed in detail in Appendix D

[29] Functionality might be defined in terms of download and upload speeds, data caps, latency and packet loss, and customer service levels

These arguments point to a need to reassess the balance of costs and benefits in deciding when, and at what level, to intervene through regulation. To the greatest extent possible, flexibility in choosing service levels and setting prices should be allowed if investment incentives are to be maximised.

4.3 Minimising incremental transition costs

Specific measures, such as use of less constraining planning laws and use of existing ducts, can lower the cost of network deployment and hence strengthen the case for NGA investment. Here we focus on two things that significantly lower the costs of network transition – technology neutrality and the opportunity to retire legacy services and network elements.

4.3.1 Technology neutrality

New technologies are improving the performance of existing access networks. These include copper[30], fibre[31] and hybrid fibre coaxial networks,[32] as well as Ka-band satellite and LTE-based mobile networks. These technologies are lowering the unit costs of delivering higher speed broadband and higher data capacity. Which technology should be deployed in each member state? There are a number of factors influencing this choice:

- There are advantages and disadvantages to investing in each technology upgrade. For example FTTH offers a greater prospect of higher speeds. But, depending on the member state, it may be costly and slow to deploy when compared with FTTC. Australia and the UK offer an interesting comparison here. In Australia the government chose the technology (FTTH), did not allow competition from alternative technologies such as HFC, set up the structurally separated company to supply NGA, and provided very high levels of public subsidy to fund the rollout. In the UK by contrast the main access provider chose the technology and deployed on a commercial basis while facing strong competition from cable. Figure 4-1 shows the very different outcomes in terms of NGA deployment
- Hybrid copper-fibre technology has also developed, with new technology and standards delivering performance that may previously have been thought unattainable with copper
- The cost of deploying each of these technologies varies according to the pre-existing market conditions in individual member states. In some there are higher quality underground ducts with more spare capacity; in some the sub loops are shorter, making them suitable for FTTC upgrades; and in others use of overhead wiring substantially lowers the cost of FTTH deployment. As a result FTTH can be a cost effective option. We note that some access providers (such as the ex-incumbents in Belgium, Germany and the UK) have chosen FTTC whilst others (in Malta, Portugal and Spain) have chosen FTTH
- The incremental willingness to pay for high speed broadband by end users, and the rate at which incremental willingness to pay falls as speeds increase, is highly uncertain and varies from one segment of the market to another.

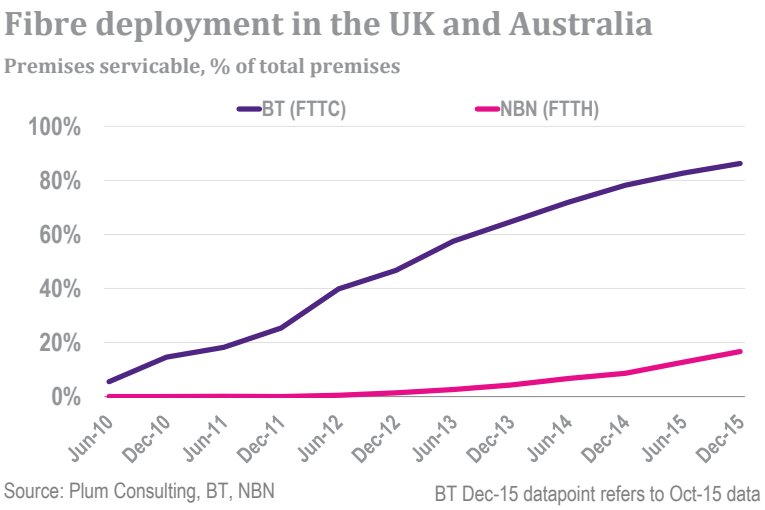
[30] For example upgrades to VDSL with vectoring, G.fast or XG.fast

[31] For example upgrades to more cost-effective GPON

[32] For example DOCSIS 3.1

Market players are best placed to make this choice in that they better understand the likely cost of deployment, willingness to pay for high speed broadband and risks involved in different choices.

Figure 4-1: Differing speeds of rollout for FTTx-



In combination these arguments suggests that a guiding principle of technology neutrality should be applied to maximise the pace and extent of high speed access deployment, and to minimise the public subsidy required in high cost areas.

4.3.2 Retirement of legacy services

Maintaining parallel legacy services and networks increases costs and undermines the economics of network upgrades. Investment is maximised if operators are free to innovate without regulatory constraints and to retire legacy services and network elements, subject to a minimum set of conditions designed to protect the interests of end-users and access seekers.

In the US the FCC has clarified the position regarding retirement of legacy service and network. See Figure 4-2 for a summary[33]. Regulatory approval to withdraw legacy services is not required provided customers are offered a broadly comparable product.

[33] FCC. August 2015. "FCC Releases Rules to Spur Technology Transitions, Protect Consumers." FCC 15-97. https://www.fcc.gov/document/fcc-releases-rules-spur-technology-transitions-protect-consumers

Figure 4-2: FCC rules to spur technology transitions while protecting consumers

The FCC does not require regulatory approval for the retirement of legacy services if the transition does not create a "discontinuance, reduction or impairment of service".

Providers seeking to retire copper must give at least 180 days' notice to interconnecting carriers and non-residential retail customers, and 90 days' notice to residential retail customers. The notice needs to be direct, clear and technology-neutral. *De facto* retirement – that is, allowing copper to degrade – is also covered by these requirements.

Incumbent providers that discontinue a TDM-based service must also give competitive carriers "reasonably comparable wholesale access on reasonably comparable rates, terms, and conditions" - on an interim basis. This measure is intended to preserve competition in the market.

The "reasonably comparable wholesale access" requirement allows for flexibility and is intended to be interpreted on a case-by-case approach. Nevertheless, the FCC set out five questions they will consider in assessing whether a wholesale access is "reasonably comparable":

- Will the price per Mbps increase?
- Will a provider's wholesale rates exceed its retail rates?
- Will comparable basic services be available?
- Will bandwidth options be reduced?
- Will service quality be impaired?

The FCC declined a request that "a carrier must present the same standardized interface to the end user as it did when it used copper." A comparable product is not therefore a strictly comparable product. The FCC also declined a request that carriers should have responsibility, beyond reasonable notice of change of service, for any required changes to customer premise equipment.

By contrast in Europe, unless all access seekers agree, five years notice is required for copper retirement. This leads to substantial delay and high dual running costs, since alternative operators may hold an access provider to ransom. This is not in the interests of end-users who want timely provision of services that meet their needs and minimisation of dual running costs.[34] Nor do such long delays strengthen infrastructure-based competition which might spur further investment.

If investment is to be maximised, access providers should be free to close legacy services and network elements after a short notice period. Policy should also permit, but not dictate the timing, of retirement. This approach is consistent with economic efficiency since market players are in the best position to assess the cost savings from retiring legacy services and network elements.[35] Further, given information asymmetries, freedom to close legacy services does not preclude commercial negotiation to pay for extended service.[36]

[34] Since end users ultimately pay for the dual running costs

[35] Plum Consulting. February 2015. "Leaving a legacy". http://www.plumconsulting.co.uk/pdfs/Plum_February_2015_Leaving_a_legacy.pdf

[36] The scope for commercial negotiation to reach an efficient outcome is illustrated by the US Navy's Space and Naval Warfare Systems Command paying for extended support for Microsoft Windows XP.
Ars Technica, June 2015. "Navy re-ups with Microsoft for more Windows XP support." http://arstechnica.com/information-technology/2015/06/navy-re-ups-with-microsoft-for-more-windows-xp-support/

4.4 Commitment, adaptability and regulatory risk

Predictability and commitment can reduce regulatory risk[37], thereby supporting investment. Predictability is maximised if a principled and evidence based approach to regulation is adopted. However, predictability does not necessarily deliver commitment. Once an investment is made, one possible response by regulators is to give investment less weight. Knowing this, investors may be reluctant to invest in the first place.

Credible regulatory commitment can help reduce this investment problem.[38] There is value in committing to an approach that rewards investment and risk in advance and in designing mechanisms which help make this commitment credible. There may also be a trade-off between commitment to a particular regulatory approach and the need to adapt to altered market circumstances.

Not only can an increase in regulatory commitment promote investment, it can also promote investment in longer-lived assets such as fibre to the premise. There are two reasons for this. First, regulatory commitment would reduce the cost of finance, thereby supporting investments with a longer pay back.[39] Second, a repeat investment game would be less important as a commitment device, provided the commitment not to expropriate returns on long-lived investment were credible.

Commitments could be forthcoming at both the commercial and regulatory level, and the two may be complementary. Co-investment and long-term voluntary contracts between access seekers and access providers may not only result in better market outcomes in terms of investment and competition, but also support a removal of, or a reduction in, regulation. Regulators, in anticipation of this possibility, could commit in advance to lift or reduce regulation based on announced thresholds, wherever voluntary commitments and/or increased competition would justify such a relaxation.

Finally an NRA could, once a market is deregulated, commitment not to reintroduce regulation in subsequent market reviews, provided that the market characteristics which justified deregulation did not deteriorate significantly.

4.5 Conclusion

Incentives for investment depend on pricing freedom, scope for service price differentiation, commitment not to expropriate investment once it is made, and the ability to retire legacy services and network elements. Investment incentives also depend on competition. Infrastructure-based competition promotes investment, and investment promotes infrastructure-based competition; whilst the impact of assess based competition depends on whether risk is shared either via co-investment or long-term contracts.

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[37] Risk is not necessarily fully compensated if risk is factored into the calculation of the weighted average cost of capital. There may also be asymmetric risk in relation to expected cash flow, in particular if successful investment is regulated and can only earn normal returns whilst investors are unable to recover the costs of unsuccessful investment.
Ruback, Richard S. October 2010. "Valuation when Cash Flow Forecasts are Biased,"
http://www.hbs.edu/faculty/Publication%20Files/11-036.pdf

[38] Witold Henisz. 2002. "The institutional environment for infrastructure investment." *Industrial and Corporate Change* 11(2).
http://www-management.wharton.upenn.edu/henisz/papers/ieii.pdf

[39] It is not necessarily the case that fibre to the premise is more risky that fibre to the cabinet, since, if fibre to the cabinet investment does not meet demand expectations, it invites intense competition and potential entry by rival infrastructures. The point here is that the net present value of an investment with a long but potentially higher payback is greater if the discount rate is lower.

We put forward specific proposals in the next two sections for changes to the framework which would promote deeper competition and a step change in investment.

5 Proposals for changing the regulatory framework

5.1 Introduction

The concrete proposals for change in this section are put forward with the aim of strengthening investment incentives and deepening competition without compromising customer protection. Some of these proposals have been discussed in previous sections and are set out briefly; others relate to procedural changes and aim to reinforce points of principle or aspects of the existing framework which it is important to preserve.

We set out proposals for change under two headings:

- Guiding principles which we believe the revised framework should follow if it is to promote investment and competition in the supply of broadband connectivity for the Digital Single Market. See Section 5.2
- Specific proposals for a revised market review process. These are described in Section 5.3.

5.2 Guiding principles for the revised framework

Based on the analysis set out in Sections 2 to 4 we propose that the revised framework should be designed to comply with eight main principles:

- Set a single regulatory objective for NRAs
- Preserve technology neutrality
- Restrict ex-ante regulation to the minimum required to deal with the competition problems identified
- Define and examine competitive conditions in retail markets before considering whether wholesale remedies are required
- Allow access providers to close legacy networks and services with the minimum of constraints
- Support and take account of voluntary agreements between access providers and access seekers
- Give regulated access providers the maximum pricing freedom which is compatible with the single regulatory objective for NRAs
- Move regulation from ex-ante to ex-post remedies where possible.

We describe these principles and set out our reasons for proposing them in the subsections which follow.

5.2.1 Principle 1: set a single objective for NRAs

We propose that Article 8 of the framework directive should be reformulated to require NRAs to pursue a single objective – the long-term interests of end users in terms of availability, quality, choice and price of connectivity and services. In applying economic regulation under this principle NRAs would

then aim to maximise overall economic welfare - including dynamic, productive and allocative efficiency. This would encourage them to consider the extent to which proposed regulations promote investment and innovation and support competition, particularly infrastructure-based competition. Establishing a single regulatory objective, rather than the three in the current Framework Directive, would also lead to greater harmonisation of regulation across the EU.

When the current regulatory framework was developed in 2001, the focus was on enabling entry to a fixed telecommunications sector in which operators enjoyed close to a 100% share of markets dominated by voice telephony. Today the fixed sector is dominated by broadband revenues (if we attribute fixed line rental to broadband for those taking broadband) and the broadband retail market share of ex-incumbent network operators is around 40% and continuing to fall steadily (see Appendix C).

Given these changes in market circumstances, it makes sense to revise the objectives set out in Article 8 of the Framework Directive so as to focus on dynamic effects and to promote improved end-user outcomes in terms of availability, quality, choice and price of services. The current form of Article 8 of the Framework Directive specifies three objectives each of equal status:

- To promote the interests of end users
- To promote competition; and
- To contribute to the development of the internal market.

The first of these is the ultimate objective, and the other two are means of achieving the first objective. As a result the current formulation of Article 8 has two undesirable consequences:

- It allows an unnecessary divergence of regulatory approaches between member states (at the expense of completing the internal market) in that it allows NRAs freedom to choose what weight to give each of the three objectives
- It leads NRAs to give undue weight to the promotion of service based competition. Specifically it does not list promotion of investment as an objective.

One way to deal with this problem would be to add a fourth objective - the promotion of investment. But this option does not deal with the objections set out above. It both continues to confuse means with ends and leads to unnecessary fragmentation of the single market.

In putting forward this principle we note that objectives which are more clearly focussed on dynamic benefits have been adopted elsewhere in the developed world. In the US the Telecommunications Act of 1996 includes:

> "…*encourage the rapid deployment of new telecommunications technologies."*[40]

In its current strategic plan for 2015 to 2018 the FCC includes the following goal:[41]

> *"Strategic Goal 1: Promoting Economic Growth and National Leadership*
>
> *Promote the expansion of competitive telecommunications networks, which are a vital component of technological innovation and economic growth and help to ensure that the U.S. remains a leader in providing its citizens opportunities for economic and educational development."*

[40] https://www.gpo.gov/fdsys/pkg/STATUTE-110/pdf/STATUTE-110-Pg56.pdf

[41] https://apps.fcc.gov/edocs_public/attachmatch/DOC-331866A1.pdf

The Australian Telecommunications Act 1997 refers to *"the long-term interests of end-users"* and to *"incentives for investment"*[42] as goals for regulation

The New Zealand Telecommunications Act 2001 includes a purpose "to promote competition in telecommunications markets for the long-term benefit of end-users…" and also states that:

> *"To avoid doubt, in determining whether or not, or the extent to which, competition in telecommunications markets for the long-term benefit of end-users of telecommunications services within New Zealand is promoted, consideration must be given to the incentives to innovate that exist for, and the risks faced by, investors in new telecommunications services that involve significant capital investment and that offer capabilities not available from established services."*

There is therefore a focus on incentives and dynamic considerations in relation to the above legislation. The New Zealand framework is under review with the discussion document raising the possibility that:[43]

> *"We are also considering the case for amending the Act's purpose statement to explicitly promote growth, innovation, and efficient investment in communications markets for the long-term benefit of end-users."*

5.2.2 Principle 2: maintain regulation which is technology neutral

We propose that the revised framework should preserve the principle of technology neutral regulation.

Technology neutrality is an important principle which has underpinned the regulatory framework since it first became law in 2003. Technology neutrality requires NRAs to set rules which do not discriminate against use of one communications technology and in favour of another. Choice of technology, along with other investment decisions on where and when to invest, is left to market players.

There is widespread support from almost all market players for retaining the technology neutrality principle. Submissions and statements by ETNO[44], ECTA[45], GSMA[46] and Cable Europe[47] are all in favour of retaining this principle. There are also strong economic arguments for preserving technology neutrality:

- Market players are better placed to make efficient investment decisions[48] than NRAs or governments. They have far more information on both the incremental costs of deploying new technologies and the incremental revenues which might flow from investing. They also have strong incentives to assess all available options in terms of costs and current and future customer demand
- There is a range of technology choices available to market players to meet end-users demands for higher speeds. As well as FTTH there are technologies such as g.fast (for upgrading copper

[42] http://www.austlii.edu.au/au/legis/cth/consol_act/ta1997214/s3.html

[43] http://www.mbie.govt.nz/info-services/sectors-industries/technology-communications/communications/regulating-the-telecommunications-sector/review-of-the-telecommunications-act-2001/consultation-8-sept-2015

[44] Steven Tas statement to the ETNO conference in November 2015

[45] *The digital single market and telecoms regulation going forward*, Analysys Mason for ECTA, September 2015

[46] http://www.gsma.com/gsmaeurope/wp-content/uploads/2015/12/2015-12-07-GSMA-TFR-consultation-summary.pdf

[47] *Cable Europe's Views on the Digital Single Market Strategy*, June 2015

[48] Which maximise economic welfare gains

loops) and DOCSIS 3.1 (for upgrading HFC access networks). Both offer very substantial broadband speed increases over existing technologies. FTTH may offer higher speeds but may be more expensive and slower to deploy than other technologies. Australia offers an extreme example of where a technology choice by government, rather than market players, has led to inefficient investment. There, the cost of FTTH deployment is now estimated at around €6,000 per household while rollout has been painfully slow (as illustrated in Figure 4-1)

- The cost of deploying high-speed broadband using any given technology varies considerably by member state. For example it depends on the availability of high-quality ducts and the extent to which overhead cabling is allowed. That means that in some countries, like Malta, Portugal and Spain, FTTH might be the right technology to deploy while in other member states alternative technologies may represent the efficient investment choice
- Attempting to favour technology choices that do not correspond to the assessment by market players would be likely to drive investment to other world regions and industry sectors and prove counterproductive.
- Technology neutrality allows the market to make the greatest possible contribution to achieving broadband policy goals and minimises the need for public subsidy.

We therefore propose a re-commitment to technology neutrality.

5.2.3 Principle 3: restrict ex-ante regulation to the minimum required to deal with the competition problems identified

The existing framework already contains a number of relevant features which reflect this principle. For example:

- That markets which are effectively competitive should not be regulated
- That remedies should be implemented at the wholesale rather than the retail level
- That remedies should be proportionate – the minimum required to deal with the competition problems identified.

These are important principles. But it is not clear that regulatory practice by NRAs always follows these principles. We therefore make suggestions for reinforcing Principle 3 in the rest of this section.

5.2.4 Principle 4: focus on retail markets and wholesale remedies

We propose that future market reviews should focus on:

- Defining and examining competitive conditions in retail markets rather than notional wholesale markets
- Developing wholesale remedies to deal with competition problems in retail markets which are not effectively competitive.

This approach focuses regulation on the right regulatory objective - that is the long-term interests of end users who are concerned about choice in the retail market.

Our proposed approach is implied in the current framework, but regulatory practice often does not reflect this. The 2014 Recommendation on relevant markets states that market reviews should start with consideration of competitive conditions in the retail market and, if this market is effectively competitive absent pre-existing *ex-ante* regulation, withdraw wholesale remedies completely. For example in Recital 10 the Recommendation the Commission states:

> *"If the retail market concerned is effectively competitive from a forward looking perspective in the absence of ex-ante wholesale regulation on the corresponding relevant market(s), this should lead the national regulatory authority to conclude that regulation is no longer needed at wholesale level"*

Nevertheless many regulators continue to focus on assessing wholesale market competition from which they exclude wholesale supply by cable operators. This logically leads to an outcome where, even if the ex-incumbent operator had (say) 20% the retail market and the rival cable operator the remaining 80%, the former would be regulated while the latter would not. The review of the framework is an opportunity to make it unambiguously clear that market reviews should focus on defining and assessing retail markets. Then, if these markets are effectively competitive, absent existing ex-ante regulation, wholesale regulation should be withdrawn.

As part of this process of defining and assessing competitive conditions in retail markets it will be important for NRAs to consider the geographic scope of retail markets for broadband access. As we point out in Section 2.3, infrastructure-based competition, especially from cable operators, is now substantial and growing steadily. But high levels of infrastructure-based competition, which might result in effective competition in the retail market, only exist in around 50% of a typical member state. By defining sub-national geographic retail markets it should be possible to lift regulation in those where infrastructure base competition is strong and focus regulation on those where it is weak or non-existent.

5.2.5 Principle 5: allow regulated access providers to close legacy networks and services with the minimum of constraints

We propose that:

- Network operators should have the option, but not an obligation, to close legacy services (for example, as part of all-IP transition) and network elements as part of a transition to fibre access
- The required minimum notice period should be short
- Permission should not be required, provided that end-users and access seekers can obtain a broadly similar service level at a similar price on the new technology network.

This last requirement corresponds to the anchor product concept, but might in future require the implementation of a virtual anchor on fibre rather than relying on copper access. The Commission's recommendation on costing and non-discrimination anticipated this possibility:

> *"If the product offered by the SMP operator on the legacy access network is no longer able to exercise a demonstrable retail price constraint on the NGA product (for example in the event of a copper switch-off), it could in principle be replaced by an NGA-based product that is tailored to have the same product features."* Paragraph 56

Allowing the freedom to close legacy services and network elements without permission would lower overall sector costs and promote investment by access providers. In particular it would give greater

incentives for infrastructure-based players to upgrade their networks so as to replace expensive legacy technologies with modern technologies which offer lower unit costs and higher levels of functionality to end users.

5.2.6 Principle 6: recognise and encourage use of voluntary commercial agreements

Voluntary commercial arrangements including co-investment and voluntary long-term contracts (as agreed between KPN and major access seekers in the Netherlands) have a number of advantages. Voluntary commercial arrangements may:

- Provide greater investment certainty – especially if the contract period for the agreement is longer than the market review period
- Improve risk sharing – for example between access providers and access seekers
- Increase the scope for service-price innovation and differentiation
- Increase the scope for the parties to the agreement to compete with rival infrastructures
- Support transition from current to next generation broadband
- Help ensure retail market competition remains effective if existing wholesale regulation is withdrawn, since voluntary agreements protect against market foreclosure by access providers.

As such voluntary agreements can increase investment incentives and infrastructure-based competition. They are an important form of innovation which should be encouraged and considered when reviewing the effectiveness of retail competition and assessing the need for, and extent of, ex ante regulation.

5.2.7 Principle 7: give access providers the maximum regulatory freedom consistent with Principle 1

Where retail markets are not effectively competitive regulation may be required to preserve effective service-based competition. This regulation needs to be carefully crafted if the case for infrastructure investment, especially by the regulated access provider, is not to be undermined. There are two main ways to do this:

- By moving away from cost oriented price regulation
- By simplifying the wholesale remedies used

Moving away from cost orientation

As we discuss in Section 4.2, use of cost oriented pricing remedies weakens the case for investment by the regulated access provider. Regulators can give access providers greater pricing freedom at the wholesale level, and hence strengthen the case for infrastructure investment, through a range of alternative measures. These include:

- Application of an investment friendly economic replicability test

- Reliance on voluntary agreements commercially negotiated between the access provider and access seekers
- Application of the anchor product pricing principle by which a basic wholesale product at an entry level price constrains retail prices whilst allowing the access provider commercial freedom regarding higher specification wholesale services and prices. Anchor product regulation was conceived as an intermediate option between no *ex-ante* price control and full cost orientation for fibre.[49]

Simplifying the wholesale remedy used

Regulation at multiple wholesale levels is complex, and discourages investment and innovation. For example, in Ireland ComReg imposes the following requirements on the regulated operator for NGA wholesale products:

- A wholesale margin squeeze test between the price for *end-to-end next generation bitstream* and *NGA Bitstream*; and
- A wholesale margin squeeze test between the price for *NGA Bitstream* and the price for *VUA*; and
- A wholesale margin squeeze test between the price for *VUA* and the price for *sub-loop unbundling*.

Imposing a series of such remedies along the wholesale value chain leads to a number of undesirable outcomes from a public interest perspective:

- It substantially reduces the regulated operator's scope for pricing flexibility and hence weakens its NGA investment case.
- It creates substantial scope for regulatory error. Regulating to achieve efficient prices for a series of related wholesale products is much more challenging than regulating for a single price
- It can lead to regulatory uncertainty. NRAs sometimes revise their cost models or margin squeeze test models to change the prices which the regulated operator can charge.

Historically, NRAs have justified imposition of multiple wholesale remedies on the grounds that it promotes investment by access seekers. The idea is that access seekers can then climb the ladder of investment to become infrastructure-based competitors to the access provider. But it is now over 15 years since the EU telecommunications markets were opened to access seekers and there is now wide range of studies which point firmly to the conclusion that the ladder of investment concept does not work and should be abandoned (see Appendix E).

We proposed that, where regulation is required, it should be focussed on one wholesale layer per geographic market[50]. However, the appropriate layer on which to focus regulation will depend on the technology deployed and the costs and benefits of alternative options. This choice should therefore be left to the NRAs. We might think of this approach as reframing, or abandoning, the ladder of investment concept. It recognises that multiple rungs of the ladder tend to become an enduring feature of regulation rather than a transitional mechanism to achieve greater investment by entrants.

[49] Brian Williamson. 2014. "Anchor product regulation – a new regulatory tool." Info, Volume 16(5). Working paper: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2336963

[50] Which will have both a product and geographic scope

We therefore propose that the revised regulatory framework should require NRAs to impose a single wholesale remedy in a retail market which is not effectively competitive unless NRAs can provide strong public interest arguments as to why there is a need to impose more than one wholesale remedy.

5.2.8 Principle 8: move from ex-ante to ex-post sector specific regulation

The revised framework should encourage NRAs to apply sector specific regulation on an ex-post[51] rather than on an ex-ante basis where possible. It is now 15 years since EU telecommunications markets were opened to competition. As a result ex-ante measures which were designed to promote market entry have become increasingly irrelevant. Over the past five years in particular we have seen substantial consolidation between entrant market players and little new entry. At the same time it is clear, as discussed in Section 2, that ex-ante regulatory measures have reduced infrastructure investment in the EU.

In these circumstances it makes sense for NRAs to use ex-post regulation more and ex-ante regulation less. For example an NRA might:

- Move from imposing ex-ante access regulation to ex-post supervision of voluntary agreements between access providers and access seekers
- Move from ex-ante economic replicability tests to tests driven by complaints
- Refrain from dealing with problems of joint dominance or tight oligopolies on an ex-ante basis.

5.3 Proposals for a revised market review process

If adopted the principles set out above would lead to a revised market review process. We make proposals for this revised process below – in terms of market definition, assessment of competition, and development of remedies. Some of the proposed changes are designed to ensure consistent regulatory practice at the Member State level; others are designed to make more fundamental changes to the regulatory framework.

5.3.1 Market definitions

We propose, in line with the arguments set out under Principle 4, that an NRA should start the market review process by defining retail (rather than wholesale) markets for fixed broadband access in terms of both the product and geographic scope. It would then examine whether these markets are effectively competitive if existing ex-ante regulation were withdrawn. When defining the geographic scope of retail markets the assessment should be based on competition law practices to identify areas where "*the conditions of competition are similar or sufficiently homogeneous and which can be*

[51] We define **ex-ante** sector specific regulation as regulation which is designed to prevent anticipated future market failure - for example requirements for an access provider to supply wholesale products cost oriented prices over a market review period. We define **ex-post** sector specific regulation as regulation designed to correct a market failure which has already occurred. Sector specific regulation can be applied on both an ex-ante and ex-post basis within this definition.

distinguished from neighbouring areas in which the prevailing conditions of competition are appreciably different"

This approach is superior to one in which NRAs focus primarily on wholesale markets in that:

- It focuses regulation on the right objective - that is the long-term interests of end users who are concerned about choice in the retail market - rather than on promoting competition alone
- It is consistent with the principle of deploying the minimum regulation required to deal with the observed competition problems
- It leads to (some) lifting of regulation which helps promotes investment and innovation by infrastructure-based operators
- It avoids the problem of regulating a weak infrastructure-based operator where it faces strong infrastructure-based competition from an unregulated. This outcome is a distinct possibility in an approach which ignores retail market conditions and defines wholesale markets narrowly
- As retail markets become effectively competitive, it creates incentives for access seekers and access providers to negotiate long-term voluntary agreements. As we discuss in Section 4 these agreements are often more likely to be in the public interest than *ex-ante* wholesale remedies

The definition of markets will depend on conditions in each member state. But we might expect relatively few retail **product** markets – perhaps a mass market for broadband access and a market for dedicated, high quality, broadband access to meet the needs of businesses.

In terms of the **geographic scope** of the market the market definition process may lead to a substantial number of sub-national geographic markets. Historically, NRAs have defined access markets which are national in scope – even in member states where it is clear that competitive conditions at the retail level vary substantially by geography. NRAs have often argued that, because the incumbent operator supplies nationwide on uniform supply conditions at both the retail and wholesale levels that the market is national in character. But this argument ignores the fact that there are significant other factors which create incentives for incumbent operators to offer national supply conditions. This includes:

- The significantly lower marketing costs associated with national supply conditions
- Possible reputational damage to the incumbent if it deviates from geographically averaged retail prices
- Regulatory and government pressure to preserve the national uniform supply conditions which prevailed in the monopoly era.

BEREC acknowledged these effects recently[52].

The alternative is to look at supply conditions in the retail markets and apply competition law practices. With this approach the case for sub-national geographic markets is strong in many member states. There are two possible techniques to apply here:

- The application of SSNIP[53] tests[54] is not especially helpful when applied to fixed broadband. These tests indicate that the geographic scope of the market is **local**. In terms of demand-side

[52] *BEREC Common Position on geographical aspects of market analysis*, BoR(14)73, June 2014

[53] Small but Significant Non-transitory Increase in Price

[54] Used primarily in the definition of the scope of product markets

substitution end users are unlikely to move location simply to get cheaper broadband services; and in terms of supply-side substitution, a SSNIP is very unlikely to entice new suppliers into the market, given the high level of fixed costs of entry

- Competition case law is more helpful:

  "According to established case-law, the relevant geographic market comprises an area in which the undertakings concerned are involved in the supply and demand of the relevant products or services, in which area the conditions of competition are similar or sufficiently homogeneous and which can be distinguished from neighbouring areas in which the prevailing conditions of competition are appreciably different"[55].

We note that NRAs in various member states, including Portugal, Spain and the UK, have used this approach in defining sub-national geographic markets over the past few years.

Defining sub-national geographic markets at the retail level, rather than national markets at the wholesale level, has a number of advantages from a public interest perspective:

- It identifies areas where there is infrastructure-based competition
- It then enables an NRA to lift regulation in these areas. In many cases this could happen immediately. In others regulation may still be required until infrastructure-based competition is sufficiently strong
- In either case this process helps increases competition between infrastructure-based rivals, strengthens the case for the previously regulated operator to invest, and so creates greater incentives for investment and innovation.

An NRA might determine that, following this analysis, a product market is national in geographic scope. In this case it might then wish to apply geographically differentiated remedies. Our proposal does not exclude this possibility.

5.3.2 Assessment of effective competition

The current regulatory framework is clear – if a market is effectively competitive then that market should not be regulated. This means that accurate assessment of competition is important if a market is not to be over-regulated. Given recent market developments there are a number of ways in which assessment should be changed to minimise the chance of over-regulation:

- The starting point for the assessment should change - from one in which the assumption is that the ex-incumbent operator is dominant to one in which there is a presumption that the market is effectively competitive. The NRA would then need to demonstrate lack of effective competition
- The NRA should take a more forward-looking approach to competition assessment. Is the market currently contestable and/or tending to effective competition by the end of the market review period? This emphasis is important. Currently many NRAs focus on current rather than likely future competitive conditions.

[55] Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services (C 165/10 EN Official Journal of the European Communities 11.7.2002)

- The NRA should in particular take account of the existence and prospects for infrastructure-based competition over the market review period in each retail market.

As part of the assessment of whether each retail market is effectively competitive, the NRA will need to judge what impact the withdrawal of existing ex-ante regulation would have. Here the NRA:

- Will need to take account of voluntary agreements between regulated access providers and access seekers. These agreements, and especially those which have three or more years to run, mean that the regulated access provider cannot foreclose on the access seeker. This suggests that the market shares of access seekers are unlikely to reduce drastically over the market review period if existing *ex-ante* regulations are withdrawn.
- Will need to consider whether withdrawal of existing regulation would lead to the loss of access to bottleneck facilities which are strictly necessary for the retail market to be competitive
- Might wish to conduct a survey to assess how end-users would behave if the regulated access provider were to foreclose on access seekers by refusing to supply the wholesale products required by existing ex-ante regulation. The Dutch NRA carried out such a survey recently as part of a review of the mass broadband market.

In modifying the basis on which to assess whether a market is effectively competitive we propose that the revised framework should signal clearly to NRAs the damaging public interest consequences of pursuing either joint dominance or tight oligopoly regulation on an *ex-ante* basis. We note that the use of *ex-ante* rules to deal with tight oligopolies is likely to be especially damaging, given that it is even more challenging to reliably establish a tight oligopoly on a prospective basis than it is to establish prospective joint dominance.

Joint dominance

Joint dominance occurs when two (or more) operators tacitly collude so as to generate supra-normal profits. A key test of joint dominance is the behaviour of the parties concerned. As such, joint dominance is more obviously a candidate for *ex-post* than *ex-ante* regulation. It is harder to judge whether tacit conclusion will occur in future than to judge whether it has occurred in the past.

There have been several attempts by NRAs to establish findings of joint dominance on an *ex-ante* basis. But these have so far failed. Nor is it clear that the characteristics of a duopoly retail broadband market between a cable operator and an ex-incumbent telco are those which would indicate joint dominance. There are undoubtedly high entry barriers and high levels of market concentration. But this market does not match indicators of joint dominance in three important respects:

- The products are **not** homogenous as joint dominance theory would suggest. The two players rely on different technologies for supplying broadband to end-users
- Cost structures are **not** similar. The cable network is contended in the last few hundred metres; the ex-incumbent operator's network is not
- There are significant and on-going technology changes. Cable operators are now contemplating upgrade of access networks to DOCSIS 3.1, while ex-incumbent operators are contemplating investment in FTTH, vectoring on VDSL and/or g fast technologies.

Given this analysis the prospects for establishing joint dominance on an *ex-ante* basis are slim; the prospects of a faulty judgement are substantial; and the consequences of NRAs actively pursuing joint dominance cases would be to introduce substantial regulatory uncertainty which would inhibit

investment. In these circumstances relying on ex-post competition law to regulate joint dominance seems like the best public interest outcome.

Tight oligopolies

Tight oligopolies occur where two or more market players generate sustained supra-normal profits without tacit collusion. Establishing that a tight oligopoly exists on an *ex-ante* basis is open to the objection listed above for joint dominance. But it is even more challenging since:

- It requires the regulator to judge, on the basis of market structure rather than financial performance, whether the market players concerned will in future each generate supra-normal profits
- Broadband supply is not a market which exhibits substantial capacity constraints. Yet this is a key characteristic of markets which are tight oligopolies
- There is not the same body of competition case law to guide NRAs as there is for joint dominance.

Given this analysis we again conclude that the best public interest outcome is to rely on ex-post competition law to deal with any tight oligopolies.

5.3.3 Selecting remedies

In retail markets which are not effectively competitive, how should the process for choosing remedies change so as to encourage investment and infrastructure-based competition? We propose the following:

- NRAs should simplify the wholesale remedies applied to deal with competition problems in a retail market;
- A cost benefit test should be required to justify any proposed remedy
- Voluntary agreements should take precedence over ex-ante rules
- NRAs should choose remedies which maximise wholesale pricing freedom
- NRAs should make credible commitments to the regulated access provider

We discuss each of these proposals below.

A simplified wholesale approach

NRAs should simplify the wholesale remedies applied to deal with competition problems in a retail market. This would mean abandoning the historic ladder of investment concept and simplifying regulation so that there is only one wholesale remedy for each non-competitive retail market - with an onus on NRAs to provide strong public interest justification for any additional remedies. The single remedy should be chosen so as to allow access to the input strictly necessary to compete in the relevant retail market. This would be determined in relation to the bottleneck identified during the competition assessment process.

The cost benefit test

The full range of remedies is often applied when a market is judged not to be effectively competitive. A more proportionate approach would see remedies subject to a test to see if the incremental benefits of intervention clearly exceed the incremental costs. We note here that regulation will have costs in terms of foregone flexibility, reduced investment and the risk of regulatory error.

In principle each proposed remedy should be tested against a lighter set of remedies, including reliance on *ex-post* obligations or even application of competition law alone. Voluntary commercial "remedies" - including open access reference offers, co-investment and long-term contracts - would also need to be taken into account in deciding what remedies, if any, are appropriate.

This approach is conceptually consistent with the proposed shift in NRA objectives set out under Principle 1 - to focus economic regulation on maximising gains in economic welfare.

Giving precedence to voluntary agreements

As we discuss under Principle 6, voluntary agreements between access providers and access seekers are often superior to ex-ante regulation from a public interest perspective. We therefore suggest that NRAs should prefer them as a mechanism for resolving competition problems. NRAs would however continue to monitor the effectiveness of voluntary agreements on the market and intervene on an ex-post basis if required by Principle 1.

Choosing remedies which maximise wholesale pricing freedom

As discussed under Principle 7, remedies need to be designed in a way which does not undermine the case for infrastructure investment by the regulated access provider. We propose that NRAs should move away from cost oriented price controls and rely instead on voluntary agreements, on application of anchor product pricing principles, or on application of an investment friendly economic replicability tests.

Moving to the last two remedies requires that there are significant constraints on retail prices already in existence. In the case of NGA retail markets there are three main sources of such constraints – the current anchor pricing effect from cost oriented copper loop prices; the development of a virtual anchor product based on NGA access or co-financing of part of the network; and the presence of infrastructure-based competition from cable operators and others. There may also be spill-over pricing constraints from sub-national geographic markets which are effectively competitive into sub-national geographic markets which are not. In these circumstances we believe it would be difficult for NRAs to justify the imposition of cost oriented wholesale remedies, except in the case of passive access.

Developing regulatory commitment

As we discuss in Section 4.4, lack of regulatory commitment increases investment risks for regulated access providers whilst credible regulatory commitments can help reduce this investment problem. One possible measure here is for NRAs to develop ***contingent remedies*** in which they commit in advance to lifting of regulation in the middle of market review periods if and when specific triggers are reached[56]. This proposal would be especially useful in providing early regulatory relief in areas where infrastructure-based competition is strengthening rapidly. As such it would create additional incentives for infrastructure investment by major market players. Another is for an NRA, once a market is

[56] For example a voluntary agreement is signed or a specified level of infrastructure base competition is reached

deregulated, to commitment not to reintroduce regulation in subsequent market reviews, provided that the market characteristics which justified deregulation did not deteriorate significantly.

Appendix A: The scale of the investment problem facing Europe

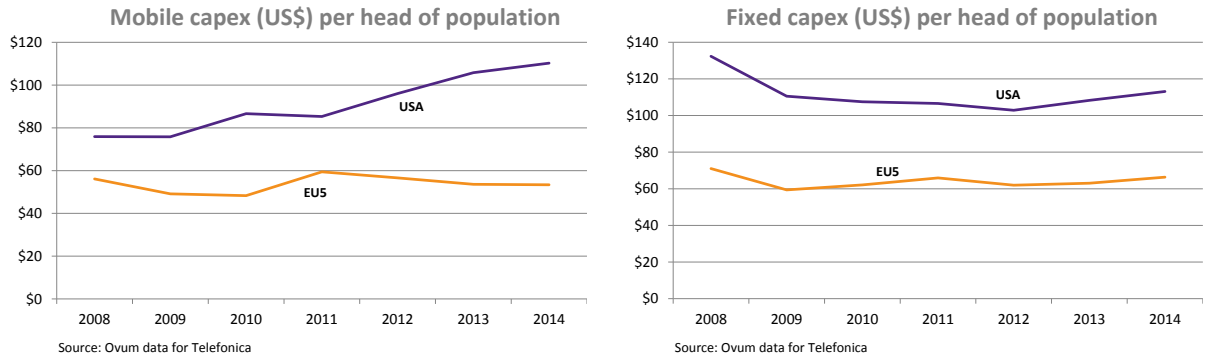
A.1 The investment gap between the EU and the US

The EU and the US follow broadly the same industrial policy in the telecommunications sector – in that they both rely on market players for the bulk of investment. So it is useful to compare the levels of investment in the two regions. Figures A1 presents this comparison, measured in terms of capital expenditure per head of population, for mobile networks and fixed networks respectively. The graphs are based on extensive research work by Ovum, which has collated the financial results from all the main operators in each individual country.

We can see that:

- The US invests twice as much per head of population as the EU5 in mobile networks[57]. Moreover this gap is growing
- The US invests 80% more in fixed networks. Here the gap is roughly constant over time.

Figure A1: The investment gap between the EU and the US



A.2 The effect of the shift to mobile in the US

In interpreting Figures A1 it is important to recognise that there is a big shift in the US telecommunications sector from fixed to mobile services. For example:

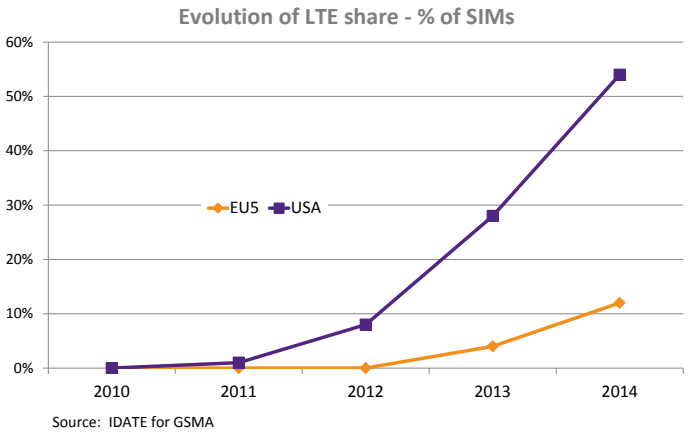
- US operators have invested heavily in LTE mobile upgrades. As a result the US has a substantial lead in LTE deployment and uptake. Figure A2 illustrates. LTE networks now reach 98% of the US population
- The main US operators have a strategy of prioritising mobile investment over fixed investment. For example Verizon operates a ***mobile first*** strategy[58] in which it has capped fixed NGA rollout

[57] Note that spectrum auction fees are excluded from investment

at 19 million lines, has sold off over 7 million (rural) fixed line since 2009, and is now planning extensive closure of its copper network in selected areas

- The number of fixed lines in the US has declined by nearly 20% whilst the number in the EU5 is virtually unchanged.

Figure A2: the US lead in LTE deployment

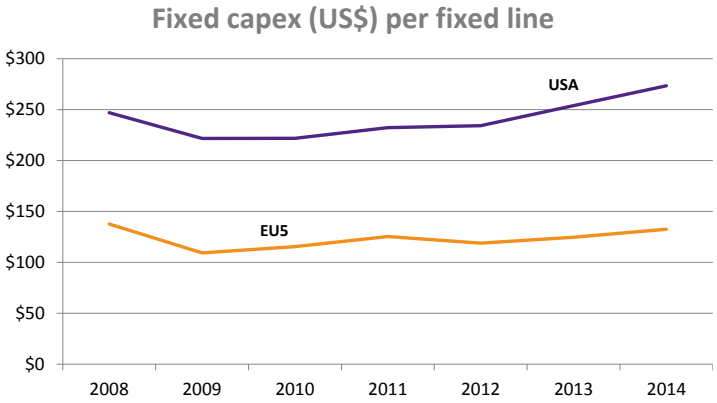


Source: IDATE for GSMA

To control for this effect we have plotted, in Figure A3, investment per fixed line in the US and EU5. The figure shows that:

- US investment per fixed line is more than double that in the EU5
- This gap continues to grow – if only slowly.

Figure A3: the investment gap in fixed networks

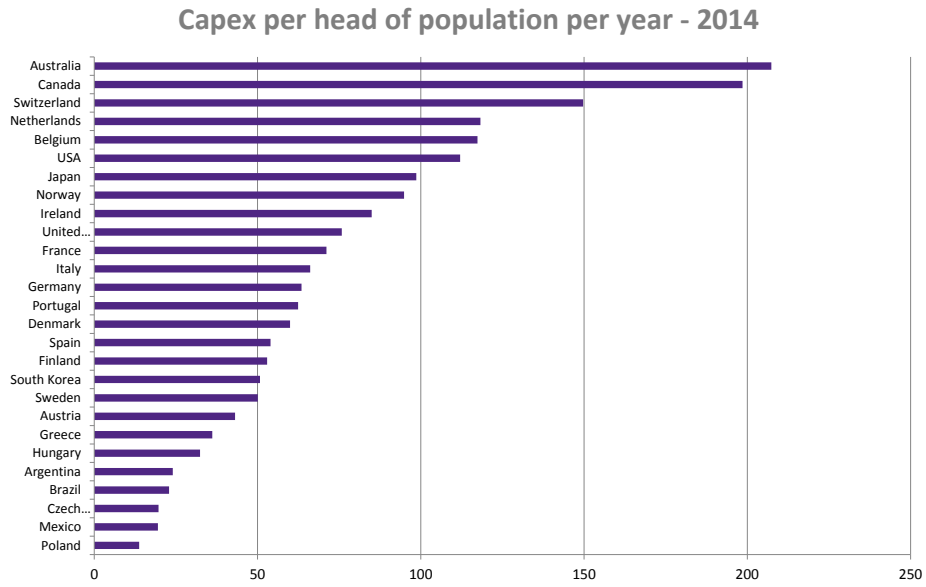


Source: Ovum data for Telefonica

[58] See for example http://seekingalpha.com/article/3738276-verizon-communications-vz-presents-at-ubs-global-media-and-communications-brokers-conference-transcript

The findings of Figure A3 are consistent with those of Figure A4, which shows the average fixed capital expenditure per head of population in 2014 for a wide range of developed countries.

Figure A4: telecommunications investment levels in developed countries



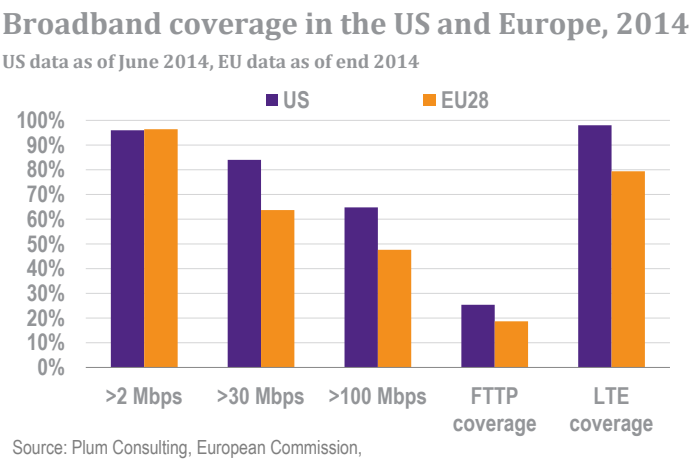
Source: Ovum data

A.3 The impact of the investment gap on broadband availability and use

The lower level of investment in the EU telecommunications sector is reflected in various comparative measures of broadband availability and use:

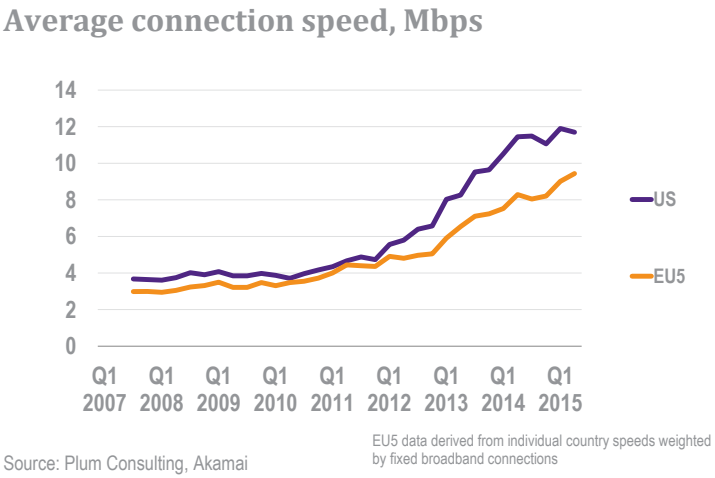
- NGA coverage is more limited, whether we compare the EU5 or the EU 28 with the US. Figure A5 illustrates for the EU 28. In practice the gap is bigger than that illustrated – partly because the US data are 6 months older and partly because actual speeds are closer to the headline speeds used in Figure A5 in the US
- The average broadband download speed enjoyed by end users is lower in Europe and the gap is widening - as Figure A6 shows
- The level of use of broadband services per head of population - a key measure the economic value of broadband - is substantially lower in Europe than in the US and Canada. Cisco projects that, on current trends, this gap will not close. See Figure A7.

Figure A5: NGA coverage – EU vs US



Source: Plum Consulting, European Commission,

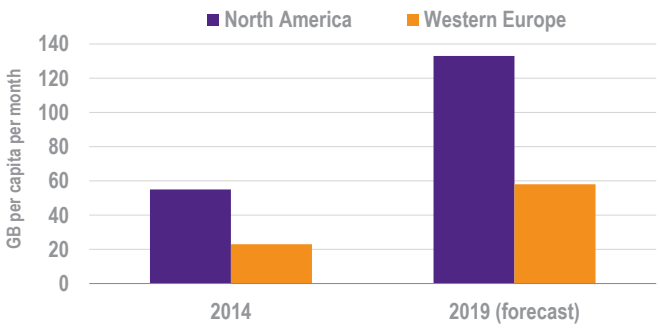
Figure A6: The growing gap in broadband speeds



Source: Plum Consulting, Akamai

EU5 data derived from individual country speeds weighted by fixed broadband connections

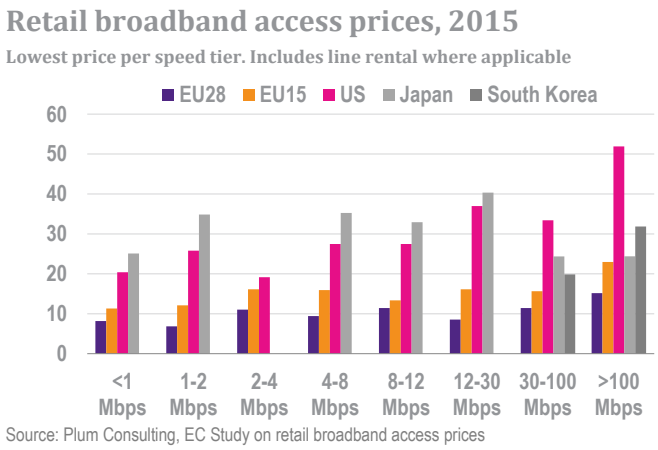
Figure A7: The gap in use of broadband



Source: Plum Consulting, Cisco VNI

Broadband prices in the EU are, almost certainly, lower in the EU than in the US. Figure A8 illustrates. We find a similar picture if we look at the OECD's Communications Outlook[59] or a recent study by Communications Chambers for Google[60]. While these lower prices may increase allocative efficiency in the telecommunications sector, they are not necessarily a good indicator of better long-term outcomes for end-users. Prices which are kept artificially low by regulation may depress investment and hence reduce the dynamic and productivity efficiency gains which result from the deployment of higher price/performance technologies. A better comparative measure of the economic impact of the telecommunication sector is likely to be the level of use of broadband services where the US is superior. We discuss this point further in Annex B.

Figure A8: The lower broadband prices in the EU



Source: Plum Consulting, EC Study on retail broadband access prices

A.4 Conclusions

We conclude that:

- The EU invests significantly less in both mobile and fixed networks than the US
- The investment per fixed line in the US is more than double that in the EU5 and the gap is widening rather than narrowing
- This lower level of investment is reflected in poorer high-speed broadband availability, lower broadband speeds and lower levels of data use in the EU.

[59] See http://www.oecd.org/sti/broadband/oecdbroadbandportal.htm

[60] See http://policybythenumbers.blogspot.co.uk/2015/02/global-broadband-pricing-study-updated.html

Appendix B: The impact of regulation on investment in the EU

B.1 The relative impact of regulation and cable coverage

Appendix A shows that EU investment in fixed networks is at a substantially lower level than in the US and that the problem is getting worse. At the same time there is less fixed line NGA coverage, lower broadband speeds and less use of broadband.

Fixed line markets in the US are subject to very little economic regulation when compared with the EU. In particular there are no requirements on dominant operators to provide unbundled copper or fibre loops. It is tempting to conclude that the absence of regulation in the US is a prime cause of the high levels of investment and better broadband delivery there. But this argument ignores the role of cable networks.

A key driver of investment in NGA coverage is the geographic footprint of pre-existing cable networks. Specifically there is a strong correlation between cable coverage and NGA coverage. Figure B1 illustrates. At the same time investment by cable operators, offering high-speed broadband services based on DOCSIS 3.0, stimulates investment by incumbent telcos. Without such competition the incumbent telco will decide whether to invest in NGA based on the incremental revenues it might generate from offering higher broadband speeds. With the presence of cable competition it judges investment on the basis that, if it does not invest, it might lose the whole of the revenues generated by customers who want higher speeds.

Figure B1: How NGA coverage is correlated with cable coverage in the EU

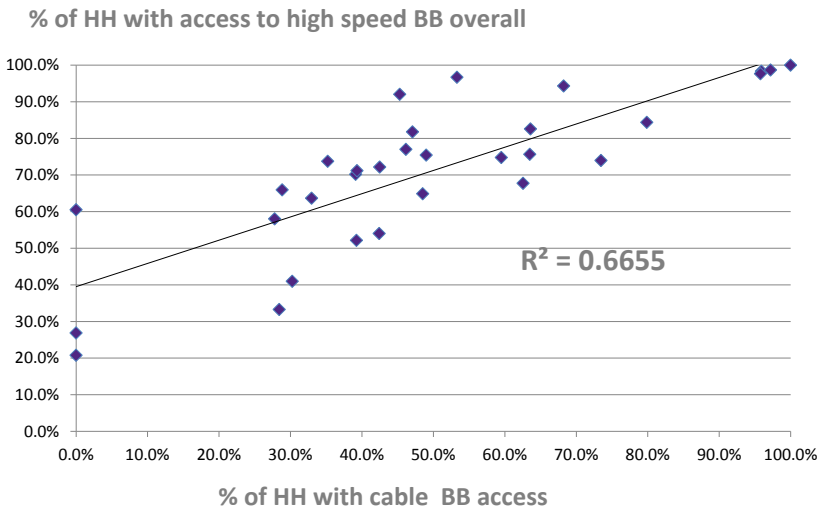
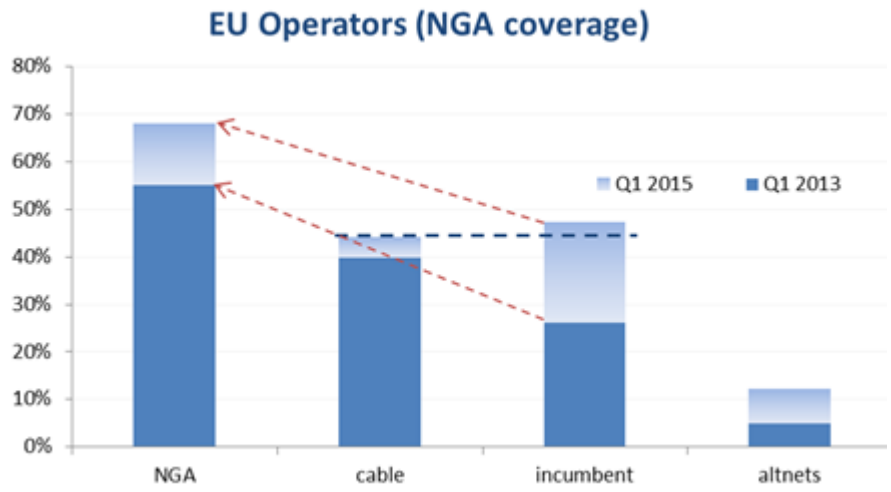


Figure B2 shows another aspect of this relationship. It indicates that:

- There is considerable overlap between NGA coverage of cable operators and NGA coverage of ex-incumbent operators

- The NGA footprint of the cable operators is expanding only slowly
- The NGA footprint of the ex-incumbent operators has expanded more rapidly and is now slightly bigger than that of the cable operators.

Figure B2: NGA coverage - capable versus copper



Source: Cullen International

Given this effect we would expect higher levels of investment in NGA coverage in countries with higher levels of pre-existing cable coverage. Here there is a major difference between the EU and the US - in the EU around 45% of households are covered by cable networks whilst in the US around 90% of households have access. So we need to control for the effect of cable coverage if we are to see to what extent the lower levels of investment and NGA coverage in Europe reflect higher levels of economic regulation.

B.2 The econometric evidence

We have reviewed the recent econometric evidence on the relationship between access regulation and investment in the telecommunications sector. Our findings are as follows:

- Grajek and Roller[61] find empirical evidence of a trade-off between access regulation and investment incentives in network industries. Their analysis differentiated between incumbents and entrants and permitted regulation to be endogenous. The results suggested that regulation discourages investment by individual entrants as well as incumbents, even as entrants' total investment increases. Because facilities-based entry is likely to require substantial firm-level investment, this is likely to have a negative impact on overall investment outcomes.

[61] Michal Grajek and Lars-Hendrik Roller. 2012. "Regulation and Investment in Network Industries: Evidence from European Telecoms"

- This research followed several other papers investigating this trade-off. For example Friederiszick[62] found that tough entry regulation (such as unbundling) discouraged infrastructure investment by entrants while Wallsten and Hausladen[63] found that unbundling obligations had a negative impact on new infrastructure investments in 27 European countries
- Cave[64] described Grajek and Roller's finding of a trade-off between regulation and investment as *"the standard result".*
- More recently Briglauer et al[65] suggested that:

  > *"unbundling might have even reduced total industry investment, meaning that investment by entrants has not been sufficient to offset the unrealised investments of incumbents"*

Yoo (2014)[66] in particular looked at the joint effects of service-based regulation[67] and cable coverage on the level of NGA coverage and the extent of non-cable NGA coverage (VDSL plus FTTH). He found that:

> *"Service-based competition has a statistically significant negative impact on NGA coverage provided by telephone companies, while facilitates-based competition [sic] from cable broadband has a statistically significant positive impact on telephone companies. Alternatively, cable broadband coverage may also be treated as a control. Either way, service-based competition has as a statistically significant negative correlation with NGA coverage."*

In other words the fact that cable coverage is greater in the US than the EU helps explain some of the difference in NGA coverage but strong service-based regulation in the EU is also an important factor in explaining the gap in broadband investment and performance.

B.3 The impact of unbundled copper loop prices

In implementing access regulation EU NRAs required incumbent operators to supply unbundled copper loops at cost oriented prices to access seekers. This measure may have suppressed investment in fixed network in the EU. The argument is as follows:

- Setting a cost-oriented price for copper loops involves a number of judgements about asset values. This means that it is difficult to set a price which is unambiguously efficient
- NRAs in Europe have, in the past, focused on driving down the retail price of basic broadband by setting relatively low copper loop prices
- The incremental willingness to pay for NGA broadband speeds is a function of how much end-users value the additional speed. So the price they are prepared to pay is the sum of this

[62] Hans Friederiszick, Michal Grajek, Lars-Hendrik Roller. 2008. "Analyzing the Relationship between Regulation and Investment in the Telecom Sector", ESMT White Paper, ESMT No. WP-108-01

[63] Scott Wallsten and Stephanie Hausladen. March 2009. "Net neutrality, unbundling, and their effects on international investment in next-generation networks". Review of Network Economics, Vol. 8, Issue 1

[64] Martin Cave. 2014. "The ladder of investment in Europe, in retrospect and prospect". Telecommunications Policy (2014)

[65] Wolfgang Briglauer, Carlo Cambini and Michal Grajek. September 2015. "Why is Europe lagging on next generation access networks?" Bruegel Policy Contribution, Issue 2015/14.

[66] *US vs European broadband deployment: what do the data say?* S Yoo, June 2014

[67] As measured by the proportion of DSL lines operated at the retail level by access seekers

additional value and the retail price of basic broadband. If the price of basic broadband falls then the price which end users are willing to pay for high speed broadband falls

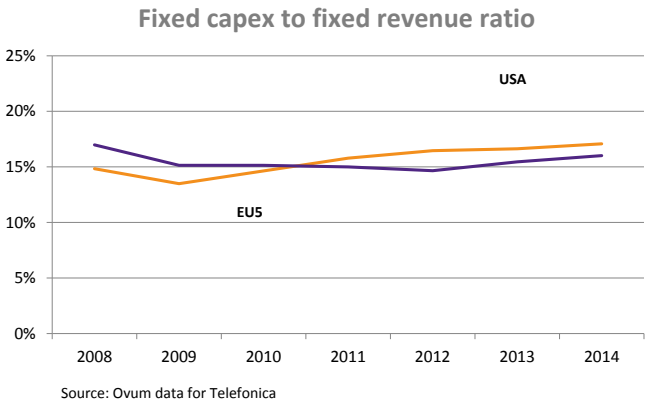
- Lower broadband prices mean lower revenues. This problem has had a growing impact on fixed network service revenues as broadband has become more important - especially if we allocate the revenue from access lines to broadband rather than voice telephony as we should now do
- Lower revenues means lower levels of investment since, as we discussed below, the ratio of capital expenditure to revenues is remarkably constant in the telecommunication sector.

These arguments helped shape the European Commission's 2013 Recommendation on non-discrimination and costing methodologies[68].

The empirical evidence on the investment gap between EU and the US is consistent with this argument. Over the past six years:

- Both revenue per fixed line and retail prices for broadband have been significantly higher in the US than the EU (see Appendix A)
- The ratio of capital expenditure to revenue for fixed line investments[69] has been almost identical in the EU and the US over the last six years. See Figure B3

Figure B3: Capex to revenue ratios – EU vs US



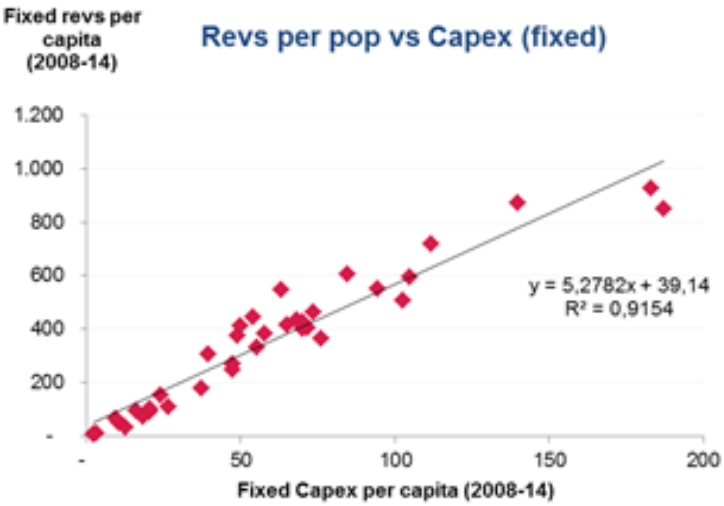
Source: Ovum data for Telefonica

- As a result the level of investment in fixed networks has been largely determined by the revenues generated from fixed services. See Figure B4. As broadband has grown in importance, these revenues are now increasingly dominated by broadband services and by the level of broadband prices
- The retail price of broadband in the US is constrained by competition but not by regulation. In the EU it is strongly affected by economic regulation.

[68] Commission Recommendation C(2013) 5761 final, Brussels, 11.9.2013

[69] A ratio which is strongly controlled by the chief financial officer of almost all established telecommunications companies

Figure B4: the relationship between fixed network revenues and fixed capex



B.4 Returns to regulated and unregulated operators

Further evidence on the impact of access regulation on investment in the EU comes when we compare the returns which are generated by the (heavily regulated) incumbent telcos and the returns of other (lightly regulated) operators. Figure B5 presents our findings. This indicates that

- Returns on fixed network investments are significantly lower for incumbent operators than for access seekers
- Generation of cash flow, as measured by EBITDA margins, is also significantly lower. Here it is important to note that we are comparing incumbent operators with cable operators – their main infrastructure-based rivals
- Investment by incumbent operators has fallen significantly over the past six years, especially in terms of fixed network investments, while investment by other operators has risen.

These differences in investment incentives between regulated and unregulated operators have a substantial impact on overall investment levels. Over the past six years investment by regulated operators[70] in fixed networks has constituted 60% to 65% of total investment in the fixed sector[71].

[70] As measured by investment by ETNO members. See for example *Annual economic Report 2014,* IDATE for ETNO, December 2014 and the more recent report in 2015

[71] This estimate is consistent with information supplied by individual operators in Germany, Hungary, Italy, Norway and the UK

Figure B5: Comparing investment by regulated and unregulated operators in the EU

Measure	ETNO members	Other operators	Source
Return on investment pa	9%	21%[72]	Boston Consulting Group
% EBITDA fixed	27%[73]	47%[74]	Analysis of company accounts
Change in fixed capex (€bn) between 2008 and 2013			IDATE Annual Economic Report to ETNO 2014
2008	17.8	8.5	
2013	16.3	10.0	
Difference	-1.5	+1.5	

B.5 Conclusion

The investment gap between the US and the EU is partly a function of the greater level of competition from cable in the US and partly a function of the stronger level of economic regulation applied to incumbent telcos in the EU.

[72] Access seekers only Cable operators are excluded

[73] EU5

[74] Liberty Global

Appendix C: The impact of existing regulation on investment and competition

C.1 Introduction

To identify how current access regulation impacts on investment and competition in the EU telecommunications sector we have:

- Reviewed existing case studies on NGA regulation in Europe[75]
- Held interviews with senior regulatory managers in eight incumbent telecommunications operators[76]
- Drawn on recent Plum studies on the subject in Malta, the Netherlands and the UK
- Analysed data from the DAE and ITU databases on broadband connectivity.

We have identified five main effects:

- Access regulation has helped entrant to increase their share of the EU telecommunications markets
- Access regulation has led incumbent operators to invest less than they otherwise would
- Relaxation of access regulation has led incumbent operators to increase their investments in NGA infrastructure
- Access regulation has raised the costs of the telecommunications sector
- Access regulation has weakened the ability of incumbent operators to compete with their main infrastructure based rivals.

C.2 The increasing market share of new entrants

Since liberalisation of the EU telecommunications sector access regulation has helped new entrants to grow their market share steadily. Between 2004 and 2014 the new entrants' share of the retail fixed broadband market[77] has grown from just over 45% to just under 60%[78].

It is important to distinguish here between infrastructure based entrants, where access regulation is of limited help and may deter investment, and entrants which rely on access base regulation to win and maintain market share. We are not aware of data which would allow us to plot market share for these

[75] *International case studies*, Analysys Mason for Ofcom, July 2015, *The digital single market and telecoms regulation going forward,* Analysys Mason for ECTA, September 2015, *Competition & investment: An analysis of the drivers of superfast broadband*, WIK for Ofcom, July 2015

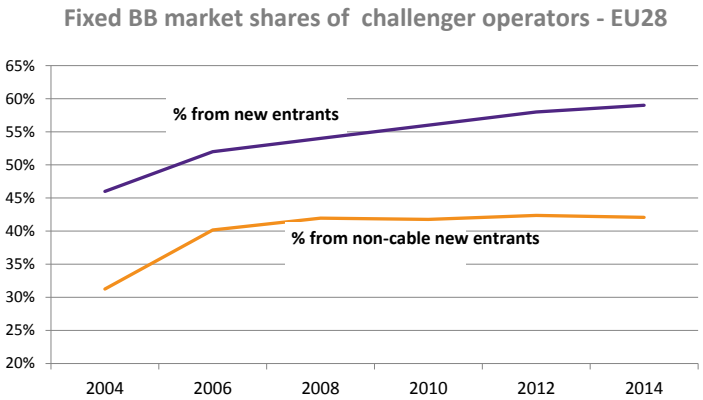
[76] In Belgium, France, Germany, the Netherlands, Portugal, Romania, Spain, Sweden, and the UK

[77] A market where new entrants have focused much of their efforts

[78] DAE database

two categories separately. But we can estimate the market share of the cable operators[79] and deduct this from the overall market share of new entrants. Figure C1 presents our findings.

Figure C1: The market share of new entrants over time



Source: Plum analysis of DAE and ITU databases

We can see that:

- The fixed broadband market share of new entrants has continued to grow steadily. On current trends in might reach 66% by 2020
- For the past eight years this growth has been driven entirely by the growing market share of infrastructure-based cable operators were access regulation is largely irrelevant
- Access regulation may be important for preserving the share of service-based competitors to the incumbent. But the main competitive pressure now comes increasingly from infrastructure-based competitors like cable operators.

C.3 The negative impact of regulation on investment and innovation

Access regulation often leads regulated operators to abandon, delay or reduce investment on new technologies (and the innovation which accompanies it). For example:

- In the Netherlands regulation designed to give access seekers first mover advantage stopped KPN from investing further in fibre in business areas ('FttO') in the Netherlands. ACM proposed that:
  - KPN should announce in advance to its rivals where it was proposing to roll out business fibre
  - KPN should then wait two months before starting to sign up customers
  - KPN should offer unbundled access (without any long term commitment on contract duration) when it did rollout.

[79] Using ITU data

KPN was concerned that these regulations would give rivals a substantial first mover advantage and use the two month waiting period to sign up the most lucrative customers in the new rollout area. Furthermore, the regulations required KPN to take the full investment risk with no possibility to contractually secure recoupment. This meant that early termination of the wholesale contract for a specifically constructed unbundled line by the access seeker would lead to stranded costs. In combination these factors undermined the commercial viability of investment by KPN. So the KPN board decided not to invest further

- Regulation delayed the introduction of vectoring technologies to enhance the broadband speeds available over Deutsche Telekom's VDSL network in Germany. It took 19 months to get NRA approval for vectoring at the street cabinet and it will take at least a further 15 months for vectoring at the local exchange. As well as delaying higher speeds for end-users, the delayed introduction of vectoring also reduced the ability of Deutsche Telekom, and the access seekers which rely on it for wholesale products, to compete with the cable operators for the revenue of customers wanting high-speed broadband
- Orange in France started to invest in FTTH in 2006. But it virtually stopped its investments between 2008 and 2011 while the government and the NRA decided on the rules for symmetric regulation of NGA in France
- In Belgium Proximus has found the phasing out of legacy services is slow and painful. For example it has to give five years notice before closing broadband central office where access seekers are collocated, which slows down network upgrades necessary to compete with cable companies
- Telekom Romania was required under a 2010 review of the broadband market to continue to offer unbundled copper loops to access seekers. This slowed down TR's migration from copper to fibre and reduced its investment in new broadband infrastructure while rivals, with higher market shares, were not restricted in the same way
- GO in Malta finalised plans to invest in FTTH deployment (alongside VDSL investments) early in 2012. But it took a further three years to agree with its regulator on the access regulations which should apply to this deployment before it could start commercial roll out.

In addition there is a common complaint amongst those we interviewed that low copper loop prices have depressed the retail price of basic broadband services and that this, in turn, has weakened the case for NGA investment. In Italy this problem has been exacerbated by retrospective adjustments to the price of copper loops. In 2015 the prices for 2010 to 2012 were reduced. This has generated high levels of regulatory uncertainty for the main potential investor in NGA, Telecom Italia.

C.4 The positive impact of relaxing regulation on investment and innovation

Some NRAs have moved away from cost-oriented wholesale pricing for NGAs. Instead they have offered wholesale pricing flexibility to SMP access providers so as to stimulate NGA investment – a trend which is reflected in the Commission's 2013 recommendation on non-discrimination and costing methodologies. This relaxation appears to have stimulated investment in several of the countries covered in a survey - including Germany, Portugal, Spain, Sweden and the UK. The UK is particularly interesting case where regulatory relaxation appears to have stimulated investment by both the incumbent and its main infrastructure-based rival:

- The UK regulator gave BT wholesale pricing flexibility for its NGA investments in 2010 – three years after functional separation of Open Reach and three years before the Commission's recommendation was published
- Since then NGA availability from BT has grown from 0% to over 80%
- This coverage is significantly higher than we would expect given the size of the cable footprint in the UK[80]
- The cable operator, Virgin Media, has now announced that it will invest in expanding its NGA footprint from 47% to over 60% of households in response to BT's investments.

In Spain and Portugal the regulators both required the incumbent operators, Telefonica and Portugal Telecom respectively, to open up their relatively modern, ubiquitous and high-quality duct networks[81] to access providers in 2006. In return the regulators provided regulatory certainty to the dominant access providers that they would relax wholesale NGA regulation substantially. By the end of 2014 Telefonica and its infrastructure based rivals had passed 45% of households in Spain with FTTH while the figure in Portugal was 66%. In both cases there are now substantial risk-sharing and reciprocal access arrangements in place between rival suppliers of FTTH infrastructure.

The French approach of symmetric regulation of NGA has meant that the access obligations on Orange were conducive to investment (once the rules were stable). . In particular Orange was not subject to asymmetric regulatory obligations of strict cost oriented pricing and ex ante margin squeeze tests. At the same time co-financing allowed it to risk share. All this gave all market players retail pricing freedom and strong incentives to invest or co-invest.

Furthermore we note that a recent paper from the Bruegel Institute made a similar point. This paper points to the fact that Central and Eastern European member states have below average GDP per head and penetration of first generation broadband. But some, notably the three Baltic States, regulate without strict cost oriented obligations and enjoy high levels of NGA penetration (averaging 90% across the three states at the end of 2014 according to the DAE scorecard). Others, notably Hungary, Poland, Slovakia and Slovenia, use stricter fibre access regulation and enjoy significantly lower levels of NGA availability (averaging 68% across the four states at the end of 2014 according to the DAE scorecard). We also note that some of the recommendations in this paper appear questionable.

C.5 The impact of access regulation on costs

Access regulation has raised the cost of the sector – especially the costs of the incumbent operators. It is difficult to judge the significance of these cost increases. But there is clearly scope for cost reductions which ultimately would lead to reduced prices for end-users. For example:

- In the Netherlands agreement with access seekers to move from unbundled copper loops to VDSL with vectoring required complex and lengthy negotiations. This included the negotiation of compensation payments, which were required by the contracts between KPN and the access seekers. The contracts were negotiated against the background of a regulatory notice and migration period of three years

[80] Which covers 47% of households

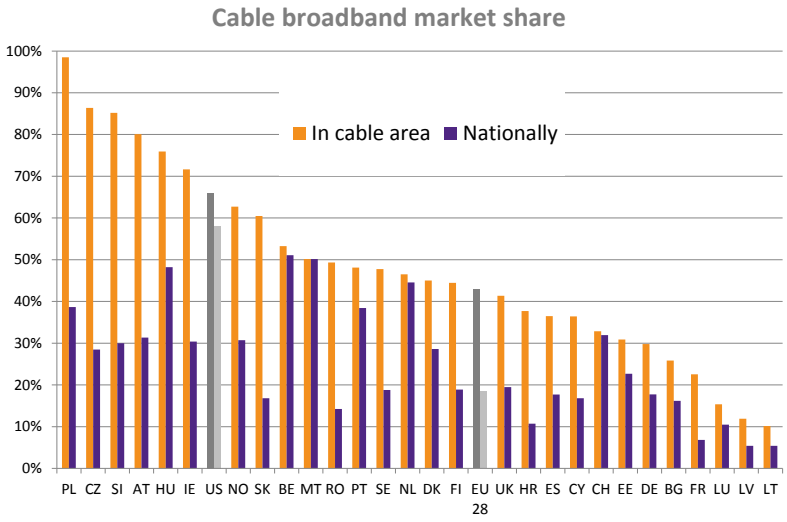
[81] Built largely before sector liberalisation

- In the Netherlands agreement with access seekers to move from unbundled copper loops to VDSL with vectoring required complex and lengthy negotiations. This included the negotiation of compensation payments, which were required by the contracts between KPN and the access seekers. The contracts were negotiated against the background of a regulatory notice period for withdrawing copper loops of five years
- In Germany Deutsche Telekom now offers over 1000 regulated products. For about 50% of them there is no, or only insignificant, demand. In all cases Deutsche Telekom is required to submit a tariff re-filing every two years for all these products
- In Belgium the NRA imposed a multicasting obligation on Proximus in 2011 and Proximus developed this functionality. There has been no demand for it.
- NGA access regulation in France has come at a cost. The FTTH architecture has been defined by the authorities and compliance is costly and slow. At the same time it is very difficult to innovate so as to become more cost efficient as lessons are learnt following rollout
- Upgrading IT systems to make them more efficient is significantly more expensive and slower than it need to be for Proximus because it is required to comply with the regulator's *operational excellence* constraints. Proximus argues that these requirements represent micromanagement of its wholesale supply processes.

C.6 The impact of access regulation on competition

In many member states the incumbent operator now has a similar or smaller market share than its cable rival in the areas where the cable operator has presence. Figure C2 illustrates.

Figure C2: The market shares of the cable operators across the EU



It shows that in 17 of the 28 EU member states the cable market share in its area of operation is 40% or higher. Yet in virtually all of these member states the incumbent operator is regulated in a way which weakens its ability to compete with its rivals. For example:

- There are lengthy regulatory processes to navigate before the incumbent operator can develop new products and set prices. In Belgium there is a 12 month notice period for phasing out old functionality and a 6 to 9 month period for agreeing new functionality with access seekers. Cable operators, which hold over 50% of the market, are not subject to such conditions
- Incumbent operators are often required to supply information on network plans to their NRA which is then made available to rivals. For example Proximus is required to supply information on its network development plans to its NRA and to update these plans at least once a year. It is also required to inform access seekers (including cable operators) of network changes nine months in advance. The effect of these obligations is both to weaken Proximus's competitive position by informing its main rivals of its investment plans well in advance and to increase the possibility of tacit collusion by the cable operators. Telia Sonera reports similar problems in Sweden
- Local monopoly power by operators other than incumbent operator typically remains unregulated. In Sweden city networks owned by the local authorities supply 55% of non-cable NGA and are often close to a monopoly supplier in their area of operation. But the NRA is reluctant to recognise this dominance and regulate them. As a result some local authorities discriminate in favour of their city networks[82] and against rivals in a way which weakens competition and slows down the provision of high-speed broadband.

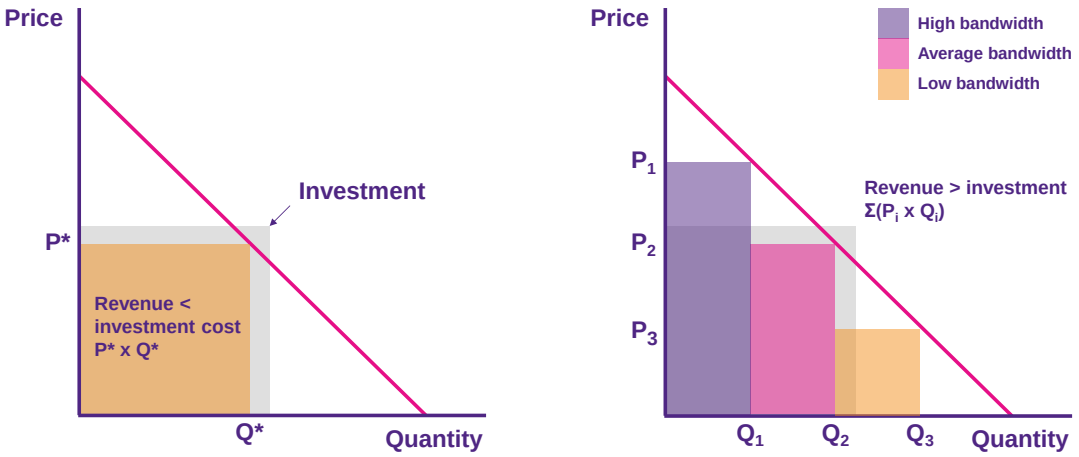
[82] Largely through control over digging rights

Appendix D: Pricing flexibility and differentiation

D.1 Service price differentiation and investment

For efficiency investment should occur when Δ WTP > Δ Cost (where WTP is willingness to pay). Figure d-1 illustrates how service-price differentiation helps align investor and consumer interests when compared with a single price.

Figure D-1: how service-price differentiation helps align investor and consumer interests

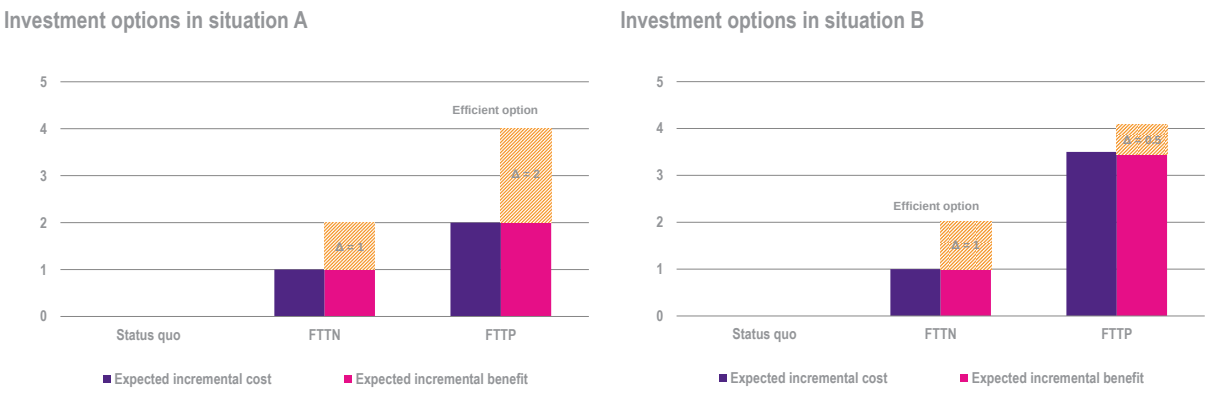


Without service-price differentiation

With service price differentiation

Pricing flexibility also helps align the investor choice of technology and the investment timing with customers' interests. With a fixed price or price cap investment choices across a portfolio of investment options with uncertainty and asymmetric information are most unlikely to be efficient. Figure D-2 illustrates the problem, where situations A and B are different possible outcomes in terms of market demand.

Figure D-2: Investment options



The status quo is shown with zero incremental cost and zero incremental benefit – all investment choices are against this counterfactual and the focus is on incremental costs and revenues. In terms of value (incremental benefit less incremental cost), fibre to the premise (FTTP) is preferred in situation A (a surplus of 2) and fibre to the node (FTTN) is preferred in situation B (a surplus of 1).

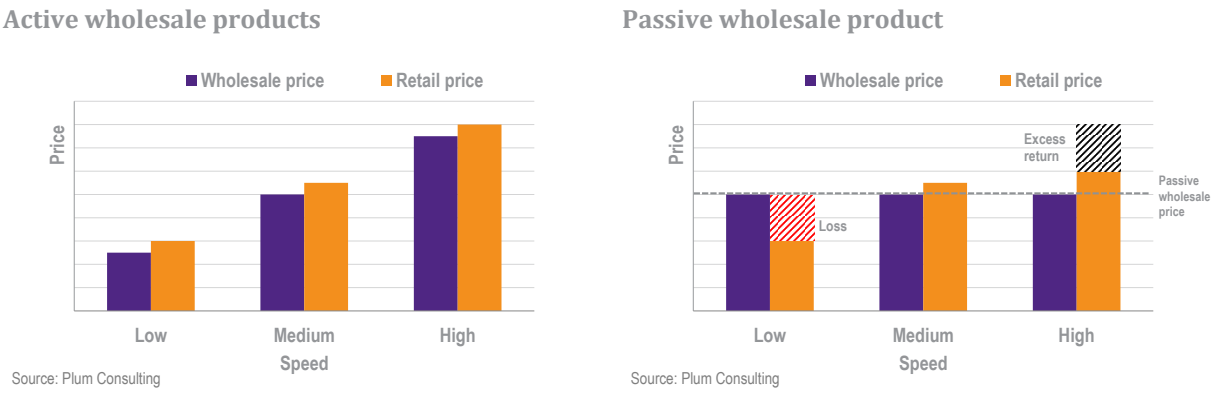
With regulation inefficiency can arise as follows. Under utility style regulation, if the return on capital is too low, the status quo (no investment) would be chosen in both situations, whilst if the return on capital were too high, FTTP would be chosen in both situations, and this would involve inefficient "gold plating" in situation B. With a price cap, the investor would prefer FTTN in both situations if the price cap were in the range 1 to 3. If the price cap exceeds 3, the investor can generate a greater surplus by making the efficient investments in both situations i.e. information rents are necessary to motivate the efficient choice (assuming there is information asymmetry).

Investors therefore need to face incentives to make the right decision *ex ante*, in other words, to bear some of the potential risk and reward and to be able to earn information rents.

D.2 Dark fibre and service-price differentiation

An unbundled "dark fibre" product available at a single wholesale rental price would undercut efforts to charge more for higher speeds and make charging less for lower speeds unprofitable. See Figure D3.

Figure D-3: Arbitrage can eliminate service-price differentiation with dark fibre access



The September 2013 EC recommendation on costing and non-discrimination recognises the need for differentiation at the wholesale level to support retail differentiation:

> *"…pricing flexibility at wholesale level is necessary to allow both the access seeker and the SMP operator's retail business to introduce price differentiation on the retail broadband market in order to better address consumer preferences and foster penetration of very high-speed broadband services"* Paragraph 49

The UK Competition and Markets Authority have also commented on potential impact of dark fibre access in relation to Ofcom proposals for the business communications market:[83]

> *"these proposals may already be having a chilling effect on the development of dark fibre networks by third parties (and the willingness of prospective purchasers to enter into such contracts, whilst the proposals were still subject to consultation, ie until at least early 2016 when Ofcom expects to publish its final conclusions, and possibly later if its decision is appealed. For example, CityFibre said that Ofcom's proposals had introduced quite a significant factor of fear, uncertainty and doubt into the industry over whether Openreach's dark fibre would become available and whether it would be set at the price point that Ofcom had indicated in its consultation documents. CityFibre said that its analysis showed that Ofcom's proposed price was 80% less in the regulated market than in London, which Ofcom had considered to be a competitive market, and so it could drive Openreach's competitors out of the market. CityFibre said that it was seeing this across a number of projects and opportunities and it had affected buying decisions and procurement decisions in the market."*

The impact of Layer 1 access on differentiation and investment incentives has been noted also by HSBC Global Research:[84]

> *"We continue to regard unbundling as inimical to investment, through the tendency to undermine the capability of operators to price segment the market, a vital element of flexibility if operators are to justify substantial infrastructure deployment…"* Page 11

[83] Competition and Markets Authority. October 2015. "Anticipated acquisition by BT Group plc of EE Limited." Page 215. https://assets.digital.cabinet-office.gov.uk/media/56339544ed915d566a00000f/BT-EE_-_Provisional_findings_report.pdf

[8484] HSBC Telecoms, Media & Technology. 24 September 2015. "UK Telecoms – Reviewing the Review".

Appendix E: The effectiveness of the ladder of investment concept

E.1 What is the ladder of investment?

The ladder of investment is a regulatory approach whereby entrants are encouraged to progress from service-based competition to increasingly deep infrastructure-based competition. Initially, the regulator grants entrants access to the incumbent's infrastructure on reasonable terms, enabling service-based competition in the short term. The regulator then encourages the entrants to move up the ladder via regulation of access and/or access prices. The concept was developed by Cave and Vogelsang (2003)[85], although this had a precursor in the "stepping stones" to infrastructure competition in the US.[86]

In Cave the order of the rungs on the ladder is driven by the ease of replicability. The first rung is retail – the entrant rebrands the service and provides the retail activities. The second is bitstream access, where the incumbent provides access to its network, and entrants need a core network of their own. The final rung on Cave's ladder was the unbundled local loop, where entrants have to build a core network down to the local exchanges of the incumbent and install their equipment within the exchanges.

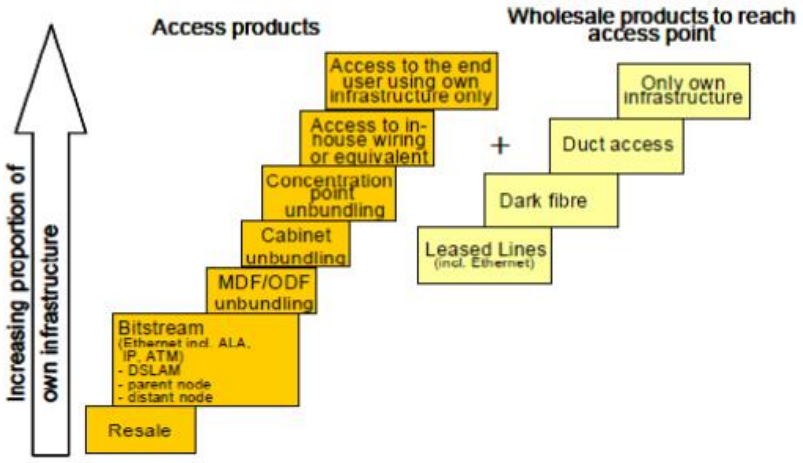
Almost all formulations of the ladder include these three rungs, but many add refinements and additional rungs. See Figure E1 for BEREC's interpretation. Some recent literature has also identified an alternative specification of the ladder (the "short ladder") consisting of only two rungs – bitstream access and LLU (the second and third rung of BEREC's ladder).[87]

[85] Martin Cave and Ingo Vogelsang. 2003. "How access pricing and entry interact"

[86] Martin Cave. 2014. "The ladder of investment in Europe, in retrospect and prospect". Telecommunications Policy (2014)

[87] Maya Bacache, Marc Bourreau and Germain Gaudin. July 2013. "Dynamic Entry and Investment in New Infrastructures: Empirical Evidence from the Fixed Broadband Industry"

Figure E-1: BEREC's view of the ladder of investment (2011)[88]



One facet of Cave's formulation is that rungs on that ladder that have become obsolete or inappropriate should be 'closed down' by raising the price of the relevant access product or ceasing to mandate it. In this way only one rung would be 'open' to the entrant at any one time. In practice, the removal of rungs has been more gradual and partial.[89] Thus the implementation of the ladder represents a departure from the original concept.

Another point of difference is the top rung of the ladder. In some formulations (such as BEREC's) the top rung is full end-to-end infrastructure competition. It is unclear whether this is intended to be the ideal culmination of the ladder of investment. If so, there remains the question of whether complete replication of infrastructure is a viable goal and whether it is in the public interest.

There are, then, different interpretations of the ladder of investment. In this appendix, the term *short ladder* means a two-rung ladder comprising bitstream access and LLU. This is similar to Cave's original formulation. The term *full ladder of investment* refers to the broader interpretation of the ladder used by BEREC and others.

E.2 Arguments for and against the ladder

Proponents of the ladder of investment idea include some European regulators, represented by the European Regulators' Group (and latterly BEREC).[90] The idea still has currency among regulators: ComReg (2013) note that "the ladder of investment must be respected in an NGA environment", while a WIK Consult paper for Ofcom in 2015 discusses the ladder at length.[91] However, the emphasis being placed on the idea may be waning. The European Commission recommendation of 2013 mentions the "investment ladder principle" only once, while an Analysys Mason paper for ECTA[92] in

[88] BEREC, October 2011. BEREC Report on the Implementation of the NGA-Recommendation.

[89] WIK for Ofcom. July 2015. "Competition and Investment: an analysis of the drivers of superfast broadband"

[90] E.g. ERG (2005). ARCEP (2007).

[91] WIK for Ofcom. July 2015.

[92] Analysys Mason for ECTA. September 2015. "The digital single market and telecoms regulation going forward"

2015 does not mention “ladder” at all. Academic discussion of the ladder of investment hinges on two key questions, discussed below.

What are the incentives for access seekers to move up the ladder?

Whether entrants make the progression from service-based to facilities based competition depends on the “replacement effect”. This concept was introduced by Arrow (1962), and holds that a monopolist has lower incentives to innovate than a competitive firm since any innovation will entail “replacing itself”. In this context, the implication is that profits from service-based competition act as a disincentive to invest in facilities-based entry. As Bacache et al (2013) put it,

> “*According to the standard view, a regulatory framework that favors service-based entry (e.g., via LLU) introduces an opportunity cost for entrants of investing later on in new lines, due to the profits that the entrants currently enjoy under service-based competition.”*

If the replacement effect prevails then incentives for moving up the ladder are weak. In order for the ladder of investment hypothesis to apply the replacement effect needs to be mitigated. The task of mitigating the replacement effect falls to the regulator.

The regulator’s task in pushing entrants up the ladder is twofold – it must ensure the next rung is available, and it must “burn up” the preceding rung, making it either unavailable or unattractive to the entrant. If this is not done the entrant may decide to remain on its existing rung. As Cave (2006) noted *"if comprehensive access products are too cheap, competitive investment will not materialize"*

There are two issues with this role for the regulator: information and credibility. The correct implementation of a ladder of investment approach requires regulators to micro-manage the industry. Determining the right sequence of rungs, the appropriate prices and the rate at which to “burn” rungs is extremely demanding in terms of both time and information. Further, asymmetric information between the regulator and an entrant on market demand and the entrant’s cost structure could lead to the regulator being manipulated by the entrant in order to obtain lower access prices.[93]

In any case, the regulator may be unable to credibly adhere to the commitments required for the ladder of investment to work. A regulator has incentives to renege on its commitments to “burn” rungs if an entrant is still dependent on favourable access terms. As Dogan et al (2010) [94] note, sunset clauses on the regulation of access were abandoned by the regulator in the Netherlands and Canada.

Bourreau and Drouard (2010) [95] develop a model of an entrant’s incentives to progress from service to infrastructure-based competition. This is based on two competing effects: the replacement effect and a “stepping stone” effect whereby an entrant gradually acquires market experience. The results suggest a trade-off between facility-based and service-based entry, at least in the short term.

[93] Vareda, João, 2007. "Access Regulation under Asymmetric Information about Demand," FEUNL Working Paper Series wp525, Universidade Nova de Lisboa, Faculdade de Economia. https://ideas.repec.org/p/unl/unlfep/wp525.html

[94] Marc Bourreau, Pinar Dogan and Matthieu Manant. February 2010. “A critical review of the "ladder of investment" approach”

[95] Marc Bourreau and Joeffrey Drouard. July 2010. “Stepping Stone or Stonewall? Progressive Entry and Incentives to Invest in Alternative Infrastructures” Working Paper ESS-10-07

Is there empirical evidence that the ladder works?

Empirical support for the ladder is limited. One 2013[96] paper noted that "*to the best of our knowledge, there is no existing theoretical literature in support of the ladder-of-investment hypothesis that access-based competition can favor investment*" while a study by Bouckaert et al (2010) [97] indicated that *"there may not be empirical support for [the ladder of investment], and that to the contrary intra-platform competition may even give adverse investment incentives."*

Bacache et al (2013) find no empirical support for the "complete ladder". Similarly, Garrone and Zaccagnino (2012)[98] provide empirical findings that *"suggest that service-based entry does not encourage facility-based entry"*, casting doubt on the ladder of investment. The authors also find that local loop prices are negatively, rather than positively, related to facility-based entry, in contrast to the ladder of investment theory[99].

Crandall et al (2012) [100] find that *"copper loop unbundling did not accelerate the deployment or increase the penetration of first-generation broadband networks, and that it had a depressing effect on network investment".* Friederiszick et al (2008)[101] also find that pro-entry regulation has discouraged infrastructure investment by entrants. Briglauer et al (2015) suggest that:

> *"More than a decade of broadband access regulation in Europe has shown, however, that the ladder-of-investment hypothesis works mainly for the lower rungs of the investment ladder."*

However, several papers find some level of empirical support for the "short ladder" – in other words, when LLU is the final rung of the ladder[102][103][104]. (It should be noted that all of these papers found no empirical support for a longer ladder). In these models the number of past bitstream access lines has a positive effect on the number of unbundled lines rolled out by new entrants (although the evidence for this correlation in some cases is not robust). Finally Nardotto et al (2014)[105] find that, while LLU in the UK only had an impact on broadband penetration in the early years, it had a positive impact on quality of service indicators such as download speeds.

[96] Bacache et al. 2013.

[97] Jan Bouckaert, Theon van Dijk and Frank Verboven. August 2010. "Access regulation, competition and broadband penetration: an international study" REPEC.

[98] Paola Garrone and Michele Zaccagnino. July 2012. "A Too Short Ladder? Broadband Investments and Local Loop Unbundling in EU Countries". http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2109423

[99] Bacache et al do not find a significant relationship here

[100] Robert W. Crandall, Jeffrey A. Eisenach and Allan T. Ingraham. March 2012. "The Long-Run Effects of Copper Unbundling and the Implications for Fiber". http://ssrn.com/abstract=2018929

[101] Friederiszick et al. 2008

[102] Bacache et al. 2013.

[103] Robert W. Crandall and J. Gregory Sidak. 2007. "Is Mandatory Unbundling the Key to Increasing Broadband Penetration in Mexico? A Survey of International Evidence" http://ssrn.com/abstract=996065

[104] Garrone and Zaccagnino. 2012.

[105] Mattia Nardotto, Tommaso Valletti, and Frank Verboven. August 2014. "Unbundling the incumbent: Evidence from UK broadband". CEIS Tor Vergata Research Paper Series, Vol. 13, Issue 1, No.331. http://ssrn.com/abstract=2505035

E.3 Where has the short ladder worked?

There is virtually no evidence which supports use of the full ladder of investment concept. But there is some which suggests that the short ladder may have had beneficial effects. This raises the question of where the short ladder is effective. There are two main studies which have considered this question.

Bacache et al (2013) identify three patterns across European countries. The first is where there is no correlation between bitstream and LLU investment[106]. The second is where there was fast take-up of bitstream access and some correlation with LLU lines[107]. The final pattern is where growth in LLU lines accelerates after the development of bitstream access[108]. The second and third patterns are consistent with a "short ladder" of investment hypothesis. The authors also divided the sample into two groups: countries with high and low cable penetration. While the ladder of investment hypothesis is still rejected for both groups, in high cable-penetration countries the number of LLU lines is negatively related to the number of new lines owned by entrants. This suggests that the ladder-of-investment approach may be less effective when there is strong inter-platform competition.

Crandall and Sidak (2007) found that, from 2002 to 2006, the share of LLU lines out of total entrant lines fell (and the share of bitstream and resale increased) for six out of the 15 countries in their sample. The authors note that this is inconsistent with the ladder of investment hypothesis. Proceeding with the remaining countries the authors conclude that the best support for the ladder of investment theory is found in France and Italy, two countries with little cable competition. These papers would thus appear to draw similar conclusions on the circumstances under which the "short ladder" of investment holds.

E.4 The ladder of investment and NGA

Some, notably ComReg, remain in favour of ladder of investment principles in an NGA context:[109]

> *"The cornerstone of ComReg's approach is to incentivise operators move up the ladder of investment, which is considered instrumental to driving sustainable competition"*

However, Briglauer and Gugler (2012) suggest that the ladder will be harder to achieve for NGA:[110]

> *"The dynamic concept of transition from service-based towards infrastructure-based competition becomes even more unlikely against the backdrop of NGA deployment, as economic replicability will be even lower in view of NGA-network topologies"*

Cave (2012) raises questions about the applicability of the ladder of investment principle in relation to the move from copper to fibre:[111]

> *"…ladder-based policy implications have to be amended when the copper ladder is first put side-by-side with, and then replaced, by a fibre ladder, which is likely to have a different configuration, given the much greater transmission limits of fibre than of copper, and hence different rungs."*

[106] Germany, Luxembourg, Netherlands, Sweden

[107] Austria, Greece, Italy, Portugal, Spain, UK

[108] Denmark, Finland, France

[109] https://www.comreg.ie/_fileupload/publications/ComReg1227.pdf

[110] Wolfgang Briglauer and Klaus Gugler. September 2012. "A critical appraisal of the European Commission´s policy towards regulating next generation communications networks". http://epub.wu.ac.at/3642/

[111] https://www.chorus.co.nz/file/48859/Chorus-Attachment-5---Martin-Cave-report.pdf

Cave also notes that unbundlers will have an incentive to keep their customers on a copper connection rather than pushing them to fibre:

> *"An unbundler which has sunk investment in building out to the exchange or cabinet will face a low marginal cost in supplying its customer with a UCLL-based, as compared with a fibre bitstream product. It will therefore have an incentive to keep the customer on the copper connection, rather than promote a switch to fibre."*

In addition there is evidence, presented in Appendix C, that copper loop unbundling has lead local loop unbundlers to oppose closure of copper networks. This reduces the incentives for access providers to invest in NGA technologies.

Finally the economic case for NRAs to require fibre loop unbundling (as opposed to copper loop unbundling) is poor. As the Commission's 2013 recommendation on non-discrimination and costing methodology recognises, there is a need to allow access providers wholesale pricing flexibility for NGA products if substantial investment is to be forthcoming. Regulation requiring fibre loop unbundling substantially reduces this pricing flexibility.

E.5 Conclusion

There is no evidence – either empirical or theoretical – to support the full ladder of investment concept proposed by BER EC and used by many NRAs. Indeed the evidence suggests that application of this concept is likely to be damaging to telecommunications investment.

There is some evidence to suggest that a short ladder of investment concept, in which NRAs require SMP operators to provide both wholesale broadband access and unbundled loops, works in a world where broadband deployment is based on use of copper loops. This is especially true in member states with low levels of infrastructure-based competition from cable operators.

The short ladder of investment may have worked in the short term in some member states. But it has now created a barrier to effective migration from copper to fibre. Copper loop unbundling has lead local loop unbundlers to oppose closure of copper networks.

Applying this short ladder of investment concept to regulation of wholesale NGA products is likely to be damaging to investment prospects. An NGA ladder of investment would involve fibre loop unbundling. This would restrict wholesale pricing flexibility for access providers and reduce incentives to invest in NGA.