



Next generation networks: why a fresh regulatory approach is required

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Table of Contents

Executive Summary.....	1
1 "Creative destruction" is a key driver of growth.....	4
2 Legacy thinking is a barrier to "creative destruction"	6
2.1 Efficient and timely investment	9
2.2 Efficient pricing over time	11
2.3 Non-discrimination and potential monopoly abuse	13
2.4 Credible regulatory commitment	17
2.5 Conclusion.....	19
3 Achieving good outcomes in practice.....	21

Executive Summary

Long run economic and social progress is dominated by the introduction of new goods and services and means of production, rather than price reductions for things that exist already. Efficient and timely investment in Next Generation Access (NGA) is key to a further wave of transformation in the economy and society.

Getting efficient and timely investment in NGA

NGA involves substantial investment, and potential options to upgrade in future. In particular, an upgrade from an initial Fibre to the Node (FTTN) network to Fibre to the Premises (FTTP) would involve a greater commitment of capital than the initial investment in FTTN. Ensuring there are appropriate incentives for efficient and timely investment will therefore be an enduring issue.

Getting decisions about initial NGA investment and subsequent upgrades right is about maximising value, not minimising cost - yet value is not reflected in a "cost based" approach to regulation and pricing. The orthodox approach to regulation therefore needs to change to support efficient and timely investment. Since network access costs will be common across services, whether voice or two-way high definition (HD) video collaboration, there is no straightforward way to allocate costs across services. Efficient prices for network access should reflect value, and change dynamically over time as demand for different services requiring different levels of bandwidth changes. Price flexibility is required to allow experimentation which will ensure alignment of investment decisions with end user valuations over time.

Investment decisions over NGA will be heavily influenced by expectations of future regulation. Credible regulatory commitment to provide the required levels of pricing, contractual and ownership flexibility over time is therefore necessary. This requires a step change away from legacy regulation which has from time to time involved opportunistic redistribution of value between access providers, access seekers and end users in a zero sum game. Regulation of NGA cannot be a zero sum game, or the networks will not be built and upgraded in the first place.

Getting the full value from NGA

Realising the full value of NGA to society requires disruptive change throughout the extended value chain, from the development of converged fibre-wireless networks to support high speed high mobile access to new business models for video creation and distribution in the entertainment industry. Getting from where we are today to a world of transformed networks and services will require "creative destruction". New contractual and ownership relationships will be required. Short term access regulation with no provision for long term commitments, and rigid boundaries for the access business, are unlikely to be compatible with the required business models. A new approach is required that can accommodate new long term investment decisions and contractual relationships.

Realising the full value of NGA also depends on the progressive switch off of the copper network with FTTP is rolled out, or elements of the network being shut down if FTTN is deployed. This approach economises on operating costs thereby lowering the lifecycle costs of NGA and ensuring that FTTN achieves its full potential (since running DSL and VDSL in parallel may compromise the performance

of a FTTN network). Legacy regulation has favoured the unbundling of network elements to support competition and innovation via the policy of local loop unbundling (LLU). This may be infeasible technically, or economically and commercially in an NGA environment. For example, in an FTTN network the roughly ten-fold increase in the number of physical locations - cabinets - that would need to be unbundled to provide the same level of competitive service coverage could undermine the case for unbundling. An active electronic wholesale access product is required.

Recent evidence in relation to the political economy of LLU also indicates that unbundling at cabinets may be undesirable even where it is feasible. LLU operators have made specific investments and, around the world, are resisting upgrades of the underlying infrastructure that would make their investments redundant (a normal consequence of technical progress is that existing assets may devalue). This demonstrates two things. First, competitive operators in the service market may actively work against end users' interests. Second, unbundling of FTTN could see similar resistance to a future upgrade to FTTP.

The regulatory framework should therefore facilitate, rather than discourage, the progressive switch off of copper networks.

Realising the full value of NGA also depends on competitive downstream service provision. In the past it has been assumed that vertical integration into services markets involves a *per se* problem of discrimination against downstream competitors. This presumption should be reconsidered in an NGA environment.

The diversity of services NGA can support, and the inability of any one player to deliver all existing or potential services, implies a shift in incentives towards voluntary open access. This has occurred in a number of areas in the ICT sector including internet based software and applications, for example, the decision by Apple to open the iPhone to third party applications development. Greater price flexibility at the access level to support efficient and timely investment would also promote voluntary non-discriminatory open access provision by network owners by allowing efficient profit opportunities at the access level.

Moving beyond legacy regulation

We have argued that to get NGA built, upgraded and delivering value requires: price flexibility; the opportunities to form ownership and contractual relationships along the value chain; freedom to shut down legacy copper network elements and networks; credible regulatory commitment not to appropriate investor value in the future; and, active access products rather than passive unbundled access products.

Where platform competition is absent, protection of the legitimate interests of access seekers and end users will be required to protect them from monopoly abuse. The challenge is achieving this whilst preserving the necessary levels of flexibility at retail and wholesale levels and the incentives to invest and innovate at the network level over the NGA lifecycle.

Legacy approaches including "cost based" regulation and TSLRIC (periodic calculation of "forward looking" cost estimates) do provide protection against potential monopoly abuse, but at the cost of undermining all of the requirements set out above for efficient and timely investment in NGA, and realisation of value from NGA.

Alternative approaches should be explored. One option would be to assure end users that they would continue to have the option to purchase "anchor products" over NGA that replicate today's products at today's prices by defining a basic set of wholesale products. Higher specification wholesale products would not be priced controlled, but could also be made available to all downstream service providers. The "anchor products" would provide a discipline on the pricing of other non price controlled wholesale products.

In conclusion, there is a fundamental choice to be made between:

- extensive and prescriptive cost oriented regulation at the access layer, which would in turn increase incentives for discrimination and lead to even more intervention - thereby stifling innovation; and
- an approach whereby a balance is struck that provides sufficient commercial freedom to lead to a virtuous cycle of more competition, innovation in terms of technology implementation and business models, and efficient and timely investment without detailed regulatory oversight.

The Australian Government's ambitions for the National Broadband Network require it to break from the first path which characterises legacy regulation and to set out along the second path.

1 “Creative destruction” is a key driver of growth

“The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers, goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates.”

Joseph Schumpeter

At a general level, long run economic and social progress is dominated by the introduction of new goods and services and means of production, rather than price reduction for things that exist already. Steam, the internal combustion engine, electricity and ICT have involved and unleashed successive waves of innovation resulting in rising productivity and income.¹ Growth is concentrated in any country at any time in a few firms in a few industries that are achieving metamorphic technological progress as a result of breakthrough innovations.² Romer pointed to the high cost of regulation and taxes that delay or prevent the introduction of new goods and services,³ whilst Hausman illustrated the cost of delay in specific instances in the telecommunications sector.⁴

Experience with electrification at the start of the 20th-century provides an illustrative example of the impact of a general purpose technology which has the power to transform production and daily life. Widespread availability of electricity allowed manufacturers to reorganise business processes to take advantage of local distributed electric motors, which replaced centralised power sources and energy distribution via belts and pulleys. In turn, this allowed changes such as the production lines introduced by Henry Ford, and lighter cheaper buildings which did not need to support mechanical power distribution. The outcome was major and sustained increases in productivity. During the central decade of the electrification process, total factor productivity (TFP) increased by around 1.25% per annum in the UK, led by manufacturing TFP growth which grew from 0.6% to 1.9% per year.⁵

The internet, broadband and next generation broadband are important components of current and future innovation in the use of ICT. For example, as William Webb noted:⁶

“Fibre optic cable remains potentially transformational for the whole telecommunications industry. The extent to which fibre cables are brought within 100-300 metres of people’s homes will determine the viability of massive upgrade of wider area mobile radio data speeds.”

More generally, as the UK Treasury noted:⁷

¹ Jovanovic and Rousseau. January 2003. “General purpose technologies.” <http://www.econ.nyu.edu/user/jovanovi/GPT.pdf>
See also: Robert W. Crandall (Editor), James H. Alleman (Editor). December 2002. “Broadband: Should We Regulate High-Speed internet Access?”

² Darby and Zucker. March 2006. “Innovation, competition and welfare-enhancing monopoly.” NBER Working Paper 12094.

³ Romer. 1994. “New Goods, Old Theory and the Welfare Costs of Trade Restrictions.” *Journal of Development Economics*, 43.

⁴ Hausman. 1997. “Valuing the effect of regulation on new services.” Brookings Papers – Microeconomics.
http://econ-www.mit.edu/faculty/download_pdf.php?id=470

⁵ David and Wright. 1999. “General Purpose Technologies and Surges in Productivity: Historical Reflections on the Future of the ICT Revolution.” <http://www-econ.stanford.edu/faculty/workp/swp99026.pdf>

Jovanovic and Rousseau. January 2003. “General purpose technologies.” <http://www.econ.nyu.edu/user/jovanovi/GPT.pdf>

⁶ William Webb. 2007. “Wireless communications: the future.” John Wiley. Page 209.

⁷ HM-Treasury. March 2008. “The UK economy: analysis of long-term performance and strategic challenges.” Page 63.
http://www.hm-treasury.gov.uk/media/6/2/bud08_strategicchallenges_645.pdf

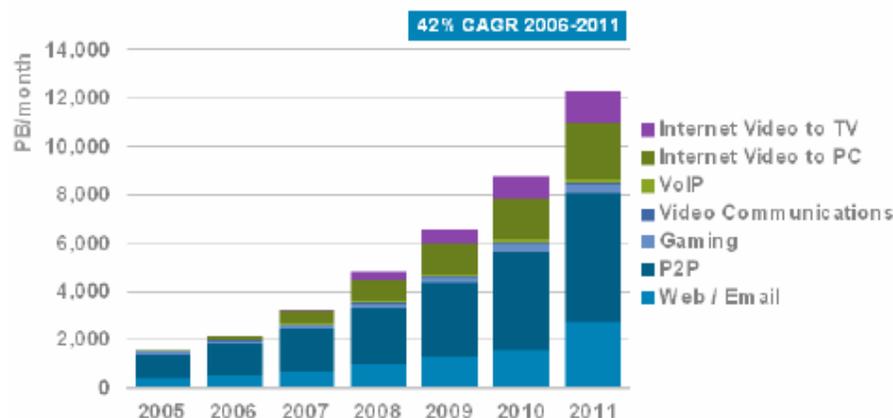
“...increased speed of communication has expanded the range of services which it is feasible to trade, leading to a more integrated global market... Future developments in ICT are likely to take this process further.”

The availability of these technologies on a timely and efficient basis is crucial. Whether or not they are available at least cost is less important.

Fundamentally, this is a process of creative destruction with fibre replacing copper, new models of competition in telecommunications replacing old ones, and new business models on the back of NGA replacing old models. This process presents a challenge to existing business and regulatory models – both of which have been conditioned by a period of stability in terms of access networks.

Australia has made a decision to proceed with wide area coverage of NGA. However, reaping the full benefits from NGA deployment depends not only on creating something new, but also on eliminating legacy systems including the progressive phasing out of copper lines and local exchanges. Further, NGA investment will not be a one off phenomenon, given forecast growth in traffic and demand. Cisco is forecasting 42 per cent annual growth to 2011 for global consumer internet traffic (see Figure 1-1).⁸

Figure 1-1: Cisco global consumer internet traffic forecast



Whilst internet traffic is an imperfect proxy for demand for bandwidth in relation to access, a number of underlying drivers such as a move to HD content, and two way high quality video and internet services which depend on high up and download speeds, point to expanding demand for bandwidth at the access level.

The issue of providing incentives for efficient and timely investment will therefore remain after investment in FTTN. Further, deciding on the right technology and timing for future upgrades is far from trivial given the level of uncertainty and degree of investment required (FTTN involves less than around one-third of the investment required for FTTP), and the fact that the option to wait itself has value.⁹ Beyond FTTP options such as the addition of wave division multiplexing are available.

⁸ Cisco. 14 January 2008. “The Exabyte Era.” An exabyte is a billion Gigabytes.

http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/net_implementation_white_paper0900aecd806a81a7.pdf

⁹ Trigeorgis. 1996. “Real options”. The MIT Press.

2 Legacy thinking is a barrier to “creative destruction”

“The difficulty lies, not in the new ideas, but in escaping the old ones.”

John Maynard Keynes

NGA will be subject to some form of “governance” whether or not any sector specific (*ex ante*) regulation is applied. General competition law is the default framework, and contracts and potential customer-political reaction all exert constraints on behaviour in the market. The need for, and nature and extent of any *ex ante* regulation should therefore be considered in this wider context.

Ex ante regulation, or the prospect of it, involves trade-offs in terms of competing objectives. Low access prices and/or a focus on “cost orientation” may conflict with incentives for innovation, efficient investment and non-discrimination; whilst a desire to maintain regulatory discretion may conflict with regulatory commitment and minimisation of the cost of funding investment. These trade-offs are familiar to regulators in today’s environment, but they are applied against legacy networks which already exist and were deployed over decades.

An important question is therefore how to make the trade-off between these competing objectives in deciding what governance should apply to NGA. The thesis of this paper is that the right trade-off fundamentally changes with NGA compared to current generation broadband access.

Given that there is a trade-off between the above objectives when substantial investment is required and the optimal approach and future upgrade path are uncertain, less rather than more *ex ante* regulation is required to achieve good outcomes. Investors in the National Broadband Network, competing infrastructure and services provided over NGA will also want to know how regulation might develop in future. Without a credible commitment to a sound framework market players will factor in the risk of something less favourable emerging, and outcomes now and in the future will be inferior as a result.

Turning to the question of why NGA changes the assessment of trade-offs, there are four reasons. First, unlike legacy networks, NGA is yet to be built. Second, NGA involves a significant degree of demand and execution risk both initially and in relation to subsequent upgrade (in particular in taking fibre from the street cabinet to the premise). Third, given the nascent nature of the market and lack of experience in commercial deployment of NGA and related services there is a general lack of information and there are information asymmetries between consumers, managers, owners and regulators. Managers and owners need to be given incentives to obtain information so as to promote efficient investment. Fourth, a greater proportion of costs will be fixed capital costs which are common across services (NGA is a multi-service platform and there is therefore no clear cut way to allocate costs across services on a “cost oriented” basis).

Regulatory thinking conditioned by the challenges and trade-offs of regulating legacy copper based telephony and broadband networks and services may therefore no longer be applicable and at the very least needs to be re-thought. Regulation, particularly *ex ante* cost based regulation, has developed in an environment where the basic technology choices had been made and the copper network was already in place, where services and markets were reasonably well defined and where overall demand was reasonably assured. It was an environment where cost reflective pricing could be applied, where fundamental judgements over risky investments were not required and where the exercise of regulatory discretion to reallocate rents in a zero sum game was arguably the norm. All of this must change for an efficient transition to, and future evolution of, NGA.

Legacy thinking has also developed in an environment where regulation has sought to promote competition by allowing the “unbundling” of network elements. The deployment of fibre ever closer to the end user will make existing unbundled network elements redundant, and changes the balance in terms of where competition is feasible and what form it should take. Where platform competition is sufficient - between fibre, cable and wireless technologies - then the regulatory question of how to facilitate access based competition need not arise (SingTel Optus has deployed significant HFC network infrastructure in urban areas in Sydney, Melbourne and Brisbane which would be capable of supporting high speed access).

Where platform competition is judged insufficient, different forms, locations and terms of access to those developed for legacy access will be required. Unbundling will either be infeasible or commercially unattractive in most or all locations with fibre to the node (FTTN) since the number of cabinets expands and the number of potential customers per cabinet falls around tenfold, thereby undermining the economic and business case for unbundling. A fit for purpose bitstream access product is therefore required. Further, there are sound reasons for retiring existing local loop unbundling alongside fibre rollout to reduce operating costs and the costs and complexity of customer migration.

Finally, NGA deployment will involve the creation of new value chains and destruction of old ones. For example, video distribution and IT for small and medium enterprises could be transformed, future development of high speed wireless services will depend on a dense fibre network to carry data to and from high density transmitter networks closer to users (pico cells) and terrestrial broadcasting may ultimately switch to fibre and satellite platforms to allow reallocation of UHF spectrum to more valuable mobile uses. Achieving these transformations is, however, far from straightforward given uncertainties and information asymmetries.

Parties may hold out for better terms, and strategies must change in large complementary steps rather than be discovered incrementally.¹⁰ Long term contractual and ownership relationships are likely to be necessary to overcome these hurdles, and such relationships are inconsistent with legacy regulation which gets in the way of bargaining and complex long term relationships (in part because regulated prices are “spot” rather than long term prices which would involve a commitment to risk sharing by access seekers). Further, such developments may be precluded with a wholesale only network operator because of requirements to offer access on non-discriminatory terms and conditions. The flexibility we see as necessary to deal with the changed environment of NGA applies both to contractual and ownership arrangements. It is unlikely that long term contractual arrangements can fully substitute for the flexibility offered by ownership arrangements such as vertical integration where that is the most efficient model to address the risks and other issues we have discussed arising from NGAs.

What is said and expected in relation to regulation will impact on the willingness of investors to invest and the price at which they are prepared to invest. The technology, cost structure and market post NGA investment will differ, changing incentives and behaviour compared to the status quo. The opportunities and costs in relation to future investment once a basic NGA infrastructure is in place will also differ – FTTN involves less than around one-third of the cost in moving to FTTP. This paper is

¹⁰ John Roberts. 2004. “The modern firm”. Oxford University Press. Where complementarities exist between a set of factors, in the sense that an increase in one variable (say new video distribution models) raises the incremental return to an increase in other factors (NGA), incremental profit maximising behaviour will not necessarily lead to the best possible outcome and a strategic move is required.

fundamentally about these differences and how to address them. The discussion that is required is over how to achieve a win-win for end users and investors in the transition to NGA.

Some of the policy challenges involved in the transition to NGA, and subsequently, have been explicitly recognised by regulators (see Box 2.1 below). However, the problem runs deeper than one of establishing the correct return reflecting risk and committing to it.

In what follows we consider four challenges: efficient and timely investment, efficient pricing, non-discrimination and competition and commitment. We consider how these challenges drive a very different approach to regulation than the legacy world model.

Box 2.1: Challenges identified by regulators

The Australian Productivity Commission has set out the following options for regulation of access prices so as to deal with *ex ante* risk and truncation of *ex post* returns:¹¹ *“If firms consider that regulators are fallible and may have difficulty separating rewards for risk from monopoly returns, then this has adverse consequences for investment. Access pricing that fully recognises regulatory uncertainty and the scope for regulatory error may be a remedy – but this may be hard to implement and may lack ex ante credibility. Access holidays, regulatory compacts and other ex ante options may provide greater certainty for carriers prior to making their investments, but they too have some practical implementation problems.”*

Ofcom set out the problem as follows:¹² *“...if the standard approach to access regulation were to be adopted for future next generation access infrastructure, the returns available to the communications provider considering deploying the bottleneck assets may be reduced such that there may not be a commercial case for making the investment in the first place.”* 3.28; and *“This problem arises as the application of mandated access at regulated prices would limit the returns available to investors, whilst the risk of losses remains unlimited. This asymmetry may distort incentives to invest in next generation access.”* 3.29

Ofcom have also characterised the problem of regulatory commitment clearly:¹³ *“For any approach to be credible, prospective owners of next generation access networks need to be confident that access terms will be set that reflect the risk incurred at the point of investment for much of the life of the asset.”*; and *“The problem is that, at some point in time, it may be hard to recall that deploying these assets was ever risky at all. The temptation therefore will be for future regulators to return to regulating assets using a cost-based approach assuming lower levels of risk and hence a lower cost of capital. If operators anticipate that this might happen, this will affect their incentive to invest. So regulators need some way of making contingent commitments; for example, committing themselves to regulating the asset in a particular way so long as the operator is found to have significant market power.”*

¹¹ Australian Productivity Commission. September 2001. “Telecommunications Competition Regulation Inquiry Report”, Page 294-295.

¹² Ofcom. November 2006. “Regulatory challenges posed by next generation access networks.” <http://www.ofcom.org.uk/research/telecoms/reports/nga/nga.pdf>

¹³ Future broadband – Policy approach to next generation access, Ofcom, September 2007

2.1 Efficient and timely investment

There is always a degree of uncertainty involved in regulation, but as the Chief Executive of Ofcom Ed Richards put it in relation to NGA in April 2008¹⁴:

“If the market does not know which end is up, a regulator would have to have extreme hubris to think it knows any better.”

Market uncertainty is illustrated by the fact that different NGA “bets” are being made, and the changing reaction of investment analysts to such bets. In some markets, little if any investment in NGA is currently occurring, whilst in the US for example Verizon and AT&T are pursuing different strategies – a high investment cost high risk-reward FTTP strategy, and a lower investment cost lower risk-reward FTTN strategy respectively. Uncertainty is compounded by the fact that the capability of legacy networks differ (depending on line lengths for example) and national market circumstances differ. There is no single right approach, even where circumstances are similar.

The decision over what investment is the right one and when to make it is therefore fundamentally a judgment. Analysis can help inform the decision, but there is no objective method for making the right investment decision, establishing appropriate ownership and contractual boundaries for the business, and establishing the right products and prices over time. In this environment, there is considerable risk in governments or regulators attempting to second guess entrepreneurial decisions.

The problem is compounded by the fact that investment decisions, demand, pricing and the cost of capital are all endogenous i.e. they depend on one another. It is not possible to fix one without impacting on the others, and questions such as “what is the right risk adjusted cost of capital?” do not have an answer independent of investment choices, pricing and demand.

Intuitively, the reason that conventional cost based regulation and cost reflective pricing will not deliver good outcomes is that we are seeking to maximise value, and value depends on benefits as well as costs. A narrow focus on cost is very unlikely to maximise value since the least cost option – or the option a regulator facing very different incentives to an investor would prefer – is unlikely to be the most valued option. Incentives for investors to weigh upside and downside risk therefore need to be preserved and a cost based approach to regulation, irrespective of allowance for risk, cannot be expected to deliver efficient and timely investment.

Given information asymmetries between end users, managers, owners and regulators efficiency is promoted by allowing parties to keep some surplus (known as “information rents”) in return for the revelation of efficient behaviour.¹⁵ Such rents differ from pure monopoly rents since they promote rather than harm economic efficiency by aligning different parties interests – in this case the interest in efficient and timely investment.

If there were only one investment option under consideration, the problem of incentivising efficient investment would in principle, but not in practice, be trivial. One would simply set a price that allows an expected return just sufficient to fund the investment. However, as Box 2.2 seeks to illustrate, the problem is deeper than choosing the correct return to allow, since in practice there are always multiple investment options (for example, involving different technologies and/or timing), and the

¹⁴Ed Richards, “Broadband Britain – towards the Next Generation”, Speech to the Institution of Engineering and Technology, 16 April 2008 <http://www.ofcom.org.uk/media/speeches/2008/04/ietspeech>

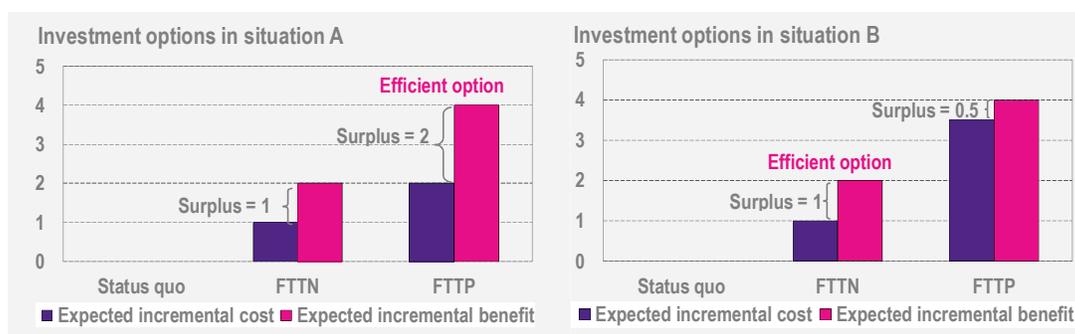
¹⁵ Laffont and Tirole. 2000. “Competition in telecommunications.” MIT Press.

question is not whether to invest or not, but when and how to invest. A binding regulated price or price cap, or the expectation of one, is likely to distort investment choices when there is a portfolio of options.¹⁶

Box 2.2: The problem of incentivising investment which maximises value

Figure 2-1 sets out an investment decision problem involving the status quo i.e. zero incremental cost and benefit, and FTTN and FTTP investment options which involve incremental costs and benefits which depend on circumstances (for example, timing or location represented by situations A and B). It is assumed that FTTP is both more expensive and more valuable than FTTN, and that the optimal value maximising investment depends on the circumstances.

Figure 2-1: Efficient NGA investment choices



In terms of value (incremental benefit less incremental cost), Option 3 is preferred in situation A (a surplus of 2) and Option 2 is preferred in situation B (a surplus of 1). Under the regulatory approaches considered above – utility style and TSLRIC – inefficiency could arise as follows. Under utility style regulation, if the return on capital is too low, Option 1 (no investment) would be chosen in both situations, whilst if the return on capital were too high, Option 3 would be chosen in both situations, and this would involve inefficient “gold plating” in situation B. Under TSLRIC with returns capped, the investor would prefer Option 2 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.

If the information required to assess efficient investment in each location were common knowledge, the regulatory problem would be trivial - the regulator could simply offer returns conditional on making the efficient investment in each location. In practice, a judgement is required over which investment to make in each location given uncertainty over the value (and therefore customer willingness to pay) for alternatives. In these circumstances, it is essential that investors 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. In a more formal analysis Gans and King (2004) considered the investment decision problem and concluded that the optimal approach is to allocate economic profit (“excess returns”) to the investor.¹ We return later to the question of whether there are options short of complete forbearance – which provide some assurance to consumers - that would substantially address the investment incentive problem.

¹⁶ Brian Williamson. September 2007. “Risk, information asymmetry, value based pricing and efficient and timely investment.” London Business School event. http://www.london.edu/assets/documents/PDF/LBS_functional_separation_investment_decisions_September_2007.pdf

The conclusion from this analysis is that it is not in general possible to decentralise the investment decision with an arms' length regulated price or pricing approach and achieve efficient value maximising investment. Sufficient price flexibility is required to allow returns to reflect value. In today's environment, where the underlying infrastructure is in the ground, this is less of a concern. In the transition to, and ongoing transformation of NGA, price flexibility is essential for efficiency.

2.2 Efficient pricing over time

"If an economist finds something – a business practice of one sort or another – that he does not understand, he looks for a monopoly explanation." Nobel Laureate Ronald Coase

The previous section concluded that regulating overall returns via comprehensive price controls or price caps could distort investment choices since the value of alternative prospective investment options is unlikely to impact much if at all on investment decisions if anticipated regulated prices would be "cost based". In this section we turn to the question of how to achieve efficient pricing in support of timely and efficient investment, in particular the dynamic structure of prices including price differentiation over time.

With NGA a greater proportion of costs will be fixed up-front capital costs which are common across services since an NGA is a multi-service platform. There will therefore be no cost oriented basis for allocating overall access costs across services. Further, there are sound grounds for differentiating prices for different service levels on the basis of demand.

Since demand for different services and different access service attributes can be expected to change over time – potentially in unpredictable ways - as NGA and the ecosystem of applications it supports matures, there is a need for price flexibility and differentiation across periods in time. In other words, experimentation in products and pricing is needed to work out what customers want and how much they will pay for it. For example, less might be charged for the access bandwidth required for a voice call versus a HD video call, and the premium on high bandwidth might be expected to grow over time as voice only service revenues were eroded by mobile and demand for services such as two way HD video calling and collaboration grows. Dynamic value - rather than cost reflective - pricing is an efficient means of promoting investment.

In particular, a single cost reflective price may simply raise insufficient revenue to support timely investment, even where overall willingness to pay exceeds investment costs. Valletti (2005) analyses an example of pricing according to differences in demand and incentives to invest in R&D, and shows that *ex ante* incentives to invest increase with price differentiation.¹⁷ However, it is important to note that literature on the optimality (or not) of price differentiation does not consider the dynamic question when investment choices are involved. The case for price flexibility to allow price differentiation and dynamic pricing can however be illustrated via a simple specific example.

Figure 2-2 illustrates how revenue with a single price may be insufficient to support investment even though overall willingness to pay is sufficient. A single tariff yields, at most, the revenue represented

¹⁷ Tommaso M. Valletti. September 2006. "Differential pricing, parallel trade, and the incentive to invest." *Journal of International Economics*. Volume 70, Issue 1. Pages 314-32.

We note that this analysis "...assumed linear demand curves and that all markets are served under both differential and uniform pricing. This has assumed away the potential market-expanding effects of differential pricing by opening up new markets." In relation to NGA we are of course also concerned also with the opening up of new markets, a prospect that is made more likely if price discrimination is allowed.

by the square $P^* \times Q^*$ which is less than the investment cost shown by the larger square. **Figure 2-3** illustrates how price differentiation could enable investment to proceed since the overall surplus captured via differentiated pricing is sufficient to support investment.

Figure 2-2

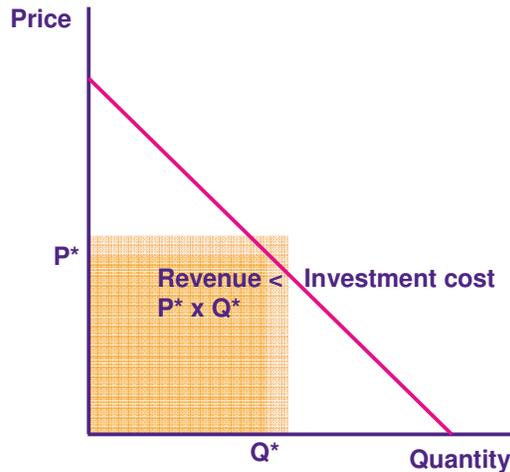
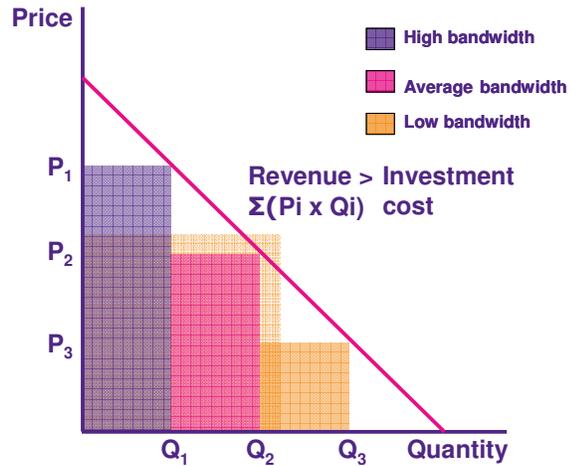


Figure 2-3



Over time the slope of the demand curve (the red diagonal line) illustrated in **Figure 2-2** and **Figure 2-3** will change with demand for high bandwidth services growing, and demand for low bandwidth services, particularly the bandwidth required to support voice potentially declining as mobile substitutes for fixed voice. The optimal degree of price differentiation can therefore be expected to change over time, and given the uncertainty over demand for bandwidth now and in the future efficient pricing requires a difficult judgement to be made. Given the uncertainty involved, there is also a need for sufficient pricing flexibility to allow for learning and correction.

The evidence from early deployments of next generation networks shows the importance in practice of product and price experimentation to take-up. **Figure 2-4** illustrates price differentiation by bandwidth based on the pricing plans offered by Verizon for their “FiOS” FTTP service (alongside a comparison with published price plans for DSL).¹⁸

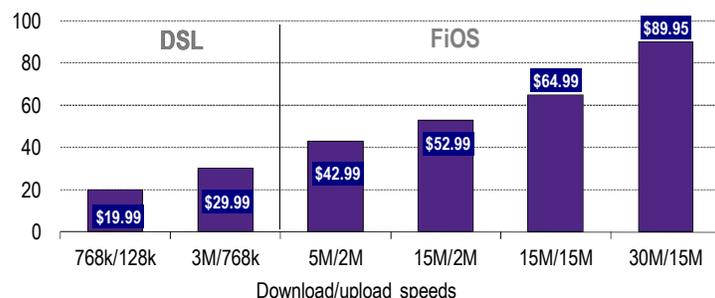
¹⁸ <http://www22.verizon.com/content/consumerfios/packages+and+prices/packages+and+prices.htm>

In a number of locations a symmetric 20 Mbps package is offered instead of 15 Mbps symmetric. Verizon also have 7 Mbps DSL plans available in some locations which are not listed in the overall price schedule.

Figure 2-4

Verizon broadband DSL and FiOS pricing

Monthly charge (USD)



Source: Plum Consulting. www22.verizon.com. Pricing for one-year contracts.

Higher prices are charged for higher bandwidth and the overall structure of prices has changed over time with a new symmetric service plan offering at least 15 Mbps in both directions (20 Mbps in a number of locations) introduced during 2007. Further, the differences in prices by bandwidth are not related to differences in access costs which are identical (though higher costs would be incurred in the core network if higher bandwidth plans were associated with higher traffic levels).

A final question is where price flexibility and differentiation is required if separate wholesale and retail prices are available (the Verizon pricing shown is for retail pricing). The answer is that differentiation must be possible at the wholesale level – otherwise downstream service providers will not be able to sustain differentiation on the basis of access attributes such as bandwidth due to arbitrage i.e. a higher price for higher bandwidth would be arbitrated away by others purchasing an average price wholesale access product.

Price flexibility is required at the wholesale and retail level to support price differentiation, dynamic pricing and efficient and timely investment. Efficient prices in an NGA environment should be value rather than cost based.

2.3 Non-discrimination and potential monopoly abuse

The previous two sections addressed the argument for pricing being endogenous to investment choice to ensure efficient choices that reflect value (benefits less costs) rather than costs alone and for dynamic price differentiation once investment is made to maximise the prospects of revenue supporting investment whenever willingness to pay exceeds cost.

Two concerns remain that regulation might seek to address: first, the need to support competition and innovation in service delivery, and therefore the need to assure access seekers that they will not be subject to discrimination vis-à-vis an access provider's own downstream arm, and that access products will be fit for purpose; and, second, the need to protect end users from monopoly abuse.

In considering these issues we note that where platform competition is sufficient, neither concern would arise and no intervention, beyond the provisions of general competition law, would be appropriate.

Where sufficient platform competition is absent, we note that NGA itself (ie, absent regulation) changes incentives in favour of openness relative to a POTS (plain old telephone service) network. There are two underlying reasons for this conclusion. First, NGA is a multiservice platform that can support a range of existing services and allow the development of new services (many of which may not have been anticipated). Openness allows an ecosystem of applications to develop that will drive demand for NGA, and the NGA platform operator, recognising that it has no monopoly on innovation, will be incentivised to encourage this to maximise utilisation of its fixed-cost platform. Second, IP technologies have facilitated entry into service provision, thereby increasing competition in the downstream market and reducing any potential benefit from discrimination.¹⁹ First generation web services, such as Skype voice and video and emerging web based video services like YouTube, provide a foretaste of the scope for applications and services competition possible on the powerful, end to end IP platform provided by an NGN.

The network operator will not be able to meet all end user needs, and where closed “walled garden” approaches were initially attempted they have typically been dismantled in the IP environment once it was realised that the demand creating effect of diversity and contestability exceeded any potential benefit from attempts to monopolise downstream service markets.

NGA may also change incentives in relation to integration, either via contract or via ownership. Voice will become relatively less important, and new value chains will emerge for video distribution, video communication, high speed mobile requiring deep fibre etc. Currently there is uncertainty about how these transformations will proceed, and whether the access provider can capture any of the value released. Contractual and ownership relationships may emerge to facilitate such transformations. However, we note that legacy regulation, which treats pricing and relationships as spot market relationships, may preclude the development of new relationships and the creation of value. Integration may also be driven by a desire to learn about demand for services and bandwidth first hand.

Further, the literature that indicates that vertical integration in a POTS world introduces an incentive to discriminate is specific to the technology and market of legacy telephony services. For example, Mandy (2000) states that “*The incentive to discriminate is theoretically ambiguous...*”²⁰ These results do not constitute a *per se* result that incentives to discriminate necessarily flow from integration – they are specific to legacy infrastructure and telephony markets.

Looking at factors that impact on incentives to discriminate Weisman and Kang (2001) concluded that:²¹

“First, the incentive to discriminate is decreasing with the regulator’s ability to detect discrimination...

Second, the incentive to discriminate is decreasing in the market elasticity, ceteris paribus. This occurs because a higher market elasticity, ceteris paribus, gives rise to a lower equilibrium downstream price which, in turn, reduces the profitability of the downstream market relative to the equilibrium upstream market.

¹⁹ Assuming that denial of access to the internet itself would not make commercial sense (or that such denial would not be permitted).

²⁰ David Mandy. 2000. “Killing the golden goose that may have laid the golden egg: only the data knows whether sabotage pays.” *The Journal of Regulatory Economics*, 17:2.

²¹ For example: Weisman and Kang. 2001. Incentives for discrimination when upstream monopolists participate in downstream markets.” *Journal of Regulatory Economics*, Volume 20(2).

Third, the incentive to discriminate is decreasing in the level of the access charge, ceteris paribus. This occurs because higher access charges raise the opportunity cost of discrimination for the VIP. This finding suggests that a policy of reducing access charges when the regulator's ability to detect discrimination is highly imperfect may well have adverse welfare consequences.

Fourth, the incentive to discriminate is decreasing in n [the number of competitors], ceteris paribus. This occurs because higher values of n , ceteris paribus, imply a lower equilibrium downstream price which, in turn, reduces the profitability of the downstream market relative to the upstream market.”

The following points consider how incentives to discriminate might change in the move to NGA (assuming the general results carry across):

- in relation to the first point above, ease of detection, there may be little if any change with NGA (if we assume that discrimination might arise via a margin squeeze and that detecting a margin squeeze requires that retail margins are assessed *ex post*);
- in relation to the second point above, the market elasticity for higher bandwidth services will (at least initially) be higher, and the incentive to discriminate lower;
- in relation to the third point, provided access pricing constraints are relaxed consistent with promoting efficient and timely investment, the incentive to discriminate would be reduced; and
- in relation to the fourth point, the diversity of downstream services, advantage of others in particular markets such as search, and ease of entry provided by the internet suggests that incentives to discriminate should be lower.

Ofcom recognise the interaction between access price flexibility and reduced incentives to discriminate.²²

“With retail minus and anchor product approaches, which involve greater pricing flexibility at the access level, there may be greater scope for margin squeeze compared to cost based forms of regulation. However, if a vertically integrated next generation access investor is allowed to take profit from the upstream wholesale products then it has much weaker incentives to discriminate against rivals. This, combined with the recognition that communications providers might help increase overall demand for next generation access could both act to diminish incentives to discriminate.”

It is important to note that the analysis on which these conclusions are based is static – there is no consideration of the potential effect of innovation and the introduction of new services in the downstream market. Intuitively one might expect this possibility to strengthen the conclusion that NGA reduces or eliminates incentives to discriminate, since the access provider cannot hope to replicate the scope for innovation from open access.

Evidence for this comes from the ICT market more generally where the scope for innovation with voluntarily adopted open models has been demonstrated. Many web services are now open to third party innovation, and platforms such as the iPhone and Symbian operating system allow third party applications. Another example is Intel, who voluntarily established institutional arrangements to

²² Ofcom. September 2007. “Future broadband, policy approaches to next generation access. Paragraph 5.36. http://www.ofcom.org.uk/consult/condocs/nga/future_broadband_nga.pdf

reassure those who innovate in the market for complements to its core asset – the microprocessor – that they will not be subject to an *ex post* squeeze (see Box 2.3).²³

Box 2.3: Intel promotes innovation in complementary markets via a commitment to non-discrimination

- First, it uses an internal organisation structure (separate divisions and profit and loss operations) and a widely publicised rhetorical device (the distinction between “Job 1” and “Job 2” which refer to the tasks of expanding demand for microprocessors and growing profitable businesses in complementary markets respectively) to signal that it expects both Intel and its competitors to make money in complementary markets.
- Secondly, it subsidises entry for all potential entrants, predominantly via widespread dissemination of intellectual property.
- Thirdly, it attempts to commit to these subsidies through the creation of a separate organisational unit (The Intel Architecture Lab) which is structured as a cost centre and rewarded for its success in promoting the health of the ecosystem as a whole, or for stimulating the demand for microprocessors.

On the one hand Intel commits to making money in complementary markets (signalling that it will not drive returns down), whilst at the same time committing not to make too much money by promoting entry.

Intel’s approach is conditioned by the firm’s belief that because it cannot match the variety of competencies of potential entrants, sustaining a credible commitment not to engage in *ex-post* squeeze of entrants is critical to its success. We anticipate similar developments in relation to NGA where investors want to maximise demand for access, and will realise they cannot do this alone. Further, as discussed in the introduction to this section, complementary changes across sectors are required to realise the full potential of NGA, and therefore to motivate appropriate investment decisions. This shift would be supported by a more relaxed, rather than more rigorous, regulatory approach.

The nature and strength of any remedies required to provide assurance of open access might therefore be expected to change. In particular, separation remedies, such as the undertakings relating to Openreach in the UK, should not necessarily be seen as a model for NGA.²⁴ In particular, the foundation of the Openreach model was not separation but equivalence in a legacy network environment. Further, the model was adopted voluntarily as part of an overall package of reform. Management therefore worked with, rather than against, the package. A focus on separation *per se*, and in particular a mandated separation, would require much more regulatory oversight and ever increasing, rather than reduced, regulation. This would completely undermine pricing flexibility. A more flexible approach to price regulation coupled with acceptance that relationships and involvement in service markets may be required to facilitate transformation is required.

A further question is what form of competition can and should be supported in an NGA environment, and what form access to NGA infrastructure should take. Wholesale bitstream products and unbundling of copper loops (local loop unbundling, or LLU) has supported competition in the current environment. With a move to FTTN unbundling may not be commercially viable, or only commercially

²³ Gawer and Henderson. December 2005. “Platform owner entry and innovation in complementary markets: evidence from Intel.” National Bureau of Economic Research Working Paper 11852.

²⁴ It should be noted that the Openreach model was primarily about credibility in relation the delivery of equivalence (an end), rather than functional separation (a means). We note that equivalence applies to some products where functional separation does not.

viable for a much smaller number of customers, given the smaller number of customer aggregated at the street cabinet versus a telephone exchange.

The reduction or elimination of the opportunity for physical unbundling with NGA eliminates scope for competition and innovation in relation to the electronics at the telephone exchange. However, beyond ADSL2+ there may be little if any scope for increased speed with DSL, at least for most customers with existing line lengths.²⁵ The reason for this is that ADSL2+ technology is near the theoretical limit in terms of line speed for longer line lengths. It is also important to note, apart from cost considerations, that VDSL2 performance in an FTTN environment may be reduced if DSL is maintained in parallel.²⁶

Further, physical unbundling, at least in Europe, has led to the emergence of support for the status quo in terms of the underlying network architecture by many unbundlers. In the absence of strong platform based competition they have no reason to support an upgrade to NGA – even if it were in end users interests – since they utilise a common input (copper loops). Unbundling of FTTN would likely see similar resistance to the transition to FTTP.

Turning to the alternative of an active bitstream access product, with the right specification, the scope for innovation and competition should increase compared to existing active products. Customer switching would also be more straightforward since it could occur via an electronic interface with no need for physical unbundling (and truck roll).

In the UK active line access (ALA) is under development for the Ebbsfleet fibre to the premise deployment. Commenting on ALA Ofcom noted that:²⁷

“products offer a greater potential for innovation for NGA deployments than exists for the active inputs in current generation access networks.”

Further, Ofcom subsequently noted that:²⁸

“Active line access is a form of bitstream which: Approaches the level of innovation supported by passive access...helps overcome technology isolation...Customer acquisition does not necessitate truck roll.”

ALA would also help overcome technology isolation, thereby reducing the risk that access seekers will resist future upgrades.

2.4 Credible regulatory commitment

“The freedom and extent of human commerce depend entirely on a fidelity with regard to promises.”

David Hume, 1739

²⁵ Williamson and Marks. June 2008. “A framework for evaluating the value of next generation broadband.” Appendix A – DSL over copper. http://www.plumconsulting.co.uk/pdfs/BSG_Value_of_next_generation_broadband_June_2008.pdf

²⁶ Light Reading. May 2006. “VDSL2”. http://www.lightreading.com/document.asp?doc_id=93103&print=true

²⁷ Ofcom. 16 April 2008. “Next generation new build.” Page 34. <http://www.ofcom.org.uk/consult/condocs/newbuild/condoc.pdf>

²⁸ Chinyelu Onwurah, Ofcom. 15 May 2008. “Next generation build.” Openreach. “Future access forum.” Page 19. http://www.openreach.co.uk/orgg/products/nga/downloads/Main_slide_deck_final.pdf

“For a market to function well, you must be able to trust most of the people most of the time; you must be secure from having your property expropriated...”

John McMillan. 2002. “Reinventing the bazaar – a natural history of markets.” Page 228

Credible commitment is one of the key ingredients of a healthy market where parties need to invest in relationships, commit resources to innovation and invest in assets whose value depends on the actions of other parties. Where regulatory intervention occurs or is anticipated by investors, credible commitment not to expropriate sunk investment is necessary to support efficient and timely investment.

The problem of credible commitment relates to incentives *ex post*, and the problem arises even with a well intentioned regulator who seeks to maximise social welfare. Appointing a benevolent regulator does not solve the commitment problem:²⁹

“The regulator’s benevolence is a virtue when the regulator can commit but not necessarily when he or she cannot commit; then the expropriation of the firm’s investment is socially optimal ex post but not ex ante.”

This general problem has been recognised in relation to monetary policy where discretion led to poor outcomes, and various institutional mechanisms have been developed to allow governments and central bankers to effectively tie their hands.³⁰

A lack of credible regulatory commitment will involve costs of various kinds, perhaps the most visible being an elevated cost of capital. However the risk of expropriation is not necessarily reflected in the observed cost of capital and will more likely show up in terms of inefficiently low levels of investment and innovation, or short termism and a lack of specialisation (since returns must be made quickly or assets re-deployed in the face of a risk of expropriation). A study of investment in a large sample of countries over an extended period – focusing on telecommunications and electrical infrastructure – found that:³¹

“...political environments that limit the feasibility of policy change are an important determinant of infrastructure investment.”

There is a long history in terms of the problem of regulatory commitment and opportunism.^{32 33} The more recent history in relation to the TSLRIC pricing methodology in particular is also far from encouraging. A stated aim of the TSLRIC methodology is to place emphasis on efficient pricing. However, in practice this methodology may rely on non-transparent modelling and be open to opportunism, for example, via the revaluation of network elements on a current replacement basis leaving aside the feasibility of building and rebuilding real networks utilising current technology when

²⁹ Laffont and Tirole. 1993. “A theory of incentives in procurement and regulation”. The MIT Press. (Page 99).

³⁰ Kydland, F and Prescott, E. 1977. “Rules rather than discretion: the inconsistency of optimal plans”. *Journal of Political Economy*, Vol 85, No 3, p619-637.

³¹ 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>

See also: Witold Henisz and Bennet Zelner. Spring 2001. “The Institutional Environment for Telecommunications Investment.” *Journal of Economics and Management Strategy* 10(1). http://www-management.wharton.upenn.edu/henisz/papers/hz_ieti_jems.pdf

³² Brian Levy and Pablo Spiller. 1994. “The Institutional Foundations of Regulatory Commitment: A Comparative Analysis of Telecommunications Regulation.” *Journal of Law, Economics and Organisation*, Volume 10(2).

³³ Scott Wallsten. March 2003. “Returning to Victorian Competition, Ownership, and Regulation: An empirical study of European Telecommunications at the Turn of the 20th Century”. http://www.wallsten.net/papers/wallsten_europe_telhist.pdf

such networks necessarily develop over time.³⁴ TSLRIC suffers from a credibility problem in that future pricing is left open to relatively non-transparent detailed modelling assumptions.³⁵ Further, to the extent that costs are fixed and common across services, incremental methods may not provide a basis for developing “cost reflective” prices in any case.

Dixit and Nalebuff, in their book *Thinking Strategically* set out a range of means of making a strategy credible. Among these are the following: reputation, contracts, burning bridges, move in small steps, and delegating to an agent who follows a rule.³⁶

In conclusion, commitment is necessary to achieve good outcomes since otherwise anticipated behaviours *ex post* will produce poor outcomes *ex ante*. The scope of regulatory commitment should widen. Institutional mechanisms can contribute to credible commitment: namely clarity of objectives and the decision making model; transparency of process and decisions; and independent monitoring and verification. It also helps if current governance arrangements and market conduct deliver good outcomes, thereby reducing or removing pressure for change.

2.5 Conclusion

Legacy telecoms markets and regulation have involved relatively static tradeoffs and a focus on cost reflective pricing, a *per se* belief that vertical integration leads to discrimination, and the periodic exercise of discretion to reallocate “rent”. The underlying implicit assumption is that regulation is a zero sum game between access providers, access seekers and end users. Regulators implicitly relied on the fact that, as the network was already built, the trade-off involved was manageable. However, potential investors may anticipate similar problems in future should they invest in NGA.

NGA requires a clear and credible commitment to a different regulatory approach which recognises the investment incentive problem, and that a different market environment will exist once investment has occurred. Price flexibility and dynamic pricing is required to allow decisions to reflect value as well as costs, and to promote efficient and timely investment. In turn more pricing flexibility alongside underlying market changes will reduce or eliminate incentives to discriminate against downstream service providers.

Absent platform based competition, access seekers will have little if any incentive to reflect end user interests in their preferences for platform upgrades since they will all be utilising a common access input. Indeed, they may oppose upgrades to the underlying platform if they have invested in specific complementary assets (as is the case with LLU). The access provider must have a relationship with end users, alongside profit opportunities for meeting their needs, to ensure that end user preferences are reflected in investment decisions.

Active access products are likely to be fit for purpose and to facilitate a smooth transition from FTTN to FTTP, whilst new ownership and contractual relationships between access provision and applications and service providers may be required to facilitate market transformation and value creation based on NGA.

³⁴ Mandy and Sharkey. September 2003. “Dynamic Pricing and Investment from Static Proxy Models”. FCC OSP Working Paper 40.

³⁵ H Ergas. 2008. “Telecommunications access pricing: the Australian experience.” http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1086856

³⁶ Dixit and Nalebuff. 1993. “Thinking Strategically”. Chapter 6.

The following section provides a brief evaluation of alternative approaches to regulation against the criteria of efficient and timely investment, protection of competition, protection of end users and credible regulatory commitment.

3 Achieving good outcomes in practice

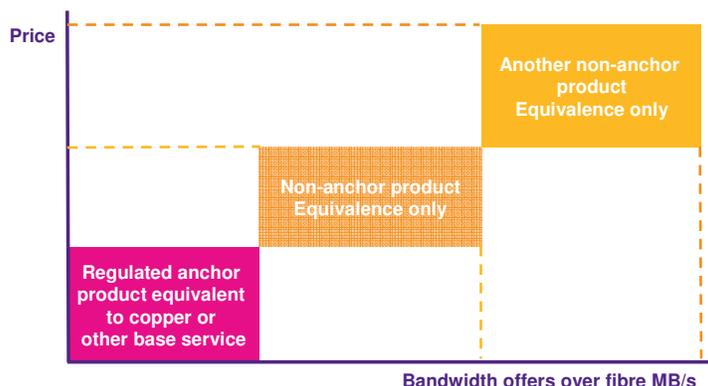
A range of options are available in terms of regulatory governance of NGA including complete forbearance from *ex ante* regulation, regulatory holidays, anchor product regulation, forward looking incremental cost based price caps (TSLRIC) and “utility style” regulation where emphasis is placed on historic costs and an agreed regulatory asset base.

Where platform based competition is sufficient, forbearance from *ex ante* regulation is appropriate. Where it is not, some form of regulatory governance may be required, or will in any case be anticipated by investors. The problem then is one of preserving sufficient flexibility to achieve good outcomes, whilst assuring downstream competitors of open and non-discriminatory access and end users they will benefit from NGA. There must also be a credible commitment to the approach – otherwise potential investors will anticipate the worst in the future.

Utility style regulation and TSLRIC fail in terms of incentives for efficient investment, and in the case of TSLRIC in relation to credible commitment. At the other extreme, regulatory forbearance may not be viewed as enduring if monopoly exists, and would likely fail the test of providing assurance to downstream competitors and end users.

An intermediate option that has been suggested is anchor product regulation,³⁷ whereby some basic voice and broadband products are subject to price commitments, whilst other higher bandwidth services are offered on non-discriminatory terms but not subject to *ex ante* price regulation. Such an approach would also improve the prospects for platform competition and/or contractual relationships that reduce the risk of future pressure for more extensive regulation. Figure 3-1 illustrates the concept.

Figure 3-1: Tiers of wholesale access pricing



In essence:

- roughly the same price and service levels available over copper are emulated over NGA i.e. end users are not made worse off by the transition;
- access prices are not derived on a cost oriented basis since those wholesale prices that are controlled are set on the basis of retail prices on the previous platform on a retail minus basis; and

³⁷ Brian Williamson. July 2007. “New regulatory approaches to next generation access.” http://www.broadbanduk.org/component/option.com_docman/task.doc_view/gid.944/

- non-anchor product prices would be set by the platform owner.

Ofcom have proposed an approach along these lines for new build fibre sites in the UK.³⁸ The approach would leave a substantial measure of risk and reward with the investor, whilst ensuring that customers who do not value the new services NGA enables can continue to purchase products over NGA that match the performance legacy products.

Another possibility, that might emerge if sufficient flexibility to decide pricing and form long term relationships were available, would be long term contracts or ownership relationships to govern access. This would provide a form of governance, and may be necessary to facilitate the full potential for value creation from NGA.

In conclusion, there is a fundamental choice to be made between extensive and prescriptive cost oriented regulation at the access layer, which would in turn increase incentives for discrimination and lead to even more intervention – thereby stifling innovation – on the one hand, and on the other hand, an approach whereby a balance is struck that provides sufficient commercial freedom to lead to a virtuous cycle of more competition, innovation in terms of technology implementation and business models, and efficient and timely investment without detailed oversight.

³⁸ Ofcom. May 2008. "Promoting higher speed broadband in new build housing developments."
<http://www.ofcom.org.uk/consult/condocs/newbuild/condoc.pdf>