Legal and regulatory reviews

Regulating next generation networks

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Abstract Operators throughout the developed world are rolling out IP-based next generation networks (NGNs) with fibre access. This paper argues that investment in NGNs should generate major long-term economic gains. As such, it is important that regulators do not delay investment with inappropriate regulation. Regulators should aim to maximise end-user benefits when taking decisions about NGNs. This may require a trade-off between competition and investment objectives. Competitive innovation, which is the prime source of economic gains, will depend on service rather than infrastructure-based competition. Regulators must ensure service providers have open and standardised interfaces for NGNs. Enabling timely investment in next generation access (NGA) fibre-access networks while preserving competition is best served through anchor product regulation where the operator is required to offer all service providers access to its NGA products on an equivalent basis, in addition to offering basic voice line and broadband access over its NGA network at regulated prices, while being free to set its own prices for higher speed access. Regulators should preserve the *ex ante* requirement for all NGNs to interconnect to allow any-to-any communication for established services like voice calls, although they should abandon the calling party pays principle. Regulators need to develop public interest tests to determine how quickly incumbent operators can withdraw legacy wholesale products and replace them with NGN-based products.

KEYWORDS: next generation networks, fibre investment, regulation, any-to-any communications, remonopolisaton, legacy wholesale products

THE PROMISE OF NEXT GENERATION NETWORKS

Compared with today's networks, next generation networks (NGNs) should bring major benefits to end users in terms of a wider range of higher functionality services, offered at significantly lower prices. Specifically:

- All NGN services, whether voice, data or video-based, are carried over a single IP transport network. Today, a major telecommunications operator typically runs circuit-switched, IP, ATM, frame relay and leased circuit (cross-connect) networks. By moving to NGNs, operators can rationalise sets of provisioning and maintenance procedures and staff by a factor of five. This should lead to a substantial reduction in unit costs and hence prices.
- Network conveyance and intelligence are separated. Network intelligence is located in centralised servers at the edge of the transport network, rather than embedded into local switches. This change of architecture makes it faster and cheaper for service providers to develop and deploy new services.
- Next generation access (NGA), in which the current copper access network is partially or fully replaced by fibre, allows operators to deliver a wide range of new services, both to mass market and corporate customers. The capacity of the copper network will soon be

reached. For example, copper-based ADSL2+ might run at 24 mbps under laboratory conditions. In practice, however, one would expect it to offer no more than 8 mbps to 50 per cent of the population in a typical EU country.[1] Such speeds are already inadequate for serving corporate sites. Indeed, the growing demand for higher up-link speeds (eg for real-time video, user-generated content and online games) and high-definition television (streamed real-time HDTV requires 9–10 mbps) is likely to render them inadequate for consumer-based services within the next few years.

ECONOMIC WELFARE GAINS FROM NGN

Figure 1 shows how the potential benefits from NGNs might manifest themselves in terms of economic welfare gains:

- New and innovative services will shift the demand curve to the right — leading to the gain in economic welfare indicated by the shaded area of Case A.
- At the same time, the lower unit cost of NGNs leads to the gains shown by the shaded area in Case B.

It is instructive to compare these gains with those generated by price competition using today's circuit-switched technologies. These are shown by the shaded area of Case C. Comparing this area with those for Cases A and B combined one can see that, with any reasonable demand and cost curves and curve shifts, NGNs are likely to generate significantly greater economic benefits than maintaining today's price competition.

There is an important message here for regulators. Cross-platform competition with cable and mobile networks is an important stimulus for investment in NGNs by incumbent fixed operators. Such investment helps them differentiate themselves from these rivals. When there is a conflict between preserving existing access-based competition (in which the incumbent's rivals rent access facilities and services from the incumbent to offer end-user services) and maximising incentives for investment in NGNs, it is important that the regulators should rule in favour of the latter if they want to maximise economic benefits.

Unfortunately this approach does not fit happily with the current EU regulatory framework[2] which specifies three objectives for NRAs in Europe:

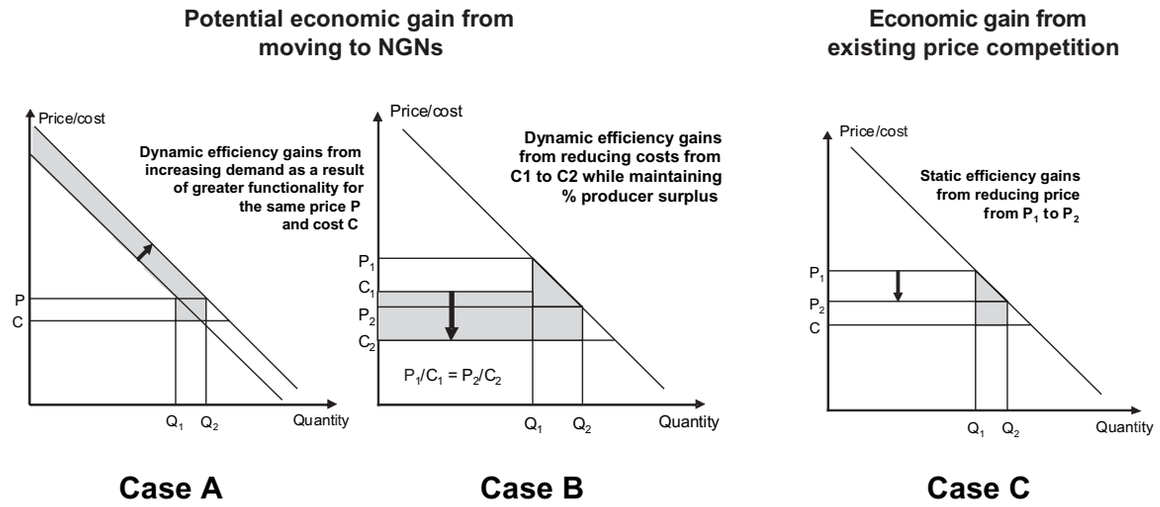

Figure 1: Economic welfare gains — deployment of NGNs versus current price competition

- to promote the interests of EU citizens;
- to promote competition;
- to complete the internal market of the EU.

It is worth noting that only the first of these goals is a proper objective. In particular, promoting competition is only a means to an end (that of promoting the interests of citizens) and not an end in itself. Given this current specification of NRA objectives there is a danger that regulators will promote access-based competition, even in cases where it is in conflict with maximising end-user benefits so as to promote the interests of citizens.

NGN — CORE VERSUS ACCESS

In discussing the regulation of NGNs it is important to distinguish between core and access networks:

- Incumbents are already making substantial investment in core NGNs; these provide transport of bits between access nodes and servers, points of interconnect and other access nodes, and provide services over the transport network. Such investment is justified in terms of cost savings alone and there is little investment risk. One can therefore expect incumbent operators to invest in core NGNs whatever (reasonable) regulatory regime is put in place.
- The case for investing in next generation access (the network from the access node to the end user) is much riskier. This network may use fibre from the access node to the street cabinet (FTTC) or to the end-user premises (FTTP). In a country with a population of 60 million, the investment required to replace the copper access network with fibre to the premises and/or fibre to node is currently over €25bn. Such investment cannot be justified in terms of cost savings alone. At the same time, the market's willingness to pay a premium for high-speed services and the cost of rolling out the fibre-access network both remain uncertain. It is important that regulators do not add unnecessarily to these market and technology risks. If they do so, they are likely to delay investment by the incumbent operators and hence the economic welfare gains shown in Cases A and B of Figure 1.

THE IMPACT OF NGN ON COMPETITION

NGNs will fundamentally change the nature of competition in the provision of telecommunications services. There are two main effects.

First, the roll-out of NGA enlarges the enduring economic bottleneck. In most developed countries this bottleneck is currently the local loop from the end user to the main distribution frame. Recognising this bottleneck, NRAs in most developed countries require the fixed incumbent to offer unbundled local loops at cost-oriented prices. Roll-out of NGA enlarges this bottleneck as illustrated in Figure 2.

The figure illustrates how KPN plans to roll out an 'All-IP' network across the Netherlands. It intends to remove the Main Distribution Frames (MDFs) from its network, selling off the 1,360 sites to provide (partial) funding for the investment, and using fibre to connect the cabinet in the access network to around 150 metro nodes at the edge of its core IP network. As a result, the viable point of interconnect closest to the end user will change. Local loop unbundling will disappear and rivals will interconnect either at the cabinet, using sub-loop unbundling, or at the metro node. Sub-loop unbundling (SLU) is technically possible but not commercially viable. While local loop unbundling offers a rival which co-locates at an MDF a market of 5,000–10,000 lines, sub-loop unbundling offers access to only 300–600 lines. As such, the revenue stream from customers is unlikely to justify the costs of collocating at the cabinet and backhauling from there to the rival's core network. So the viable point of interconnect closest to the end-user moves from the MDF 2–5 km from the end user to the metro node or core node, perhaps 30–50 km from the end user.

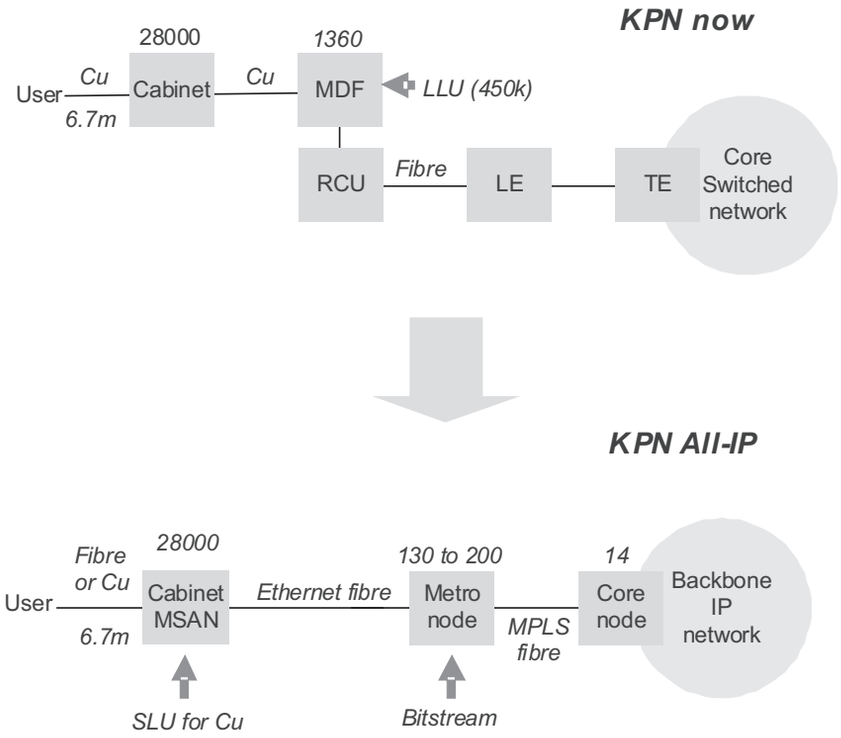

Figure 2: The impact of NGA roll out on local loop unbundling

Secondly, the move to NGNs creates opportunities for strong application-based competition. The roll-out of the core NGN separates service control and intelligence from network conveyance. Service providers no longer need to roll out their own network to offer differentiated and innovative services to end users. Instead they can offer such services by simply connecting their servers to an incumbent's NGN. This separation of network intelligence and conveyance has an important effect on the nature of competition. It shifts the main source of competitive innovation away from the infrastructure-based competition associated with network ownership and towards application-based competition based on ownership of an NGN server. This shift lowers the barriers to entry. It is much cheaper to deploy a server than a network. One can therefore expect a wide range of new (and existing) services to be provided on a competitive basis.

Together these two effects lead to a new model of competition as shown in Figure 3.

With general deployment of NGNs one can expect to see:

- Strong application-based competition in the supply of services. The incumbent's retail division will face competition from a range of corporate service providers (eg IBM and EDS) and a wide range of mass market

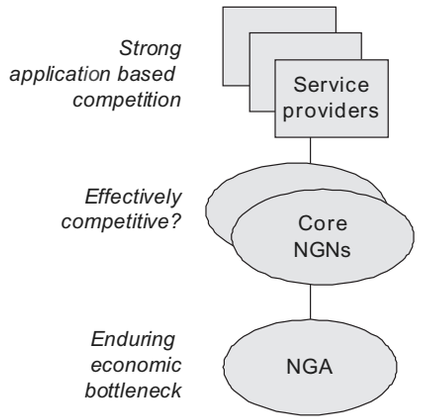

Figure 3: A new model of competition

service providers (which might include strong retail brands, entertainment service providers and global ISPs like Google and eBay). Innovation at this point in the value chain is likely to generate major economic gains. It is therefore important that NGN operators offer a standardised and open interface to service providers. Market mechanisms should ensure that this happens. But this interface is very important and it would be prudent for NRAs to monitor the efforts of the market players closely.

- An economic bottleneck in the fibre-access network. Typically only one nationwide player, the incumbent, will be able to offer the ubiquitous presence and high bandwidth required to serve the mass and corporate markets in the future.
- Major rivals buying NGA from the incumbent at a few dozen electronic interfaces and linking these points of interconnect together with an NGN of their own. This development is less certain than the other two. It is not clear what the gateways between the NGNs will look like or how much they will cost. If these gateways are expensive when compared with today's points of interconnect then the economic bottleneck run by the incumbent might expand further — from the NGA fibre-access network to the NGN as a whole.

What is the appropriate form of regulation of such a value chain so as to maximise end-user welfare? The remainder of the paper considers this question. Regulation of interconnect between NGNs and the more challenging issue of NGA regulation are examined first. This analysis assumes that the incumbent operator has SMP10 in local loop provision and that it is rolling out its NGN on a replacement rather than overlay basis. In other words, the paper focuses on what constitutes appropriate remedies when the incumbent has SMP in the supply of NGA. This is not always the case. In some countries, like the Netherlands, the CATV operator offers strong competition to the incumbent in the supply of NGA services; in others, such as Denmark, the electricity companies are making substantial investments in fibre NGA in certain parts of the country. Wireless access technologies may also mean that the incumbent does not have SMP in the supply of NGA, although this is unlikely. Ofcom examined this possibility in its recent discussion document on NGA.[3] It concluded that wireless technologies were unlikely to provide access services at NGA speeds, at least in the short and medium term.

REGULATION OF INTERCONNECT BETWEEN NGNs

What, if any, *ex ante* regulation should govern the exchange of traffic between NGNs?

Operators face some challenging technical issues in terms of ensuring end-to-end quality of service and appropriate levels of security for services. Most regulators and operators agree that these issues are best resolved through use of open standards and discussions between the operators (in the UK, for example, Ofcom has established NGN UK, a body run by the operators, to resolve such problems), with regulators only intervening on an *ex post* basis in the event of market failure.

Here the paper considers whether two basic regulatory principles which govern interconnect in the circuit-switched interconnect world should be preserved following the transition to NGNs:

- Should all operators be required to interconnect so as to enable any-to-any communication for established services like voice telephony?
- Should the calling party pays principle apply in the NGN world, as it does for the bulk of calls in the circuit-switched world?

These two principles lead to the well-known 'terminating monopoly' problem which requires regulators to set cost-base call termination charges for most networks. The argument is as follows:

- The originating operator must deliver end-to-end calls under the any-to-any principle.
- The terminating operator is the only route to the called party, giving it monopoly power over termination.
- The terminating operator charges the originating operator a termination charge under the calling party pays principle.
- In a competitive world, the terminating operator has strong incentives to raise its termination charges as high as possible so as to generate super normal profits which it then uses to subsidise its retail services and attract additional customers.

There are strong arguments for keeping the any-to-any principle for established services. Such a principle helps to maximise economic welfare by ensuring that each end user can call all others. It also prevents large operators from leveraging market power by threatening to refuse interconnect to smaller rivals.

The move to NGNs is, however, an opportunity to abandon the calling party pays principle. The principle is based on the premise that the calling party causes the cost of a call and so should pay for it. A few moments thought shows that this is a false premise. Figure 4 sets out a few of the actions which occur when a voice call is made from A to B. It is clear from this figure that both A and B control the costs of the call. For allocative efficiency, both parties should therefore share the cost of the call rather than the calling party bearing 100 per cent of the costs. Jeon, Laffont and Tirole show that, to maximise allocative efficiency, the originating and terminating network should share the costs of the call in proportion to the benefits which the calling and called party each receive.[4]

Action	*Effect*
A sets up call to B	A generates costs
B refuses call: • after looking at CLI • displaces more important activity	B controls costs
B takes call but quickly terminates it	B controls call costs
A finds B is wrong person and terminates call	A controls call costs

Figure 4: Who generates the cost of a voice call?

With this analysis in mind, the following proposal is made:

- Keep the *ex ante* requirement for any-to-any interconnect for established services, abandon the calling party pays principle, and let operators negotiate interconnect.
- Monitor new end-to-end services for market failure and, if necessary, implement the any-to-any requirement *ex post*.

The likely consequence of such a regulatory framework is that charging for interconnect will move to bill and keep, or something approximating to it. Indeed, this mechanism, by which each operator recovers call costs from its customers for both inbound and outbound traffic so that no interconnect charges are levied, is used by many IP networks and circuit-switched mobile networks today. If the parties cannot agree on interconnect charging arrangement and withhold payments, while at the same time they continue to deliver traffic for termination, then they are effectively operating a bill and keep system.

Moving away from calling party pays to bill and keep would remove the terminating monopoly problem. This in turn would allow the NRAs to withdraw from setting regulated prices for termination charges.

REGULATING NGA: APPROACHES SO FAR

There is as yet no general agreement on how best to regulate access to the incumbent's NGA network. The central problem is what access obligations to impose on the incumbent so as to preserve competition at the retail level while providing incentives for timely investment in NGA by the incumbent.

Different countries have adopted different approaches to solving this problem, each with its own drawbacks. For example:

- In the USA and Hong Kong, the regulator has chosen a policy of pure infrastructure-based competition and there are no regulatory obligations on incumbent operators to provide rivals with access to their NGA networks. In the USA, however, there are limited obligations on incumbent operators to provide access to the NGA to enable the delivery of services to certain corporate sites. This policy clearly has attractions in countries where there is already strong infrastructure-based competition (eg between the incumbent telecommunications operators and the CATV operators in the USA) but not in countries where infrastructure-based competition is weak. In addition, this approach raises substantial 'net neutrality' concerns. Third-party service providers are worried that vertically-integrated operators will discriminate in favour of their own retail businesses.
- In Australia, Telstra proposed a regulatory holiday on access to its NGA. It was unable to agree terms with its regulator and investment in NGA was abandoned.
- In Germany, the Government has passed an amendment to its telecommunications law granting Deutsche Telekom a regulatory holiday on access to its NGA, unless the NRA can demonstrate that 'lack of regulation will obstruct on a long term basis the development of a sustainable competition oriented market in the field of telecommunications services and networks'.[5] The European Commission objected to this approach and has started court proceedings against the German Government on the grounds that the amendment is inconsistent with the EU regulatory framework.[6]

At the same time the EU regulatory framework offers little guidance to NRAs. For example, does an NGA network support:

- Emerging market retail services? Here the framework advises NRAs not to impose *ex ante* regulation
- Established retail services? Here, if there is SMP, the likely remedy is *ex ante* obligations on the incumbent to provide access to others at regulated prices.

The problem of course is that NGA supports both types of retail service. The NRAs therefore face a dilemma.

REGULATING NGAs: OPTIONS FOR CONSIDERATION

In recent consulting work, Indepen evaluated six options for regulating NGA. These were:

- *Option 1: structural separation*. Under this option the incumbent operator is required to float off its access business as a separately owned company. This option solves all of the main competition problems and also has a spin-off benefit for the telco — there is now substantial evidence that the financial markets view the access business of an incumbent telco like a regulated utility and are prepared to provide it with capital at lower interest rates. It does, however, raise two fundamental objections:
  - — NRAs do not have the powers to impose such drastic remedies;
  - — the move to NGA will shift the natural boundary between the access and core network businesses over the next five years. It does not make sense to consider structural separation during such a period of rapid technology change.

  Other forms of separation are possible which avoid these problems. In the UK, for example, BT has implemented functional separation — floating off its access business as Openreach, subjecting its staff to certain behavioural constraints and establishing an independent board to monitor its behaviour. This has built confidence within the UK industry that BT is treating rivals and its own retail and wholesale businesses on an equivalent basis in terms of price quality and

process used to supply and maintain the access products purchased. However, Openreach remains an operating division of BT and BT still has both the incentives and the means to squeeze the margins of its rivals.

- *Option 2: Long Run Incremental Cost (LRIC) plus*. Under this option, the NRA sets a regulated access price at which service providers can rent NGA from the owner while the owner gets a return on investment which is at a premium to its weighted average cost of capital. This premium is designed to compensate the owner for the risk they run in investing in NGA and so encourage timely investment. There are two major difficulties with this option:
  - — how does the NRA set the right premium?
  - — can a single premium work effectively or, once a level of return is set, will the incumbent simply invest in NGA in areas where it is profitable to do so and continue to use the copper network in other areas?
- *Option 3: the utility model*. Here the NRA requires open access (in which all downstream businesses, including those of the incumbent, are provided on equivalent terms) to products offered over NGA facilities at regulated prices. These are set to guarantee the investing incumbent operator a modest return on its investment in NGA so as to reflect its long-term cost of capital. There is no risk to the incumbent. This option is similar to the approach used to regulate investment in (say) the water industry across much of Europe, hence the label 'utility'. It is unlikely to be acceptable to most NRAs. A guaranteed return to the incumbent operator, whatever the demand for NGA, would mean that the NRA might have to agree to general price rises for existing access services in order to pay for NGA.
- *Option 4: open access model*. Here the NRA requires the incumbent to provide open access to products offered over its NGA facilities but leaves it to set the prices for these offerings. There are substantial competition concerns with this option. It effectively gives the incumbent freedom to raise the price of voice line access and basic broadband (eg 2 mbps) offered over NGA, and breaches the European Commission's technology neutrality principle. As NGA replaces the copper network, the incumbent would offer regulated Unbundled Local Loop (ULL), bitstream and voice line access products in the non-NGA areas but unregulated equivalents in the NGA areas. So the access network technology used determines the conditions of supply for equivalent products.
- *Option 5: anchor product regulation without open access*. This option involves differential regulation of the wholesale products offered over the NGA network. The NRA requires the NGA operator to supply basic voice line and broadband access over NGA facilities at regulated prices and on equivalent terms to all access seekers — these are the anchor products. However, it leaves the NGA operator to set its own prices for the higher-speed broadband products and to offer them only to those service providers with which it chooses to negotiate contracts. Like Option 2, the investing incumbent takes all the risk. But unlike Option 2, the upside return, if NGA is successful, is not truncated. This option provides the incumbent with strong incentives for timely investment and the flexibility to invest when and where appropriate. Nevertheless, serious competition concerns remain. The vertically integrated incumbent is free to foreclose competition from its main rivals and it is likely that one of the great benefits of moving to NGNs, the creation of application-based competition described previously, would be severely weakened.
- *Option 6: anchor product regulation with open access*. This option is a modified version of Option 5 under which the incumbent is required to provide open access to the higher-speed products as well as to supply anchor products at regulated prices. The main difference between the two product sets

is that the incumbent sets the price of the former. This option preserves strong incentives for timely investment and the flexibility to invest when and where appropriate. It also gives the incumbent the freedom to experiment with wholesale pricing for the higher-bandwidth products so as to maximise market demand. Competition concerns are also reduced substantially. The incumbent could still squeeze its rivals' margins but there are three constraints on such behaviour:

— the price-regulated anchor products constrain the wholesale prices that the incumbent might charge for higher-speed broadband through a chain of substitution;
— the incumbent would wish to recover its NGA investment as quickly as possible, and would be keen to get end users to use its higher-speed broadband services (where it makes higher margins) as quickly as possible — the best way to do this is via a wide range of service providers, rather than relying solely on the efforts of its own retail business;
— the incumbent would need to consider the possibility of an *ex post* competition law case against it.

Option 6 is not sustainable in the very long term — the NRA would probably need to specify a trigger point in terms of the market share of non-anchor products at which investment risk was considered minimal. Once this market share was reached, the NRA would review NGA regulation with a view to moving to a more conventional form of regulation such as Option 2. As a way of regulating NGA over the next decade, however, Option 6 is the most promising of the six options. Moreover it is consistent with the EU regulatory framework. It requires *ex ante* price regulation for access products which support established services while refraining from the imposition of investment-chilling *ex ante* regulation on access products which support emerging markets services.

Of course, Option 6 is still second best to an outcome in which there is strong competition between rival operators, each offering their own NGA. But such an outcome is unlikely. Once one operator upgrades a street for NGA, the incentives for another to do the same virtually disappear and the most likely outcome is one of a street-by-street monopoly, even in countries where there are two active NGA suppliers. Of course, this argument does not necessarily apply to a major apartment block or office block.

REGULATING THE TRANSITION TO NGNs

The transition from today's circuit-switched world to NGNs raises some difficult regulatory problems. The incumbent operator will, as it moves to NGNs, phase out legacy wholesale products and replace them with new NGN-based wholesale products. The Alternative network operators (AltNets) which use these products to provide services to their customers will ask for long notice periods before withdrawal of these legacy products. But if the NRA imposes these long notice periods on the incumbent then it raises the incumbent's costs, by requiring it to run circuit-switched and next generation products in parallel for a substantial period. This has two undesirable consequences:

- it raises prices for consumers;
- it could lead to delay in NGA roll-out and a consequential delay in the economic benefits which NGA brings.

A good example of this problem arises when one considers local loop unbundling. As discussed previously, a move to NGA makes the investment in DSL Access Multiplexers (DSLAMs) and backhaul by local loop unbundlers redundant. So the question arises as to what notice period the incumbent should give the local loop unbundler before closing an MDF and rolling out NGA. There is no general agreement:

- in the Netherlands, OPTA has proposed a five-year period (although this proposal was

subsequently withdrawn in January 2007);
- in Hong Kong, OFTA has set a four-year transition period;
- in the USA, the FCC has set a 6–12-month transition period.

There is a clear need for public interest based guidance on how quickly to discontinue legacy wholesale products. This will need to balance the higher operating costs generated by long notice periods against any negative impact on competition generated by short notice periods. In drawing up such guidance it is important for NRAs to focus on the impact of withdrawal of legacy products on competition and not the impact on existing competitors. A problem for NRAs here is that they face intense lobbying from existing AltNets with legacy models. The withdrawal of local loop unbundling could mean that such operators go out of business. Perhaps it is this lobbying which is distorting rational analysis. Some NRAs have talked about the transition from local loop unbundling to NGA bitstream access as if it involves a severe weakening of competition, but this is not obvious. Indeed, a move from local loop unbundling to NGA could strengthen competition at the retail level in two main ways:

- NGA could lower the cost for end users to switch between communications providers. Instead of the fault-prone, slow and costly manual processes of local loop unbundling, NGA with an electronic provisioning interface would offer low-cost, almost instantaneous, reconfiguration of access network services between service providers.
- NGA could enlarge the market available to many communications providers and make it possible for them to market their services on a nationwide rather than local basis. This is especially important when serving corporate customers. In the UK, for example, a service provider might offer nationwide service using a range of access network products by interconnecting at a few dozen points of interconnect. This compares with the current situation in which local loop unbundlers locate their equipment at 1,200 MDF sites to reach 70 per cent of the UK population.

Given these considerations, regulators might want to consider whether there is a case for overriding the contractual terms between a local loop unbundler and its supplier — which typically involve a 12-month notice period. A key consideration here is the speed with which a local loop unbundler might migrate its customer base from current products to NGA bitstream.

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