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"Please hold for your connection": Determining points of interconnection for open access broadband

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"Please hold for your connection":
determining points of interconnection for open access broadband.
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Abstract

One of the early decisions facing a regulator in the context of an open access Next Generation Access networks (NGA) is the location of the points of interconnection to that NGA. This decision is one which needs to take into account the scope of the natural monopoly associated with an NGA and the extent to which there is the potential for competitive supply of transmission services (or backhaul) from access seeker points of presence to the NGA.

The Australian NGA is called the National Broadband Network (NBN). This paper starts with the research question, "where are the optimum sites for points of interconnection to the Australian NBN?". The paper commences by describing the architecture of the Australian NBN and considering some of the issues which arise from the fact that it is designed to be ubiquitous. The paper considers the issues that need to be considered in determining the extent to which there is a natural monopoly in transmission services as well as the effects on outcomes that arise from the existing deployment of infrastructure associated with the delivery of digital subscriber line broadband services based on unbundled local loops and line sharing services.

The paper then moves to consider the requirements for consideration in the Australian regulatory context. This is summarised by the phrase "long-term interests of end-users" and the paper considers the interpretation of this phrase in the context of decisions on the number and location of points of interconnection. There is a review of the nature and extent to which operators in Australia contributed to the deliberations of the Australian regulator in determining the location of points of interconnection. In turn the paper then describes the actual approach taken in respect of the Australian NBN and the rationale behind those decisions.

The final part of the paper describes the decision that was taken along with the rationale. It also examines the subsequent positions taken by stakeholders in respect of the points of interconnection to the Australian NBN.

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1   Introduction

The National Broadband Network in Australia is a next generation access network (NGA) which is intended to provide broadband access over a passive optical network to 93% of the homes and businesses in Australia. The balance of premises in Australia is to be served with broadband services using wireless (about 4%) and satellite (about 3%). This paper considers the points of interconnection with the fibre NGA.

1.1   Next Generation Access

Four approaches to the regulation of Next Generation Access (NGA) networks have been identified (Pennings and Ramahandry 2010). The one which applies in Australia, in common with much of the Asian region, is an "open access" model. Pennings and Ramahandry characterise the open access model as having a high level of (state) subsidisation, with competition at the services level and behavioural rules for functional separation. This is a good summary of the approach taken in Australia in respect of the Australian NGA, which is called the National Broadband Network (NBN). In context, the NBN is a Layer 2 Ethernet access network which will be provided as a replacement for existing fixed infrastructure with an assumption of monopoly characteristics.

That is, the policy behind the NBN is not based on inter-modal competition (Ware and Dippon 2010). Instead, a new entity known as NBN Co has been established to design, build and operate access network infrastructure which replaces the existing fixed network. NBN Co is a wholly owned Australian Government business enterprise. The NBN is intended to deliver high-speed broadband services at affordable prices to all Australians. The technologies used will be fibre-based coverage with bit rates of 100 Mbps to 93 per cent of homes and businesses and wireless or satellite coverage with bit rates of 12 Mbps to the remaining 7 per cent of premises. These bit rates represent the government's initial requirement for the NBN but it is expected that speeds of 1 Gbps will be available when the fibre network is first deployed.

The Australian Government policy recognised the natural monopoly characteristics of an NGA but the potential to delivery separation of a deeply vertically integrated Australian telecommunications sector. Part of the original announcement of the NBN included the statement by the Prime Ministers that the NBN policy (Rudd 2009):

> *delivers separation between the infrastructure provider and retail service providers. This means better and fairer infrastructure access for service providers, greater retail competition, and better services for families and businesses.*

A later policy position, described in this paper, was a requirement for uniform national wholesale pricing with an expectation that this would mean comparable retail competition across the whole of Australia (a current outcome for digital subscriber line services in the absence of regulatory intervention).

In turn, these policy decisions, particularly the use of the term "all" raises issues as to whether the analysis should use the types of universal service analytical tools which are available, such as maximising the economic welfare of consumers (as described by Madden 2010). Alternative approaches could situate the analysis by comparison with both Europe (Bohlin and Teppayayon 2010) and the US (Simon 2010). The specifics of the Australian Government policy are distinct from these otherwise helpful analytical approaches. Consequently, it is likely that the Australian context will be different from the position facing other regulators and operators. However, the contribution of this paper is a description of the practical regulatory approach that was taken in Australia in respect of an open access network.

1.2   Advice Sought

The Australian Government asked the Australian Competition and Consumer Commission (ACCC) for advice on the appropriate location of points of interconnection to the NBN. The government request, made jointly to the ACCC and NBN Co, required a process, including public consultation, to provide advice to the government as to the most appropriate approach in relation to the number of initial points of interconnection to the NBN that will best meet the long-term interests of end-users. The government requested that the advice address issues including the:

(a)   short and long-term competition impacts of the initial number and location of points of interconnection on the backhaul and retail markets;

(b)   current and prospective state of competition in the backhaul market including pricing and the location of and value of any assets that may be stranded by the agreed number and location of points of interconnection and options for addressing any adverse implications (if any) for existing backhaul asset owners; and

(c)   stakeholder response to the consultation process.

Importantly, the request for advice from the Australian Government recognised that there were likely to be balances made between the long-term interests of end-users and future prospects for competition in retail and wholesale markets. This paper draws heavily on the discussion documents

released by the ACCC in the consultation process that it conducted to provide that advice (ACCC 2010a, 2010b).

2 Competition, technology and natural monopoly

The regulation of access to telecommunications services in Australia is based on an access list model. In the Australian context, the services on the access list are known as declared services. Although there is no "reference interconnect offer" in Australia, there is a similar mechanism and this is known as a "special access undertaking" (SAU). It is anticipated that NBN Co will provide access to its network using an SAU. One of the declared services is the domestic transmission capacity service (DTCS). This is a service for the carriage of communications between two transmission points via symmetric network interfaces on a permanent, uncontended basis. The relevant network interfaces include Ethernet as well as synchronous digital hierarchy.

2.1 Network architecture

NBN Co has decided that the network architecture for its Next Generation Access (NGA) will be Gigabit Ethernet passive optical network (GPON). In turn, NBN Co proposed to offer a wholesale Layer 2 Ethernet bitstream access from Network-Network Interface (NNI) to the User-Network Interface (UNI) located at the premises. The network boundary at the premises would be at the output of the UNI. That is, network termination equipment will be provided by NBN Co.

A point of interconnection (POI) is the inter-network location where traffic is exchanged between one network and another. In a Layer 2 Ethernet context, the POI is the location of the NNI.

3 Context

After its initial consultation with prospective customers, NBN Co had originally proposed that the NBN should have about 200 POIs. However, an aspect of the political environment in Australia in 2010 was the formation of a minority Government after a general election in August of that year. In order to form the minority Government, the leader of the Australian Labor Party, Julia Gillard, made an agreement with independent and Green Party Members of Parliament. The agreement with two independent Members of Parliament of 7 September included a provision that the NBN should offer uniform national wholesale pricing (Gillard 2010).

NBN Co had two key drivers when it proposed to change the number of POIs by reducing the location of POIs to mainland state capital cities. The first of these was to implement uniform national

wholesale pricing. The second was to encourage retail competition by reducing entry costs for retail service providers. On this basis, NBN Co proposed to offer 14 POIs with 4 POIs in each of Sydney and Melbourne and 2 POIs in each of Perth, Adelaide and Brisbane (NBN Co 2010b). After redundancy issues had beet taken into account, this represented 5 POI locations. NBN Co presented the case that there were three options for POI location:

(a)   distributed model – approximately 800 POIs;

(b)   semi-distributed model – an indeterminate number of POIs; and

(c)   centralised model – 14 POIs.

NBN Co expressed its preference for the centralised model (NBN Co 2010b).

3.1   Transmission

There are a number of providers of backhaul services in Australia, including those which offer DTCS services. Indeed the ACCC had reduced the geographic scope of the declared DTCS service over time as competition evolved. In reducing the geographic scope of regulation of the DTCS, the ACCC took the view that regulation was no longer required when three or more fibre providers were present in the relevant geographic areas (ACCC 2009). In that decision, the ACCC did not require the additional optical fibre networks to also be offering transmission services to that market, as it reasoned that the presence of the optical fibre was a strong indication that those transmission services would be capable of being provided without the supplier incurring prohibitive costs. However, if it could be demonstrated that a particular network could not be used to provide wholesale services that network would not be counted as a potential competitor. The scope of this geographic deregulation was relatively limited. It covered DTCS services in some metropolitan areas and certain capital-regional routes. However, the ACCC has also found that Telstra (the incumbent fixed line operator) has a greater than 80% market share of the DTCS market in regulated areas (ACCC 2011).

3.2   Ethernet services

The nature of the wholesale only, Layer 2 Ethernet bitstream service that NBN Co proposed to offer, simplified some of the considerations in providing advice to Government. The fact that the service proposed is at Layer 2 means that there is a physical address at each end of the service. That is, the location of any UNI has a matching NNI. Further, one of the advantages of Ethernet is the fact that it is well standardised. This means that it is feasible for a service to be described in terms of an interface at a POI (NNI) as well as at the connected premises (UNI). The fact that the offering was a bitstream service is consistent with a model that does not expect facilities based competition in the

NGA (Nicholls 2008a, 2008b). On the other hand, there is an issue which arises from a Layer 2 Ethernet bitstream service. This is the one of identifying the physical address in the bitstream. This issue is addressed by "tagging" streams using virtual local area (VLAN) tags. These are the C and S tags defined in IEEE802.1ad. As a practical matter, if 1:1 S tagging is chosen by the access seeker (which would be common for non-multicast services), then the access seeker requires an NNI for each 4,000 services. As a practical matter, multiple access seekers can address a single network termination unit (at Layer 2), as all four physical (MAC) addresses at any premises are available to all access seekers providing services to that premises.

4   Challenge and framework

The concept of "long-term interest of end-users" (LTIE) is one which is core to the regulation of competition issues in telecommunications in Australia. The objectives of the LTIE are set out in section 152AB(2) of the Competition and Consumer Act 2010. Broadly, the objectives of the LTIE are divided into three elements. The first is the promotion of competition. The second is achieving any-to-any connectivity in relation to carriage services that involve communication between end-users. The third is encouraging economically efficient use of, and economically efficient investment in, infrastructure by which telecommunications services are supplied and any other infrastructure by which telecommunications services are, or are likely to become, capable of being supplied.

4.1   Applying the LTIE criteria

In applying these objectives, the ACCC has historically (ACCC 1999) considered that "long-term" has an economic meaning. That is, a balancing of the flow of costs and benefits to end-users over time in relation to the criteria. The ACCC has used a standard approach of regarding competition as the process of rivalry between firms, where each market participant is constrained in its price and output decisions by the activity of other market participants. The benefits of competition to end-users are lower prices, better quality and a better range of services over time. In turn any-to-any connectivity encompasses the objective of end-users on different networks being able to communicate with each other. The approach to the LTIE analysis assumes that economic efficiency has the three components of productive efficiency, allocative efficiency and dynamic efficiency.

Clearly, these objectives are interrelated. In many cases, the LTIE may be promoted through the achievement of two or all three of its elements simultaneously. In other cases, there may be some trade-off between the different elements and this creates a need to weigh up the different effects.

For example, it may be in the LTIE to receive a benefit for even a short period of time if its effect is not outweighed by any longer term cost.

4.2   Natural monopoly

One aspect of the LTIE, which was important to the ACCC, was the outcome that might occur if the existing backhaul market was over-built by NBN Co as part of the implementation of a centralised POI outcome. The early thinking was to consider the extent to which an access network could be regarded as a natural monopoly. In general the fixed sector has elements associated with it which have the characteristics of "a natural monopoly" (Sharkey 1982). Definitions of natural monopoly are not pejorative and are often associated with the concept that a monopoly can, in some circumstances, be a socially desirable outcome (Gasmi et al. 2002). However, the ACCC had come to the view that there was a competitive backhaul sector (at least in the geographic areas where DTCS had been deregulated). Further, the vibrant digital subscriber line (DSL) competition, using both unbundled local loop and line sharing, was an indication that there was no barrier to DSL entry (at least in metropolitan areas) caused by a failure in the backhaul sector.

There are always risks in assuming that there is a direct equivalent between a service using an NGA and the legacy DSL solutions (Nicholls 2008a). However, The rationale behind regulation of the local loop is that it exhibits some natural monopoly characteristics. Even where there is effective inter-modal competition, there is a risk that consumers will have a limited choice (the telephone company or the cable company). However, the centralised POI approach seemed to be one which was based on extending the access network well beyond the point where natural monopoly characteristics could be observed or where inter-modal competition would be expected. Additionally, the ACCC noted that NBN Co had made the statement that it intended to only offer wholesale Layer 2 bitstream products "in order to occupy as small a footprint as possible in the overall value chain". NBN Co's objective was to will create the opportunity for access seekers to build upon this basic offering in order to sell wholesale services to other retail service providers (that is, bundled, aggregated offerings) and differentiated retail services directly to consumers.

5   Locating the natural monopoly

5.1   Inquiry process

The ACCC issued a discussion paper in October 2010, which raised 23 questions designed to address all of the issues on which the Australian Government had sought advice. The scope of the questions

included backhaul wholesale markets as well as retail markets (ACCC 2010b). The discussion paper elicited 26 submissions from stakeholders.

In the main, the operators of transmission infrastructure supported an approach that used semi-distributed POIs. Telstra, with its ubiquitous transmission infrastructure, was comfortable with a fully-distributed POI outcome. A number of smaller internet service providers suggested that a centralised POI model would be represent a lower barrier to entry at a national level for retail services.

5.2   Scorched node approach

One of the issues, which needed to be considered in determining where the boundary of the natural monopoly occurred, was one of technology. Potentially, an examination of the location of existing transmission services would be driven by the DSL technology employed for the provision of services over copper. That is, there was a potential that using existing infrastructure would imply a scorched node approach. That is, there needed to be consideration of both scorched earth and scorched node approaches (for example, Vogelsang 2003). If NBN Co was proposing to build completely new infrastructure, this would be a major consideration. In practice, this issue was not paramount. On 20 June 2010, NBN Co and Telstra had entered into a financial heads of agreement under which NBN Co would use Telstra exchange space, ducts and lead-ins in the roll-out of its network (NBN Co 2010a). This was an important consideration in terms of the LTIE objective of efficient use of infrastructure. Given that NBN Co had made a decision to use infrastructure which included all of the elements of infrastructure used in existing local loop services, a decision which had elements of a scorched node (rather than scorched earth) analysis was consistent with the anticipated implementation.

5.3   Market analysis

As a result of the submissions and its analysis, the ACCC concluded that the semi-distributed approach to the initial POI location was the option which was likely to best meet the LTIE.

The ACCC took the view that the semi-distributed approach would be most likely to promote competition in retail and wholesale markets. This was based on the ability for service providers to compete in relation to price and service innovation.

The ACCC considered that the centralised POI approach was likely to have a detrimental effect on competition in the transmission markets, as it would result in the removal of existing competition in those markets. It took the view that the use of appropriate competition criteria in the semi-

distributed approach could result in POI locations that would preserve existing competition in the relevant transmission markets and allows for future competition to develop.

The ACCC also noted that the semi-distributed approach would best promote the efficient use of and investment in infrastructure. Under this approach, transmission assets on competitive routes would continue to be capable of being utilised for all traffic and existing competition would be maintained, which would provide incentives for efficient use of and investment in infrastructure.

The ACCC considered that the centralised POI approach would bypass existing transmission assets for the carriage of NBN traffic, which would be likely to result in inefficient use of that infrastructure. Existing competition between suppliers of transmission services would also be eliminated under this approach, with subsequent implications for the efficient use of that infrastructure and future investment in the transmission infrastructure, which is incorporated into the NBN.

5.4   Competition criteria

When considering the location of NBN POIs, the ACCC considered different matters than those used in the determination as to when to deregulate DTCS markets. The ACCC took the view that it was important that interconnection to NBN Co's network be permitted at locations which preserved existing competition in the provision of transmission services. Further, the ACCC intended to maximise the potential for future competition in transmission services to develop. As a result, the ACCC considered that there were greater risks if a POI is placed in a location which disrupts or displaces existing competitive markets than if it is placed in a location where competitive outcomes were expected, but not realised.

On this basis, the ACCC developed a set of "competition criteria" to determine where POIs should be located. The competition criteria were that NBN Co should initially locate its POIs where:

(a)   it is technically and operationally feasible to allow interconnection (this will usually be at the fibre exchange for each FSA); and

(b)   there are at least two optical fibres within a nominated distance from that site which:

(i)   connect that site to an optical fibre network which is connected to a capital city; and

(ii)   delivers wholesale transmission services to service providers who wish to connect to the NBN at that location.

The ACCC then provided this advice to the Australian Government on 30 November 2010 (ACCC 2010a).

6   Implementation

6.1   Planning Rules

The first issue which arose from the competition criteria was for NBN Co to develop a practical set of "Planning Rules" which would allow the location of POIs to be identified and which were consistent with the competition criteria set out in the ACCC's advice to Government. The first assumption that was made was that NBN Co would choose to locate POIs in Telstra exchange buildings (central offices). If an exchange building was unsuitable, then NBN Co would either build a new facility or provide "virtual interconnection". The virtual interconnection would be implemented by presenting the NNI at a facility which is remote from the actual location of the Ethernet switches associated with that NNI. An exchange might be unsuitable for the location of a POI because there is insufficient floor space, power or air-conditioning.

The ACCC provided NBN Co with aggregated data showing, for each exchange service area (ESA), the number of competitive backhaul transmission providers with an optical fibre passing through (within 100m) an exchange or within an ESA. The ACCC also provided NBN Co with further guidance in relation to a number of specific aspects of applying the competition criteria.

The ACCC advised NBN Co that the "technically and operationally feasible" element of the competition criteria was not intended to be treated as a separate, threshold consideration, but rather an element to be appropriately balanced with the other elements, and that it could incorporate cost and efficiency considerations. For cost and efficiency reasons, NBN Co expects only to deploy Ethernet aggregation switches at the nominated POIs. In effect, in densely populated areas, each GPON splitter is carried on a dedicated wavelength from the local optical line terminator located at a fibre serving area (FSA) to the Ethernet aggregation switch at the POI. The area served by each POI is called an Access Aggregation Region (AAR) by NBN Co.

The ACCC provided NBN Co with further advice as to potential interpretations of "there is other evidence that the particular route is, or is likely to become, effectively competitive". As a result, NBN Co determined that a "soft cap" of approximately 80,000 premises should be applied for metropolitan AARs and approximately 100,000 premises for outer metropolitan and regional AARs.

NBN Co formulated the following more detailed planning and dimensioning rules and applied those rules to identify the proposed location of the NBN's initial POIs (Planning Rules). The Planning Rules apply to three 'bands' of FSAs identified by the ACCC based on their location.

These bands are:

(a)   Metro: FSAs in metropolitan areas, including central business districts, in mainland state capital cities (excludes Darwin, Hobart and Canberra) that are limited by the size and/or access to suitable facilities for the active equipment;

(b)   Outer Metro: FSAs in the metropolitan areas in mainland state capital cities (excludes Darwin, Hobart and Canberra) that are limited by the optical fibre budget (that is, maximum distance from the location housing the active equipment); and

(c)   Regional: FSAs in all other areas (that is, not Metro or Outer Metro).

The Metro POI planning rules are:

(a)   Multiple FSAs (two or more) are aggregated along a contiguous boundary to provide an AAR of approximately 80,000 premises.

(b)   The FSAs within the AAR are chosen so that the POI is in the exchange building maximally served by transmission providers, with a minimum of 2 backhaul transmission operators, and the remaining contiguous FSAs (i.e. non-POI FSAs) are minimally served.

The Regional and Outer Metro POI planning rules are:

(a)   Multiple FSAs (two or more) are aggregated so that the POI is in the maximally served exchange, with a minimum of 2 backhaul transmission operators, is closer to the mainland state capital city along each of the transmission paths, and the remaining contiguous FSAs (i.e. non-POI FSAs) are minimally served.

(b)   A 'soft cap' of approximately 100,000 premises should be applied to regional and outer-metro AARs.

Other relevant inputs to the selection of the location of the POI are as follows :

(a)   At least one of the backhaul transmission operators must provide a geographically protected transmission path to the capital of the mainland state in which the POI is located (i.e. to Sydney, Melbourne, Brisbane, Adelaide or Perth).

(b)   POIs are not in pairs (FSAs are not dual homed).

(c)   FSAs should generally be connected to a POI in the same state.

(d)   Each AAR must be a single contiguous region.

(e)   Fibre installed under the Government regional backhaul black spots program is included as a provider of wholesale transmission services.

(f)   NBN Co's transit network should not be considered when assessing the number of operators.

6.2   Subsequent amendments

On 20 December 2010, the ACCC commenced a public confirmation process in respect of the 120 POIs which were proposed by NBN Co as a result of applying the competition criteria and the Planning Rules. The ACCC received 8 submissions in response to this confirmation process. As a whole, these recommended the:

(a)   relocation of 7 POIs;

(b)   addition of 20 POIs; and

(c)   consolidation of 9 POIs into 4 (generally where proposed POIs were close together).

The ACCC invited NBN Co to review these submissions in the context of the competition Criteria and the Planning Rules. As an outcome of this review and in consultation with the ACCC, NBN Co proposed to relocate five POIs, add two POIs and consolidate one POI. Other proposed additional or relocated POIs did not meet the Planning Rules. Three proposed relocations were considered redundant as they were covered by the additional POIs and other relocations. There was minimal consolidation of POIs as this would likely be inconsistent with the competition criteria and the Planning Rules. The balance of the consolidated POIs proposed in submissions would have resulted in POIs that do not meet the competition criteria or the Planning Rules.

The ACCC and NBN Co were satisfied that the revised list of initial POIs, incorporating these changes, was consistent with the competition criteria and the Planning Rules. The location of actual POI facilities (for example, in an exchange building) is subject to change as a result of technical feasibility issues such as physical space and the availability of power and cooling.

7   Conclusions

This paper has shown that Australia is deploying an open access NGA, known as the NBN, which is state owned and uses GPON in its fibre based delivery of Layer 2 Ethernet bitstream services to 93% of premises. The ACCC was asked for advice by the Australian Government on the appropriate

location of POIs to the NBN. In providing that advice, the ACCC considered the LTIE criteria to determine the scope of the natural monopoly associated with the NBN and the extent to which there is the potential for competitive supply of transmission services from wholesale customer points of presence to the NBN.

The architecture of the Australian NBN assisted in determining where an appropriate set of POI locations could be implemented. The paper examined the interaction between the new NBN and the existing deployment of infrastructure associated with the delivery of digital subscriber line broadband services based on unbundled local loops and line sharing services.

The paper then moved to consider the requirements for consideration in the Australian regulatory context. This was summarised by the phrase "long-term interests of end-users" and the paper considered the interpretation of this phrase in the context of decisions on the number and location of points of interconnection. In particular, the paper reviewed the nature and extent to which operators in Australia contributed to the deliberations of the Australian regulator in determining the location of points of interconnection. It showed that even a new build network might require a scorched node approach. The actual approach taken in respect of the Australian NBN was described along with the rationale behind those decisions. Although the Australian context is different from the position facing other regulators and operators, the paper presented a description of the practical regulatory approach that was taken in respect of an open access network.

The paper described the competition criteria that were developed as part of the advice to Government and highlighted the distinction made between competition matters used as the basis of deregulation and competition criteria on a forward-looking basis. The paper ended by describing the practical Planning Rules that needed to be developed in order to allow a network to be designed and actual POI locations to be identified.

The process was conducted in a period of a few months (from October to December 2011) and there is likely to be some movement in the location of the POIs (but not the number). The sound analytical framework provided by the LTIE criteria allowed the ACCC to provide its original advice to Government. An understanding of the network issues permitted this to be implemented using a pragmatic and pro-competitive set of Planning Rules.

8   Acknowledgements

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