NBN Co consultation paper: proposed wholesale fibre bitstream products

December 2009

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Contents

1. Introduction

Background

NBN Co's role is to realise the Australian Government's vision for the development of a next generation national broadband network. To do this successfully, we need to consult widely to ensure our plans for the network meet the current and future needs of our wholesale customers and the wider Australian community.

This Consultation Paper:

- sets out the conceptual framework that will underpin the development of our proposed wholesale fibre bitstream products

- focuses on the 90% of premises that are expected to receive high speed broadband services through fibre to the premises (FTTP) technology.[1] It does not consider wholesale product offerings over wireless or satellite networks

- outlines our current thinking on the design of the NBN Co fibre network and the wholesale bitstream products to be provided over that network

In particular, this paper will discuss:

- the objectives that will underpin NBN Co's development of its fibre wholesale products

- the level in the vertical technology stack in which NBN Co intends to offer its fibre wholesale products

- the high-level technology standards on which NBN Co will build its network

- NBN Co's proposed policy for determining the location of Points of Interconnect (PoIs)

- an overview of the two fibre wholesale products that NBN Co intends to initially offer to its wholesale customers

- the service features that are intended to be supported by NBN Co's wholesale fibre products

This Consultation Paper does not attempt to outline the full details of NBN Co's proposed wholesale fibre products, nor does it describe the various pricing structures of those products. The price structure of our wholesale fibre products will be presented to the industry during NBN Co's consultation program that will take place in early 2010.

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[1] Note that in some deployment scenarios (e.g. Multi-Dwelling Units or MDUs) fibre will be delivered to the premises and distribution of services to individual units or service locations will occur via internal building wiring. The details of the MDU solution are not contained in this Product Consultation Paper.

Summary of NBN Co's proposed wholesale fibre products

- NBN Co plans to offer a wholesale Layer 2 bitstream product – in doing so, NBN Co will seek to occupy as small a footprint as possible in the overall value chain, leaving retail service providers (RSPs) with significant ability to innovate and develop new services in the higher levels of the value chain.

- The location of PoIs will be optimised to support healthy competition among RSPs and align with contestable backhaul. For more densely populated areas, such as urban and regional centres, a "local" Point of Interconnection (PoI) is will be established for each Fibre Serving Area (FSA),[2] while for less densely populated areas, a "district" PoI (which aggregates two or more FSAs together), will be established. If competitive backhaul is not available from a PoI, supplementary provision of backhaul may be required for a limited period of time to permit the emergence of competitive backhaul on these routes. Only one PoI will be available for any FSA. The number and location of PoIs is still to be determined.

- NBN Co will offer its wholesale Layer 2 bitstream product in two forms:

  - the **Local Ethernet Bitstream (LEB) product** will provide our wholesale customers with a Layer-2 access service between the Optical Network Termination (ONT) at an end-user premises and a "local" PoI, located at the Fibre Access Node for the relevant FSA. The LEB product is likely to be offered in capital cities and regional centres. It is envisaged that the LEB product will be made available in respect of the significant proportion of FSAs in Australia.

  - the **Aggregated Ethernet Bitstream (AEB) product** is likely to be offered in rural areas where there are no competitive backhaul services below the PoI. The AEB product enables aggregated access to one or more FSAs via an aggregated link. The LEB product will not be available in locations where the AEB product is made available.

- Both the LEB and AEB products offers will be based on an Ethernet platform, utilising Gigabit Passive Optical Network (GPON) as the physical access technology. The technology will deliver a range of active service features including security and Quality of Service (QoS), as well as IP multicast.

- Our wholesale products will support access by multiple RSPs, a range of customer premises equipment (CPE) and will include an interface for analogue telephony. The detail of how these elements will be presented to our wholesale customers will be discussed in later consultation papers.

[2] A Fibre Serving Area (FSA) is defined as the area covered by one or more Passive Optical Networks (PONs) terminating at the same "Fibre Access Node".

NBN Co consultation and industry collaboration

NBN Co acknowledges the extensive work undertaken on the national broadband network by the industry under the auspices of Communications Alliance. This work has greatly contributed to NBN Co's current thinking on various important issues and has provided NBN Co with a comprehensive insight into the views of key industry players. NBN Co appreciates these important efforts.

As NBN Co will ultimately be responsible for the design of the wholesale products on its network and the supply of these products to its wholesale customers, NBN Co wishes to now undertake an additional consultation process, directly facilitated by NBN Co. The purpose of this consultation is to obtain direct feedback from the industry on our proposed wholesale products and to better understand the main issues. Our consultation process is intended to complement the ongoing work of the Communications Alliance.

Our objective is to be open and transparent in our dealings with the industry and interested stakeholders. To these ends, we are keen to provide our stakeholders with the opportunity to provide their views to us directly on key elements of our products and services. Accordingly, the views expressed by NBN Co in this Consultation Paper are intended to serve as the starting point for direct consultation with our wholesale customers and interested stakeholders. In addition, NBN Co will continue to collaborate with industry as part of the Communications Alliance process.

We welcome written submissions from interested parties on the various questions set out in this Consultation Paper. Interested parties will have until 12 February 2010 to provide written submissions. Submissions can be sent via email to: feedback@nbnco.net.au

NBN Co has scheduled two forums in January 2010 to discuss this Consultation Paper. They are:

- **Sydney**: 20 January 2010
  Metcalfe Auditorium, State Library of NSW,
  Macquarie Street, Sydney, NSW 2000

- **Melbourne**: 29 January 2010
  Village Roadshow Theatre, State Library of Victoria Conference Centre,
  328 Swanston Street, Melbourne, VIC 3000

You can register to attend these forums at the 'Events and Publications' section of nbnco.com.au

We also plan to hold consultation forums in other capital cities in early 2010. Following the completion of this first round of consultation we expect to release a detailed product specification.

NBN Co also plans to hold similar consultations with our stakeholders on other topics, including the operational and deeper technical requirements of our wholesale customers.

2. Building a fibre access network

90 per cent of Australian premises are planned to be served by a fibre access network. While NBN Co is currently undertaking a detailed assessment, planning and design process, to facilitate the consultation program, an indicative configuration of the access network is set out in the following diagram:
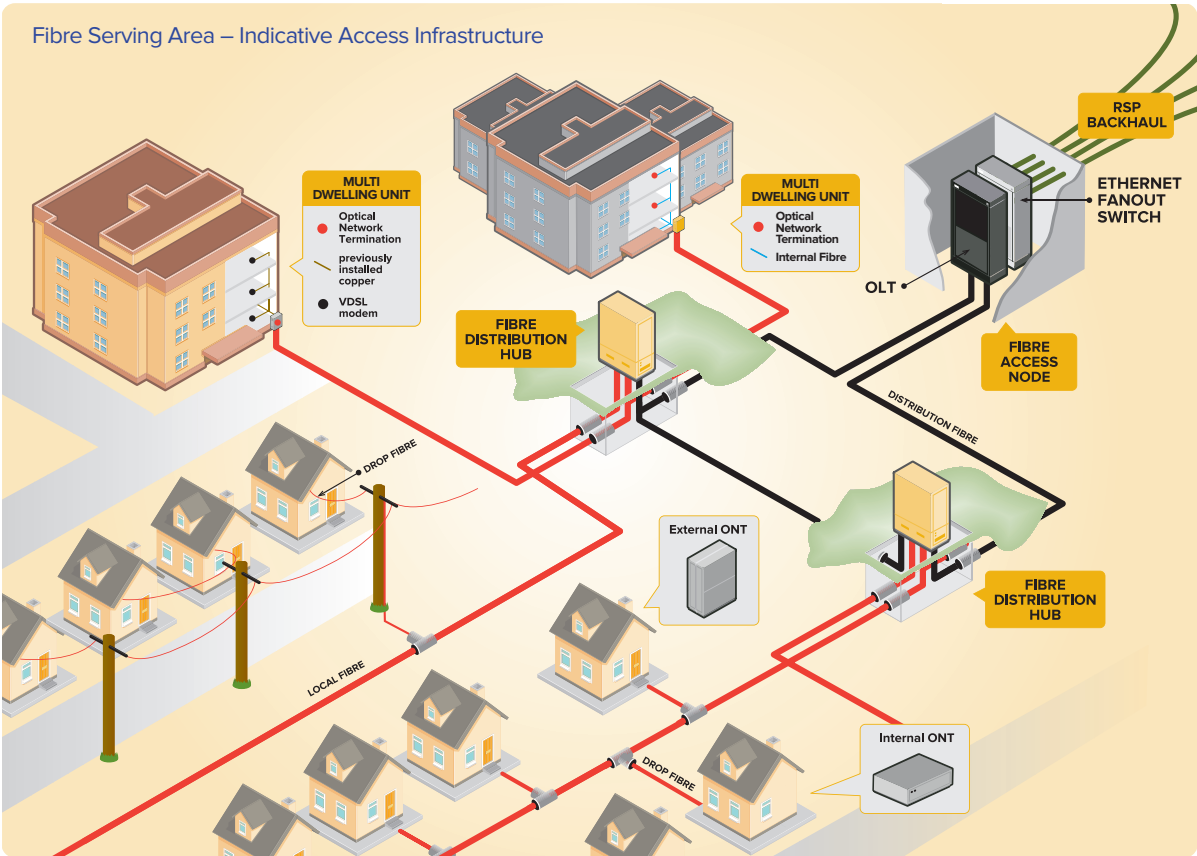
The key purpose of this diagram is to facilitate discussion and ensure consistent use of terminology through the consultation process. It should be noted that this diagram is intended to provide a high level overview of the network configuration which NBN Co currently envisages. It should in no way be taken as representing a final or committed view and the final network design may incorporate additional active and passive network elements not represented in the diagram.

In particular the following design elements have not been determined:

• the number, boundaries and size of the fibre serving areas

- the number and location of PoIs
- the mix between aerial and underground deployment
- the usage of internal or external ONTs and the mix between these (if both are used)

The remainder of the consultation paper will discuss the following key issues:

- choice of layer in the vertical technology stack
- high level technology standards
- location of PoIs
- important product elements

3. NBN Co's overall product objectives

In developing our wholesale product offering, NBN Co has been guided by the following objectives:

- **Coverage** – It is NBN Co's objective to ensure that the characteristics and capabilities of NBN Co's access network facilitate delivery of a consistent end-user experience by RSPs throughout Australia

- **A level competitive playing field** – NBN Co is committed to an **open access network** that provides an equivalence of opportunity for our customers that:
  - supports **differentiation and innovation** by RSPs – by providing them with an experience as close as possible to owning their own network
  - supports **healthy retail competition** by ensuring the product set does not dsproportionately favour a small number (or one) player
  - promotes **maximum end-user choice** in terms of both services and providers
  - allows secure **simultaneous delivery of multiple applications**, potentially by multiple RSPs, with predictable levels of quality

- **Cost effectiveness** – will be delivered in a number of ways. NBN Co will:
  - **seek simplicity** by limiting the functions that we perform to those that are critical to delivering our objectives, thereby controlling cost for our customers
  - **focus on uncontested infrastructure** by carefully evaluating where NBN Co participates in the network and technology stack to ensure that there is limited NBN Co investment in assets and activities that are already provided by other operators on a competitive basis
  - **align with global standards and proven technology** to ensure competitive vendor pricing and minimise technology risk/risk of stranded assets

- **Customer care for RSP's and end users** - NBN Co is committed to:
  - ensuring the network provides **reliability, availability and security**
  - **supporting, where required, critical services** such as emergency services, traffic management, telemetry etc. Note that the requirements inherent in the provision of many of these services are yet to be analysed in detail. Therefore the implications of this principle are not fully explored in this paper.

4.   Choice of layer in the vertical technology stack

As a wholesale-only provider, NBN Co has three principal alternatives when determining where it wishes to participate in the vertical technology stack:

- Layer 1 – otherwise known as the physical or passive layer – which would involve the provision of dark fibre to RSPs

- Layer 2 – otherwise known as the link or active layer – which would involve the provision of fibre and an active bitstream service

- Layer 3 – otherwise known as the network layer – which would involve the provision of fibre and an IP stream product

Function	Example Product	OSI Model
Cross-network communication • Controls routing and ensures reliability	IP Stream/'white label' products	7. Applications Layer
		6. Presentation Layer
Area Networking • Creates connection and transfers data	Ethernet	5. Session Layer
		4. Transport Layer
		3. Network (IP) Layer
Transmission Medium • Defines mode of trasmission and receipt	Dark fibre	2. Link (active) Layer
		1. Physical (passive) Layer

NBN Co considers that a Layer 2 product is most closely aligned with NBN Co's stated objectives and is most likely to facilitate the achievement of optimum competitive outcomes over the short-to-medium term. Layer 2 products are also most likely to support end-user choice and simplicity, while avoiding the downside risks associated with Layer 3 products, such as a lack of competitive differentiation and limited scope for innovation.[3]

Additionally, NBN Co does not consider that a Layer 1 product would, at this point in time, encourage a market structure that is compatible with NBN Co's objectives, given:

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[3]As NBN Co intends to deliver a multi-cast capability, some Layer 3 awareness will be required within the NBN to support the delivery of IPTV services.

- the limited number of wholesale providers over the short-to-medium term that are likely to have the scale to utilise Layer 1 products in the provision of high speed broadband services to 90 per cent of end-user premises

- that the emergence of vibrant retail competition would be dependent on the offerings of a third party wholesale provider that acquired the Layer 1 offering from NBN Co

- the increased complexity to the industry associated with the provision of multiple services to multiple RSPs where NBN Co offers only a Layer 1 product

The detailed assessment can be summarised as follows:

- **Coverage**: Overall, Layer 2 services deliver acceptable coverage without forcing unacceptable compromises in other areas. Layer 3 products typically provide the highest level of network coverage for RSPs as they require lower investment and imply the availability of centralised PoIs. However, they would also limit the coverage of innovative services given the focus on 'white label' products. Layer 1 products provide RSPs with the lowest level of network coverage, given the need for highly localised investment in infrastructure. Layer 2 products represent the best overall option for facilitating network coverage. Layer 2 products do not typically require the same extent of localised infrastructure investment as Layer 1 products (although an element of investment is still required), while giving RSPs the ability to offer innovative and differentiated services.

- **Support for differentiation and innovation**: Layer 1 and Layer 2 products would provide an experience as close as possible to ownership of the physical layer, providing RSPs with the maximum ability to innovate and differentiate their retail services. A Layer 3 product would significantly limit differentiation and reduce the rewards of innovation. This would likely lead to a commoditisation of IP transport, potentially limiting innovation and differentiation at the wholesale level.

- **Healthy retail competition**: Layer 2 is most likely to support a market structure which promotes healthy retail competition. Layer 1 would require each acquirer to undertake the substantial investment in active electronics in a substantial number of locations across the country. Further, the provision of Layer 1 products only would result in a situation where competition in those areas would be conditional upon a Layer 1 acquirer supplying its own Layer 2 or Layer 3 wholesale products to other RSPs. This could create a high degree of dependence by smaller RSPs on the supply of Layer 2 and Layer 3 wholesale products by the acquirer of Layer 1 products. This is likely to limit retail competition in certain geographic areas to a select few players, or a single player.

- **Maximum end-user choice**: Layer 2 is likely to deliver the highest degree of choice for end-users by facilitating both RSP and service choice. Layer 1 may result in a market structure that does not promote end-user choice of RSPs, while Layer 3 is would likely stifle choice given the delivery by NBN Co of 'white label' products.

- **Access to multiple application**s: Layer 2 and Layer 3 products would provide the potential for multiple RSPs to serve end-user premises with multiple applications. As outlined, in the 'Healthy retail competition' section above, the provision of Layer 1 services only would make this more difficult.

- **Simplicity**: These factors are all inter-related and best achieved through participation lower in the technology stack. Participation by NBN Co at Layer 3 in the technology stack has the potential to add significant complexity and IT costs, particularly in the short term. The provision of Layer 1 products is the least technically complex option for NBN Co. However, a split between NBN Co as a Layer 1 provider and a different wholesale provider acquiring the Layer 1 service to supply its own Layer 2 and Layer 3 wholesale products will lead to additional cost and complexity to the industry.

- **Focus on uncontested infrastructure**: Provision of Layer 1 services only is likely to leave RSPs exposed to a lack of competitive local access or backhaul infrastructure. Layer 2 may have some residual exposure to uncontested backhaul but this can be managed through the location of PoIs (see the discussion in Chapter 6). Layer 3 would be likely to result in NBN Co investing areas where there is already contested infrastructure leading to unnecessary duplication and higher costs.

- **Reliability availability and security**: Layer 2 is superior to Layer 1 on this dimension. Without NBN Co's own active equipment monitoring the passive infrastructure, our ability to identify faults or potential faults will be impaired and the overall level of reliability of the NBN may be impacted. Layer 3 would provide greater control to NBN Co on more elements of the end user service. This may deliver some operational advantage but would mean reduction of control for wholesale customers.

A graphical representation of the rankings of merits of the three choices is outlined below. It demonstrates that Layer 2 products are likely to deliver an overall superior solution whereas Layer 1 and Layer 3 products offer a more variable level of performance across the objectives.

Rating of options against objectives and other considerations

Coverage

Level competitive playing field

- Support for differentiation/innovation
- Healthy competition
- Maximum end-user choice
- Multiple applications

Cost Management

- Simplicity
- Focus on uncontested infrastructure

Performance

- Reliability and Security

WEAKEST   STRONGEST

● LAYER 1   ▲ LAYER 2   ■ LAYER 3
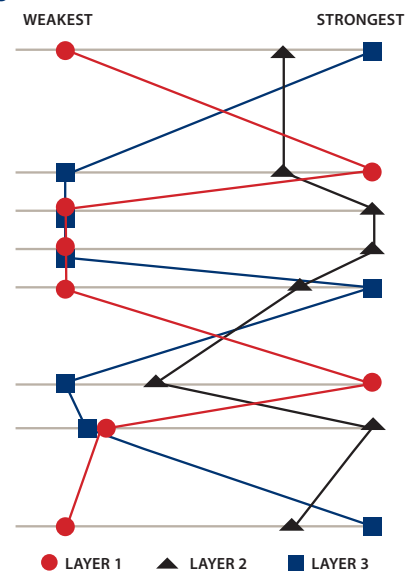
Questions

- What specific challenges or concerns are raised for your organisation as a result of a Layer 2 focus by NBN Co?

- For RSPs who wish to acquire a Layer 3 wholesale product, which entities are best positioned to meet this need? How might NBN Co facilitate the delivery of such a Layer 3 product by these entities?

5. High level technology standards

It is NBN Co's view that the Layer 2 products for mass-market fibre services should be based on Ethernet delivery, utilising GPON as the physical access technology. Please note that NBN Co has yet to define Layer 2 offers beyond the mass-market.

1.   Ethernet

Ethernet is the default delivery technology and de-facto standard for Layer 2 wholesale fibre products. It has been prescribed and recommended by a number of standards bodies (e.g. the Broadband Forum and the Metro Ethernet Forum) and overseas regulators as the preferred Layer 2 broadband access technology.

Ethernet:

• supports RSP service differentiation as a result of a ubiquitous interface that is neutral to higher layers

• facilitates competition and choice as it is able to support multiple services and RSPs on the same physical interface, when necessary

• offers flexible and potentially substantial bandwidth, as required

• supports security and grades of QoS

• offers transparency required to identify and manage faults by NBN Co and RSPs independently

• offers competitive equipment pricing as a result of broad adoption, with prices continuing to decline as a result of experience curve effects

2.   GPON

Point to multipoint technologies (known as PON – passive optical networks) such as Ethernet Passive Optical Network (EPON) and Gigabit Passive Optical Network (GPON) provide a shared medium for customers, with only individual fibre tails post the splitter. In contrast, point-to-point optical networks provide customers with a full fibre for their exclusive use.

It is NBN Co's view that adoption of a PON architecture as opposed to a point-to-point architecture should be the primary network architecture for mass market services, because it can be substantially more economical for large radius coverage areas required in the Australian context, with savings in fibre and deployment, fibre management, power consumption and carbon footprint. In addition,

an appropriately conceived PON architecture does not preclude the deployment of point to point Ethernet services as required for high end, substantial capacity, and mission critical services

As the more recent standard, GPON is more capable than EPON in several important respects:

• NBN Co's wholesale service mix is intended to support a mix of time sensitive and volume sensitive applications including voice, data, security, entertainment (and all other applications foreseen for the network). In this context, the underlying IP payload carrying downstream capacity for the GPON standard is approximately 2.3 Gbps compared with around 900 Mbps for EPON. The usable upstream capacity for GPON is approximately 1.2 Gbps compared with around 750 or 800 Mbps for EPON. The extra capacity provides important additional flexibility during deployment and enables a more efficient evolution towards higher capacity end user services

• asymmetric bandwidth more closely reflects the anticipated needs of residential customers (unlike EPON)

• more mature QoS – OAM&P, security and network protection capabilities

• lower fibre cost/higher splitting ratio for equivalent average end user performance

• viable over longer distance from the OLT

• most recent new network deployments have been GPON

• ITU and FSAN standards

Taking these factors together, the GPON alternative represents opportunities for greater flexibility, efficiency, aggregate performance and utilisation in a mass market deployment context.


Questions

• What are the key implementation issues that the industry and end user wish to raise about Ethernet and GPON?

• What specific end user requirements would trigger a choice to deploy a point to point solution to a particular location instead of an appropriately dimensioned and assured PON solution?

6. Location of Points of Interconnect for NBN Co wholesale fibre network

In offering a Layer 2 Ethernet product, NBN Co has significant flexibility in determining the locations of its PoIs.

The following chart from the Communications Alliance's work on the NBN Reference Model illustrates how the Layer of the wholesale product offering influences the possible PoI locations available to wholesale customers:[4]

• interface points 1 and 2 align with a Layer 1/passive product

• interface points 3a and 3b align with a Layer 2/active bitstream product

• interface points 4 and 5 align with a Layer 3/IP stream product
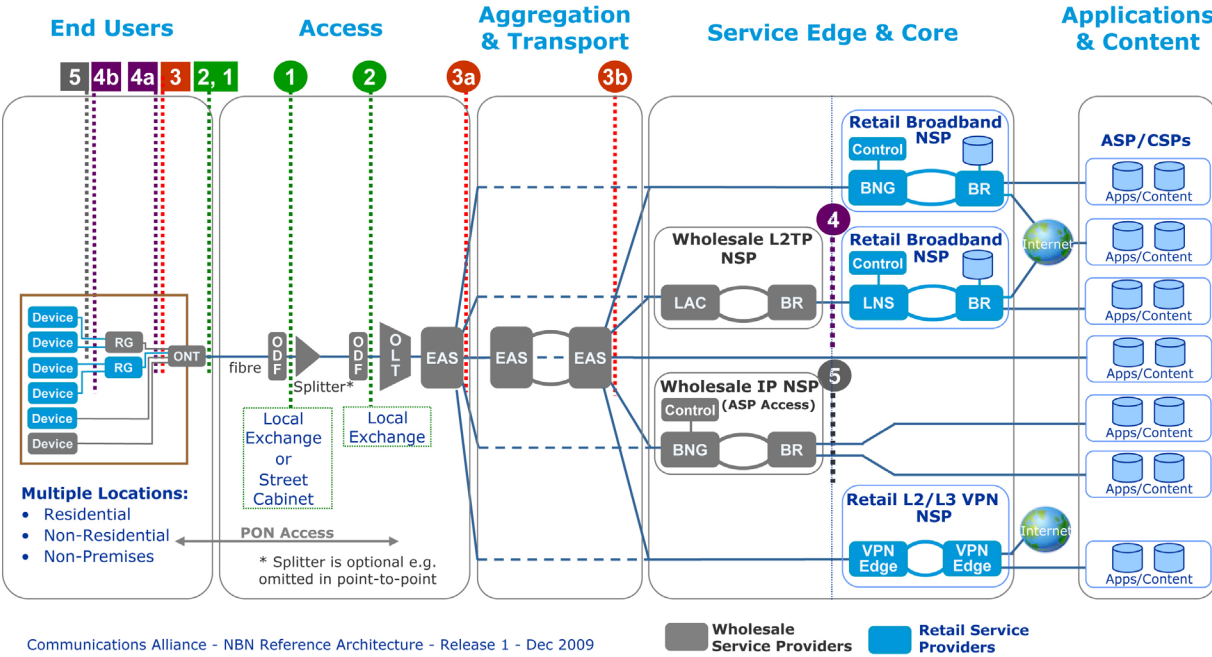
Communications Alliance - NBN Reference Architecture - Release 1 - Dec 2009

Source: Communications Alliance

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[4] Note that rather than "Transport" referred in the Communications Alliance diagram, this paper uses the term "Backhaul". Both terms relate to the carriage of communications between the PoI and a RSP's network infrastructure.

Implication of layer choice for geographic scope/PoI location

As the diagram below demonstrates, a Layer 2 wholesale product provides a wider range of options in regard to the location of PoIs.
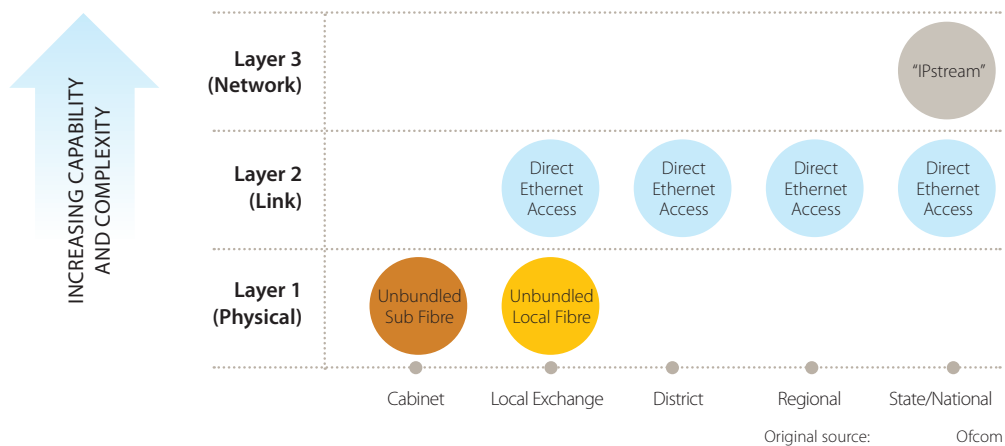
NBN Co has four main options when determining PoI locations for its Layer 2 Ethernet products:

1. local – at the same location as the OLT, such that access to the PoI provides access to all lines connected into that location's Fibre Serving Area

2. district – the PoI serves two or more Fibre Serving Areas

3. regional – upstream in the network from the location of the OLT, aggregating a number of Fibre Serving Areas and corresponding to a footprint for a relatively large geographic area

4. state/national – at capital cities

NBN Co's approach to locating PoIs will seek to strike a balance between encouraging innovation and efficient investment in backhaul infrastructure without embedding or increasing barriers to entry for smaller RSPs in less densely populated areas due to limited competition in the backhaul segment. This will be facilitated, in the first instance, by aggregating together smaller regional FSAs to a single PoI. This will provide access to a larger number of end users through a single PoI to create incentives for RSPs to offer services in that location, and in turn increases the likelihood of competitive backhaul build-out to that point. Secondly, the location of these PoIs will be selected based on the existence or likely emergence (e.g. the relative ease of building) contestable backhaul options. This would facilitate an appropriate level of retail competition and provide access to competitive backhaul.

It is intended that only one PoI will be available for each FSA.

NBN Co considers that optimising the location of the PoI in the proposed manner achieves the best balance across the following range of objectives:

- **Coverage**: Ensuring that PoIs are positioned where there are multiple backhaul providers strikes the appropriate balance between ensuring high levels of RSP activity across Australia but without impacting the long term incentives to build backhaul networks.

- **Healthy retail competition**: District interconnect in less densely populated areas is most likely to support healthy retail competition by providing all RSPs with equivalent opportunities. Establishing only local PoIs in less densely poulated areas would require either substantial investment in backhaul or dependence on a limited number of backhaul providersto allow for a RSP to provide retail services in these areas. Therefore, providing only local PoIs in less densely poulated areas may preclude a wide range of RSPs from operating in certain areas. Conversely, it is also clear from the current profile of DSLAM based investment that local PoIs would be effective in major urban areas. Accordingly, providing only regional, capital city or national interconnect would reduce barriers to entry but would significantly reduce the scope for innovation, investment and competition in backhaul infrastructure and may strand significant amounts of existing investment in backhaul infrastructure.

- **Simplicity/Cost management**: The establishment of only one PoI for any given geography ensures simplicity in the network design (with associated cost savings).

- **Focus on uncontested infrastructure**: Local PoIs in less densely populated suburban and regional areas are likely to leave RSPs to a lack of competitive backhaul infrastructure. District PoIs in these areas may result in some residual exposure to uncontested backhaul but is likely to incentivise new investment over time by aggregating larger volumes of end-users per PoI. If NBN Co were to locate their PoIs only in each capital city it would be likely to undermine existing investment in contested inter-exchange infrastructure and strand significant backhaul investments by several other access providers.

- **Encourage appropriate investment**: It is intended that the location of regional and district PoIs will change over time in line with increased levels of investment in competitive backhaul infrastructure. When competitive backhaul infrastructure is put into place, NBN Co envisages that the location of regional and district PoIs will progressively move closer to the end user (e.g. to a local PoI).

Questions

- Do you believe this model will help foster participation by RSPs in less densely populated locations? What other barriers exist to participation by RSP in these locations? How might NBN Co help address them?

- Do you believe this model allow sufficient space for participation and investment by commercial backhaul players? What concerns may need to be managed?

- What criteria should be considered when determining whether the currently available backhaul to a particular proposed regional or district PoI is competitive?

- What criteria should be considered to assess the likelihood of competitive backhaul being developed in the near-term future at a regional or district location where present backhaul options are not yet deemed to be competitive?

7. NBN Co wholesale fibre bitstream products definition

A. The product offering

NBN Co is proposing to initially offer the following two FTTP products to the market:

1. Local Ethernet Bitstream (LEB)

2. Aggregated Ethernet Bitstream (AEB)

Essentially, both products have the same access capability, with the AEB service offering a short-haul aggregation service for those rural and regional areas where contestable backhaul options have not yet emerged.

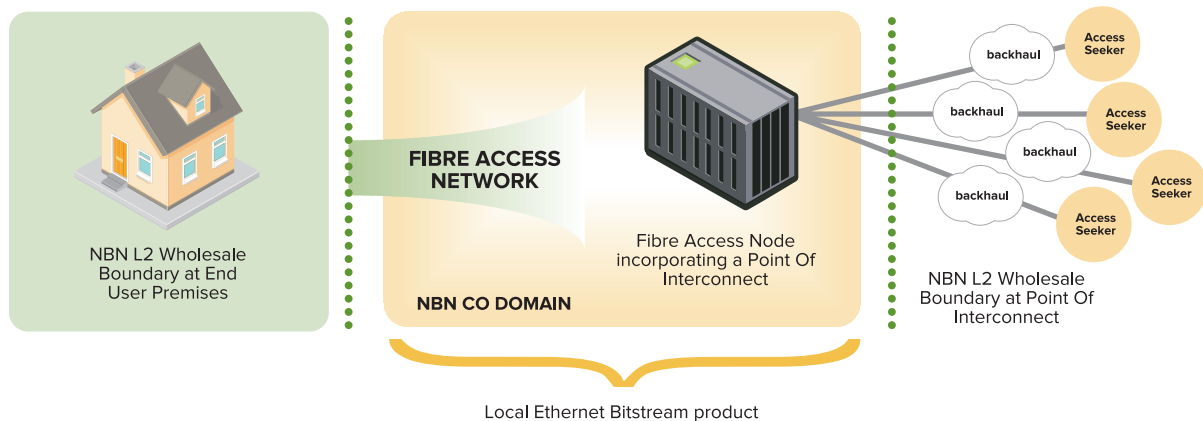### 1. Local Ethernet Bitstream product

The **Local Ethernet Bitstream** product will provide our wholesale customers with a Layer 2 Ethernet access service between the ONT at the end-user premises and a local PoI, located at the Fibre Access Node for the relevant Fibre Serving Area.

The LEB product is likely to be offered in capital cities and major regional centres.

The LEB product provides access from the PoI to all end user premises directly connected within the FSA to the Fibre Access Node. The LEB product does not provide access to end user premises situated outside of the FSA for that Fibre Access Node.

The LEB product consists of two main components:

1. A per end user element (with the possibility of one or more services per end user), that provides a designated connection between the ONT at the end-user premises and the Fibre Access Node, with given service parameters (e.g. Peak Information Rate, Committed Information Rate, QoS markings, etc). This product component is hereafter referred to as the **LEB Access Link**.

2. A connectivity link/interface element connecting LEB Access Links to the wholesale customer's network via a local PoI. For example, this may be a 1 Gbps optical fibre termination. This product element is hereafter referred to as the **LEB Connectivity Link**.

It is expected that the LEB product will be the most frequently deployed access to an end user premises.

2. Aggregated Ethernet Bitstream product

The **Aggregated Ethernet Bitstream** (AEB) product will provide our wholesale customers with a Layer 2 Ethernet service between the ONT at the end-user premises and a district PoIs located at an Aggregation Node, which in turn is connected to Fibre Access Nodes within Fibre Serving Areas.

The AEB product enables aggregated access to one or more FSAs via an aggregated link. The AEB product is likely to be offered in low population density areas such as rural towns and some regional areas.

The AEB product consists of three components:

1. A per end user element (with the possibility of one or more services per end user), that provides a designated connection between the ONT at the end-user premises to the Aggregation Node. This element will be called an **AEB Access Link**. This element is essentially the same as the **LEB Access Link**.

2. A fibre transit circuit that links the AEB Access Link to the AEB Connectivity Link (that incorporates the PoI). This element will be called the **AEB Transit Link**.

3. A connectivity link/interface element connecting AEB Transit Links to the wholesale customer's network, via the district PoIs. Although different variants of this product are likely, for efficiency it is expected that the AEB product will provide contended access to FSAs. For example, this may be a 1 Gbps optical fibre termination. This product component is hereafter referred to as the **AEB Connectivity Link**.

Aggregated Ethernet Bitstream product
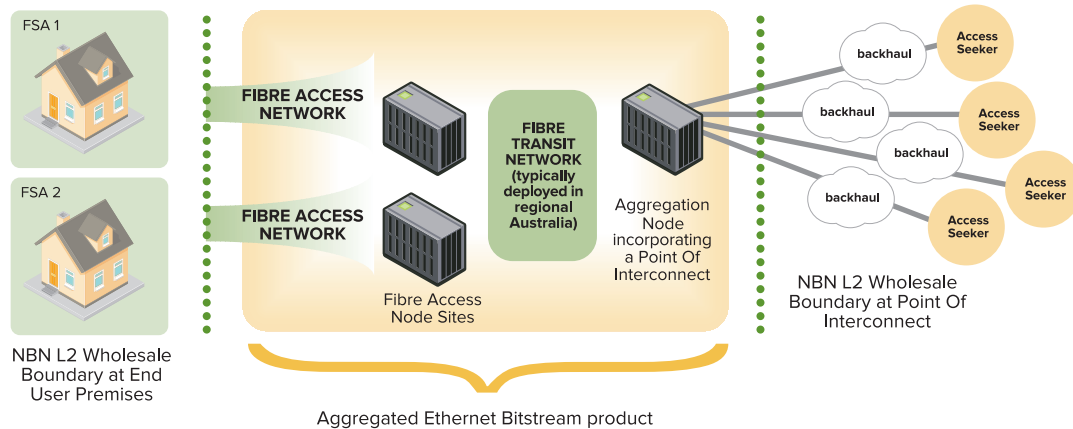
B.   Product Conditions

The LEB and AEB products will be offered as standalone products. The LEB product will not be available in FSAs that are serviced on an aggregated basis via the AEB product, until a LEB product is launched for that FSA.

One of NBN Co's objectives is to promote a level playing field. Ensuring that all RSPs are able to acquire the same service and compete equally in a given area is an important means of achieving this objective. By offering the LEB and AEB product on a mutually exclusive basis, NBN Co will be ensuring that all wholesale customers have an equivalent opportunity to compete in any given area. So, in a particular area where contestable backhaul is not available, only making the AEB product available will ensure that there is no competitive advantage or disadvantage to any wholesale customer irrespective of whether that wholesale customer self-provides backhaul or acquires the backhaul from a third party. Therefore, NBN Co considers that offering the LEB and AEB on a mutually exclusive basis is likely to best meet NBN Co's objective of ensuring a level competitive playing field and is less likely to result in competitive distortions in the marketplace.

It is it is important to note that the LEB and AEB products do not provide a wholesale customer exclusive access to the ONT in the end-user's premises. NBN Co intends to design its product offerings in a manner that allows end-users to choose multiple RSPs to supply them with retail services.

8. Important product elements

NBN Co will develop detailed product specification documentation for the LEB and AEB products. While details have not been finalised, NBN Co will, as part of this specification, establish parameters in respect of the following technical issues:

Bandwidth Rates

1.1. Access Circuit Rate Offerings

Each LEB/AEB Access Link will have a Peak Information Rate (PIR) for downstream and upstream speeds from the Fibre Access Node to the end-user premises.[4] In addition, each LEB/AEB Access Link will have a Committed Information Rate (CIR) for both downstream and upstream speeds. The CIR is the throughput that the RSP can expect the LEB/AEB Access Link to deliver in a congestion scenario.[5]

1.2. Connectivity Link Rate Offerings

The LEB /AEB Connectivity Link will have a Gigabit Ethernet optical interface, operating in multiples of 1 Gbps. The minimum required capacity that will need to be purchased will be a function of the number of OLTs (and hence passive optical networks) served within the respective FSA from the corresponding Fibre Access Node. Further details on the dimensioning rules will be forthcoming.

Traffic Management & Prioritisation

NBN Co's product offering will provide QoS options to support voice, video and other QoS sensitive applications (although timing of these options is subject to current assessment). Ethernet and GPON provide the capabilities to support a QoS differentiated product. The LEB and AEB products will support 802.1p identification of Ethernet traffic priority.

It is anticipated that RSPs would have the choice of selecting between a range of different QoS levels, with flexibility to configure a contention ratio appropriate to their business and applications needs. The individual QoS classes will offer differentiated performance in terms of parameters such as throughput, delay, jitter, packet loss etc at differentiated prices. RSPs will be able to choose a class or combination of classes to best meet the needs of their particular service offering.

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[4]Peak Information Rate (PIR) is defined as the maximum data throughput that may be achieved on a given circuit or link. Data which exceeds the PIR will be discarded in accordance with the traffic management policies. The PIR is defined and measured as the data throughput rate over a period typically of the order of milliseconds.

[5]Committed Information Rate (CIR) is defined as target sustained data throughput on a given link. Data which exceeds the CIR but is below the PIR may be delivered, subject to the traffic management policies (e.g. traffic may be delivered in situations when the network is not in congestion). The CIR is defined and measured as the data throughput rate over a period typically of the order of milliseconds or seconds.

At this stage NBN Co is planning to support 4 classes of service although it has not been determined when and how all options would become available. They are:

- **'Critical'**
  - Provides guaranteed low levels of delay and jitter
  - Suitable for voice and other communicative services. This is the highest priority traffic

- **'Expedited'**
  - Assurances for the levels of jitter and packet loss
  - Suitable for video / VOD, including multicast services
  - This class provides a second highest priority of traffic

- **'Priority'**
  - Provides a higher level of assurance than the best effort class, with lower probability of delay, jitter and congestion
  - Suitable for commercial data services, business grade data services

- **'Best effort'**
  - No performance guarantees
  - Suitable for high speed internet
  - This is the lowest priority traffic and anticipated to carry high volumes of data with varying levels of performance according to instantaneous congestion

Security and VLANs

NBN Co's network will be designed to support network security and integrity to ensure secure delivery of services and support multiple end-users. NBN Co will achieve a high level of security in its product offering by including the ONT as part of the service – it will not be possible for customers to connect directly to the fibre in the end user's premises. Each LEB Access Link and AEB Access Link will be supplied as a separate virtual data stream within the NBN Co network. The IEEE 802.1ad VLAN scheme will be used to differentiate LEB and AEB Access Links. NBN Co will notify the service provider of the C-TAG and S-TAG at the time of end user activation.

Voice Option

As a means to aid transition from current access technologies to the NBN, inclusion of Plain Old Telephone Service (POTS) capability is being considered to support legacy telephony services.

It is proposed that this will be achieved via an Analogue Telephone Adapter (ATA) integrated within the Optical Network Termination (ONT). Session Initiation Protocol (SIP) will form the core of the interface definition for this capability. Further details of the implementation of the POTS capability will be released in due course.

Multicast

Multicast is a technology whereby content transmitted simultaneously to two or more end users (e.g. IPTV programs) is carried as a single stream as far into the network as possible before being replicated (i.e. divided) and on-forwarded to end-users. Replication may occur at more than one point along the end to end path, resulting in a tree of replicated streams. The multicast technique can achieve significant bandwidth savings for the delivery of one-to-many services.

It is NBN Co's intention to deliver a multicast capability, which will require the incorporation of some Layer 3 awareness to support its delivery. The details of multicast implementation are still under consideration.

Optical Network Termination

The details regarding the ONT are under consideration.

NBN Co proposes providing and managing the ONT, with the User Network Interface (UNI) serving as the demarcation point between NBN Co and RSPs/end-users.

It is proposed that the initial design of the ONT will:

• contain multiple service ports, thereby allowing multiple services to be provided by multiple RSPs to end-user premises

• support a range of CPE and network user interfaces, thereby facilitating innovation in CPE by RSPs and a competitive CPE market

A number of key elements are under active consideration, including:

• indoor / outdoor installation

• minimum / maximum quantity of Ethernet ports

• whether the Ethernet ports should provide Power-over-Ethernet

• the number of telephony ports supported by the ONT

• power requirements / battery back-up and the responsibility for maintaining connectivity of mains power and maintaining a good working battery

• whether an RF port is provided

Questions

- This section outlines key elements of NBN Co's planned product specification. Are there any other technical parameters that should be included?

- What multicast capabilities have service providers identified? Should the NBN Co access network proxy IGMP functionality and consolidate reporting before passing messages through to the service provider, or do particular services require access to all IGMP communications from all end users? In other words, should NBN Co manage multicast signalling scalability on behalf of the access seekers, or would this unacceptably limit the kinds of multicast services that are being contemplated?

- How to provide SPs with the ability to confirm connectivity and power?

- Whether standards are required for CPE installation, reporting and management to allow customer self install, remote CPE configuration and downstream service provisioning?

- How to ensure continued support for smart grid and other public services such as safety, health and education?

- How should legacy voice services be provided?

- The benefits and disadvantages of integrating Pay TV capabilities into the ONT?

- The merits and disadvantages of an RF Overlay approach towards Pay TV versus an IP multicast approach?

- Should battery backup capabilities, for the purpose of maintaining POTS (or optionally, data) connectivity for a limited period of time following a power outage, be offered to end users at the time of ONT installation and should the choice be optional? How can the environmental costs be responsibly managed and how can the costs appropriately shared between end users and their chosen RSPs? How can end users be best educated to make an informed choice?

9. Conclusion and next steps

Consultation program

This Consultation Paper has outlined a high level description of NBN Co's proposed network architecture and product design. We have also incorporated a range of questions that will be important for the next stage of our deliberations as we refine our thinking and work up detailed product specifications and develop our pricing and offer sets.

NBN Co would welcome written submissions from interested parties on the various questions set out in this Consultation Paper and on other issues that are considered relevant. Interested parties will have until 12 February 2010 to provide written submissions. Submissions can be lodged via email on: feedback@nbnco.net.au

NBN Co has scheduled two forums in January 2010 to discuss this product consultation paper. They are:

- Sydney: 20 January 2010
  Metcalfe Auditorium, State Library of NSW,
  Macquarie Street, Sydney NSW, 2000

- Melbourne, 29 January 2010
  Village Roadshow Theatre, State Library of Victoria Conference Centre,
  328 Swanston Street, Melbourne VIC, 3000

You can register to attend these forums at the 'Events and Publications' section of nbnco.com.au

We also plan to hold consultation forums in other capital cities in early 2010. Following the completion of this first round of consultation we expect to release a detailed product specification.

NBN Co also plans to hold similar consultations with our stakeholders including a discussion of the operational requirements of our customers.

Next steps

NBN Co is now in the process of developing our network design and detailed product specifications. This will include an examination of the following issues:

- Confirmation of the number and location of PoI's

- Defining the next level of specificity on product definition, specifically the combination of

  – Downstream and upstream speeds - both PIR and CIR

  – Quality – prioritisation/QoS model with associated drop and scheduling preferences

  – Capacity – whether we will apply download caps and if so, at what level

- Definition of the product which will substitute for a legacy voice only product

- Diagnostic and service monitoring elements

- Order management, systems and processes

- Management of critical services

- The provision of TV services over the GPON

NBN Co is also working on the pricing structure of our offer set. This will be the subject of a further industry paper in the first half of 2010.