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Temporary Special Services White Paper

ISDN on the nbn™ Ethernet Bitstream Service

Contents

nbn provides product capability to enable the industry to develop solutions for the migration of copper-based Integrated Services Digital Network (ISDN) business services to Australia's broadband network.

nbn provides key product capabilities suitable to support the migration pathway for exchange-fed copper services including Telstra's retail and wholesale ISDN service offerings (ISDN 10/20/30 and ISDN2 services) to the **nbn**™ Ethernet Bitstream Service (NEBS).

NEBS can help the industry standardise the provisioning and management of their access infrastructure around solutions comprised of the fibre-based access technologies of Fibre to the Premises (FTTP), Fibre to the Node (FTTN) and Fibre to the Building (FTTB). It also offers a range of Enhanced Service Levels facilitating assurance support to businesses and other end-users.

The purpose of this white paper is to outline how **nbn**'s product capabilities for the fibre-based access technologies of FTTP, FTTN and FTTB can enable the industry to develop business packages and bundles that are the same as or better than their legacy copper-based equivalents in the Temporary Special Services (TSS) product classes of ISDN services (ISDN 10/20/30 and ISDN2 services), within the meaning of the Subscriber Agreement between **nbn** and Telstra.

Temporary Special Services are a set of telecommunication products delivered on copper, primarily targeted at the business market. The complete list of more than 20 Telstra retail and wholesale special services is available on **nbn**'s website.[1] This white paper is aimed at the TSS product class of ISDN.[2]

This forms part of a series of white papers to illustrate the capability of the **nbn**™ network as a suitable migration pathway for TSS. For the full schedule of white papers, please refer to the Integrated Product Roadmap on **nbn**'s website.[3]

This is a white paper published by **nbn** in accordance with the Subscriber Agreement between **nbn** and Telstra.

[1] http://www.nbnco.com.au/connect-home-or-business/information-for-home-or-business/will-it-work-over-the-nbn/what-services-will-be-switched-off.html

[2] Specifically, the SS Classes described as "ISDN10/20/30 – P", " ISDN10/20/30 – N" and "ISDN10/20/30 – B" and "ISDN2 – P", "ISDN2 – N" and ISDN2 – B" in Tables 1 and 2 in clause 1 of Schedule 4 of the Telstra Migration Plan.

[3] http://www.nbnco.com.au/content/dam/nbnco/documents/Integrated-Product-Roadmap.pdf

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What are Traffic Classes and how do they work?

Traffic Class 1 (TC-1)

nbn's Traffic Class 1 capability provides service providers and their end-users with performance objectives covering bandwidth, delay, jitter and packet loss:[4]

Traffic Class	nbn™ Network	Frame Delay (one way)	Frame Delay Variation	Frame Loss
TC-1	NEBS-FTTP	≤ 6 ms	≤ 3 ms	≤ 0.01%
	NEBS-FTTN/B	≤ 25 ms	≤ 10 ms	≤ 0.04%

The TC-1 traffic class is targeted towards real-time, interactive multimedia applications, with the following characteristics:

- Low bit-rate
- Low frame delay, frame delay variation, frame loss

The attributes of this class are aligned to the characteristics of the DSCP Expedited Forwarding per-hop behaviour described in RFC4594.

TC-1 provides a committed level of premium capacity with limited ability to burst above its CIR, suitable for applications that require deterministic performance and are likely to be sensitive to packet loss.

Traffic Class 2 (TC-2)

nbn's Traffic Class 2 capability provides service providers and their end-users with performance objectives covering bandwidth, delay, jitter and packet loss:[4]

Traffic Class	nbn™ Network	Frame Delay (one way)	Frame Delay Variation	Frame Loss
TC-2	NEBS-FTTP	≤ 6 ms	≤ 10 ms	≤ 0.01%
	NEBS-FTTN/B	≤ 25 ms	≤ 16 ms	≤ 0.04%

TC-2 is engineered to address the needs of business services that require tighter performance commitments than a 'best-efforts' solution, such as those carrying high-bandwidth, real-time, interactive multimedia applications. Every fibre-based NEBS[5] service may be configured to use TC-2 by selecting a bandwidth rate from a flexible menu of standardised profiles.[6]

The TC-2 traffic performance undertakings for bandwidth are enforced by a set of values prescribing burst rates. For TC-2 class traffic, a bi-directional, fixed burst period of 10 ms applies.

The NEBS product is built of four product components, including two key logical components that are dimensioned by the service provider to deliver the value proposition required to secure their target market.

[4] Note: Some minimum speeds, features and capabilities may not be available for fibre-based FTTN and fibre-based FTTB where the Line Rate of the service cannot accommodate this. All performance metrics described in this paper are subject to the service provider selecting appropriate features of NEBS, dimensioning services appropriately and complying with **nbn**'s Fair Use Policy. All performance metrics are subject to exclusions such as end-user equipment configuration and management of application usage. See **nbn**'s Wholesale Broadband Agreement on the **nbn** website for a full list of these qualifications.
[5] Fibre-based NEBS refers to Fibre to the Premise (FTTP), Fibre to the Node (FTTN) and/or Fibre to the Building (FTTB).
[6] Some bandwidth rates are only available for NEBS supplied using FTTP.

What is an AVC?

The NEBS Access Virtual Circuit (AVC) provides a direct, one-to-one connection at Layer 2 between the service provider and its end-user's premises. Traffic crossing the AVC is structured to identify the end-user and moves securely through the NEBS infrastructure between the service provider's connection to the POI/NNI on one side and the UNI which serves the Premises on the other. For FTTP, the location of the UNI port is found on the **nbn** supplied Network Termination Device (NTD), for FTTB (and FTTN delivered to a multi-dwelling unit) on the customer side of the MDF or for FTTN (to a single dwelling unit) through the telecommunications outlet. This gives the service provider a high degree of control and management over many aspects of service configuration and performance. When **nbn** terminates NEBS on an NTD it does so on an Ethernet interface. For fibre-based FTTP, the maximum size of an Ethernet frame at the UNI-D is 1,992 bytes for default-mapped or DSCP or 1,996 bytes for Priority-Tagged and Tagged modes. For fibre-based FTTN/B, the maximum size of an Ethernet frame at the UNI-DSL is 1,592 bytes (for Default-Mapped and DSCP) and 1,596 bytes (for Priority Tagged and Tagged). This is from the destination MAC Address to Frame Check Sequence (FCS) inclusive, which matches standard Ethernet behavior.

AVC bandwidth options

NEBS NEBS gives service providers the bandwidth capacity and flexibility to control their end-user's traffic profiles. Each AVC automatically supports a TC-4 subscription, which is a 'best-efforts' bandwidth allocation. At order time, service providers may choose an AVC profile that allows it to carry an amount of TC-2 traffic to support the provision of high-bandwidth, business-critical interactive multimedia applications. The TC-2 bandwidth capability of up to 20 Mbps on fibre-based FTTN/B, or up to 100 Mbps on fibre-based FTTP, can be used to construct retail services that match or exceed the upper end of speeds which many DSL-based retail Ethernet services available in the Australian market today could achieve. **nbn** also provides differing modes of addressing the Traffic Class 2 AVCs at the UNI, including Default-Mapped, DSCP, Priority-Tagged and Tagged options.

The **nbn** Traffic Class 1 bandwidth profiles of 0.15 Mbps, 0.3 Mbps, 0.5 Mbps, 1 Mbps, 2 Mbps and 5Mbps are available on both FTTN/B and FTTP, which may be used to support a viable migration pathway from legacy voice solutions such as ISDN2.

What is a CVC?

The NEBS connectivity virtual circuit (CVC) collects AVCs from a connectivity serving area (CSA) and presents them in an aggregated bundle to the service provider at the POI/NNI, again using a selectable mix of highly scalable, cost-effective and widely supported physical Ethernet interfaces. A single CVC may contain AVCs that are presented to end-users and delivered across all fibre-based NEBS access technologies. The maximum Ethernet frame size at the POI/NNI depends on whether a particular AVC is presented to a UNI-D or UNI-DSL. For an AVC to a UNI-D, the maximum Ethernet frame size is 2,000 bytes, which comfortably exceeds the maximum size of a standard Ethernet frame. For an AVC to a UNI-DSL, the maximum Ethernet frame size is 1,600 bytes from destination MAC to FCS (inclusive), which matches standard Ethernet behaviour for double-tagged (802.1ad) frames.

CVC bandwidth options

CVC bandwidth profiles are flexible and can be 'mixed-and-matched' between traffic classes to achieve a granular assortment of traffic class capacities. The CVC profile is a customised set of single traffic class-specific values. The service provider may choose a particular bandwidth for one traffic class independently of the bandwidth chosen for another traffic class on the same CVC. In some cases, the CVC might only specify and carry one or two of the available traffic classes if it has no need to support the others.

The speed tiers for each traffic class on a CVC are always symmetric, even for those (like TC-4) that are asymmetric when considered for an individual AVC.

Symmetric speed tiers available		
TC-1 traffic class speed tiers	5, 10, 20, 25, 30, 40, 50, 60, 80, 100 120, 150, 200, 250, 300, 400 and 500 Mbps	✔
TC-2 traffic class speed tiers	5, 10, 20, 25, 30, 40, 50, 60, 80, 100, 120, 150, 200, 250, 300, 400, 500, 600, 700, 800, 900 and 1000 Mbps	✔
TC-4 traffic class speed tiers	100, 150, 200, 250, 300 to 10,000 Mbps (in 100 Mbps increments).	✔

Contention management

The NEBS interconnection architecture allows each service provider to use the aggregating CVC into a serving area to directly influence its end-users' traffic experience. **nbn** does not prescribe the AVC bandwidth ratios applied to a CVC for fibre-based NEBS, so the service provider is free to scale the CVC to either:

- Protect the performance metrics for that class for traffic crossing each AVC; or
- Experience some degree of contention among AVCs, to strike an economic balance between performance and cost.

Provided the service provider doesn't oversubscribe the CVC, and maintains an average utilisation level that does not exceed the recommendations for NEBS (70%), the general performance levels of TC-2 are expected to provide an appropriate migration path for existing exchange-fed copper services available in Australia today. service providers are responsible for testing the operation of their services, including contention and dimensioning, to ensure they obtain desired performance and other service characteristics.

Traffic class signalling

NEBS is designed to allow the service provider and/or end-user's equipment to set the IEEE 802.1Q PCP field in the Ethernet header of a tagged Ethernet frame presented at the UNI or POI/NNI (available for the UNI if Tagged or Priority Tagged mode is selected). By using this field in supported modes, the frame can declare the traffic class membership (TC-1, TC-2 or TC-4) for the journey over the AVC while leaving the IP Precedence/DSCP field to signal end-to-end Class of Service (CoS).

For the purposes of CPE compatibility and/or management simplicity, the service provider or end-user may prefer to use the IP Precedence/DSCP field in an IP packet, or employ a default class membership for every frame at the UNI. NEBS can also support this requirement and **nbn** has published the required values for IP Precedence/DSCP mapping of each traffic class.

Compatible NTD CPE

Telstra's ISDN services operate using Network Terminating Equipment that meets the European Telecommunications Standards Institute (ETSI) standard for ISDN as well as Australian Specific standards. For both ISDN 2 and ISDN 2 Enhanced, Telstra provides an NT1 terminating device as part of the service. This device terminates the ISDN service from the Telstra network and enables the end-user to connect Customer Premises Equipment to the network. The NT1 equipment also provides the end-user with a 16 Kbits/second bi-directional data channel service.

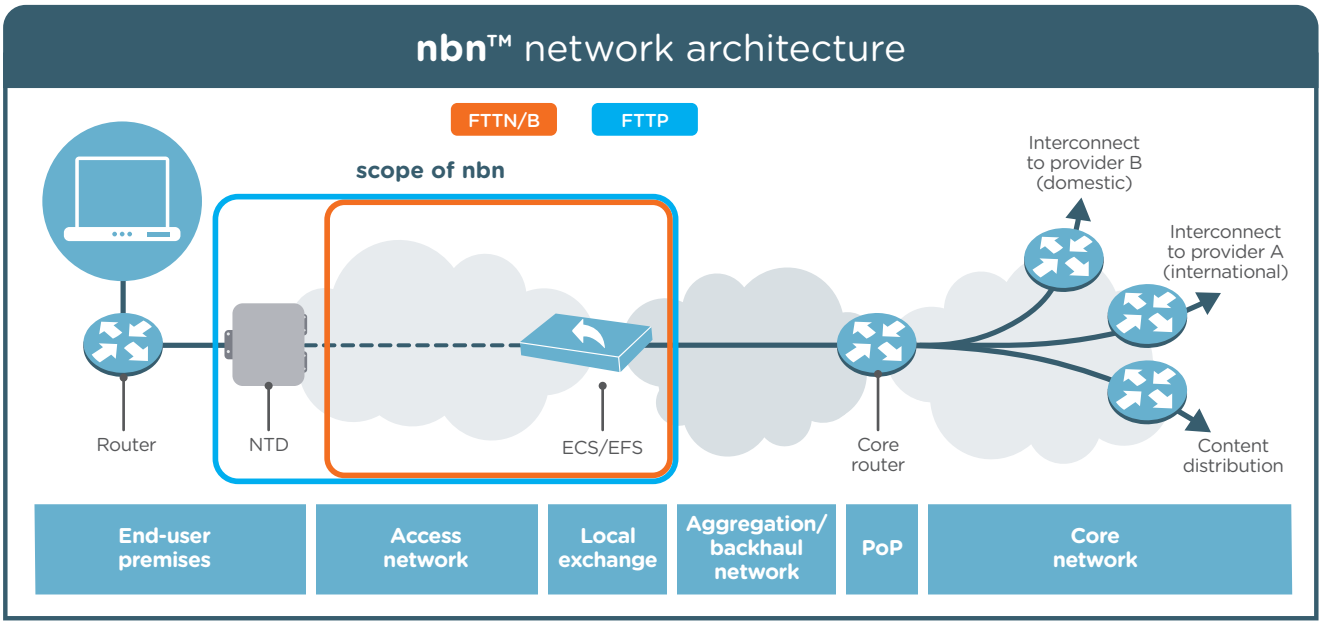
For ISDN 10/20/30 (Primary Rate Access), the service can be connected using either copper or fibre based 2Mbit access services. For optically connected services, Telstra provides an Optomux that is essentially a fibre to copper based multiplexer. The end-user then connects to the service via a Telstra provided NT1 equipment as per that provided for ISDN2.

In the case of a migration of ISDN services to NEBS-FTTP, **nbn** will supply an NTD. In the case of a migration of ISDN services to NEBS-FTTN/B, service providers would need to provide a VDSL2-capable modem installed beyond the socket (FTTN) or MDF (FTTB) at the end-user's premises. The VDSL2 equipment hardware and firmware intended for use with the UNI-DSL must support full-vectored interoperability with all of the DSLAM chipsets and firmware combinations as specified by **nbn**.

If there is a priority to maintain the delivery of ISDN based services to end-users in order to minimize the impact on the service, service providers will need to replace the current ISDN-NT1 equipment with a suitable ISDN-IP (or ISDN-Ethernet) appliance at each site that will enable the delivery of ISDN over packet data. In the case of NEBS-FTTN/B, there may be implementations of this equipment available that incorporate a VDSL modem - which may simplify the implementation from both an installation and support perspective.

Standardised broadband network architecture

Each variant of **nbn**'s fibre-based NEBS solution involved will either modify or replace the existing access provided as part of a current ISDN service. The solution aggregates end-users within a service area and backhauls their Ethernet traffic to and from an NNI/POI for interconnection to the service provider. This is consistent with broadband architectures used in Australia and other parts of the world, and helps to standardise changes at the end-user's premises. The diagram below shows an illustrative comparison of the scope of the **nbn** access replacement within a standardised broadband network architecture.



For the service provider, the use of nbn's fibre-based NEBS service will see the modification, replacement or elimination of certain copper access components, depending on the access technology:

- The provision of an **nbn**™ supplied NTD for FTTP or a service provider-/end-user-supplied VDSL2 modem for FTTN/B
- The existing copper access will be replaced with fibre for FTTP or modified by **nbn** for FTTN/B
- DSLAM infrastructure is not required for FTTP and is provided by **nbn** for FTTN/B

Given the ubiquity of IP for today's data applications and networks, the service provider and end-user may take this opportunity to adopt industry trends and move entirely to a contemporary IP/Ethernet architecture, forgoing ISDN-based carriage in the process.

If certain ISDN characteristics are still required, the service provider and/or end-user may elect to reproduce ISDN functionality using one of two options:

1. Employ an end-to-end substitution approach that involves the placement of specialised ISDN-over-packet (emulation) equipment at each end-user premises. These devices would provide ISDN-related features such as clocking, framing and signaling over an Ethernet transport, including the portion travelling via NEBS. The central ISDN network would be bypassed, possibly allowing the retirement of legacy equipment;
2. Employ a single-end substitution approach that involves the placement of specialised ISDN-over-packet (emulation) equipment at one end-user premises and another closer to the local ISDN carrier switch located in the exchange.

Whichever option is selected, the TC-2 traffic class can be ordered in bandwidth profiles which include enough capacity for a full ISDN BRI or PRI service (in fact, several of them in some cases) over a single NEBS link, provided the service provider and end-user configure the NEBS link and services running over it appropriately, for example by scaling the class subscription with sufficient bandwidth, and correctly managing the consumption and Quality of Service (QoS) treatment of other applications.

Commercial advantage

For a Service Provider, **nbn**'s TC-2 AVC and CVC product components as well as Enhanced Service Levels for assurance would be considered cost inputs into an end-to-end solution offered to an end-user i.e. **nbn**'s TC-2 product components will be one of the many costs and input parameters in the overall solution.

nbn's product provides attractive capabilities and commercial pricing for service providers to deliver an end-user solution.

Industry standards

If service providers elect to deploy a migration solution that replaces ISDN completely, then there will no longer be any need to comply with ISDN standards. Application level industry standards will still be applicable (for example PCI DSS for Argent Payments Solutions which is currently available over ISDN 2). However these are independent of the carriage service over which they are delivered.

If service providers elect to deploy a migration that maintains the use of ISDN over Packet Data, the end-to-end service will still need to comply with the Comms Alliance Standard and ETSI standards for ISDN Basic Rate and Primary Rate.

Network demarcation

A migration of ISDN services to NEBS will introduce two new Network Demarcation points for service providers within their network as per any other migration of services from Telstra's Copper Access to the **nbn**™ network. This will be the same irrespective of the migration path chosen by the service provider.

Namely, the service provider Demarcation Point with the **nbn**™ network which will be:

- For FTTP – The Ethernet port on the **nbn** supplied NTD provided at or near the end-user site (on which the service provider would interface the CPE) and **nbn**'s Point of Interconnect (POI).
- For FTTN/B – the first Telecommunications Outlet, Passive NTD or Customer Side MDF provisioned at the end-user site, (on which the service provider would terminate a suitable VDSL2 modem), and **nbn**'s POI.
- For both the FTTP and FTTN/B solutions, the **nbn**™ network POI presents an Ethernet interface that the service provider can connect to their existing network. If the service provider wishes to continue to offer ISDN-based services after migration has occurred, the service provider will also need to deploy ISDN-over-packet emulation technology at the end-users' premises and/or within its own network. Note that the identification, testing and selection of ISDN-over-packet emulation technology is beyond the scope of the **nbn**™ network.
- For the end-user, there would be no change in network demarcation.

Sophisticated customer reporting, monitoring and diagnostics tools

ISDN end-users currently do not have any access to reporting, monitoring or diagnostic tools. **nbn**'s reporting, monitoring and diagnostic platform provides service providers with the opportunity to deliver a range of new monitoring and control services to their end-users as part of the migration. Critically, these tools enable service provider's operational support teams to be able continue to effectively monitor ISDN services now delivered over NEBS.

nbn's Customer Operational Reporting platform also provides the service provider with visibility of the underlying performance of **nbn**™ services that can be used as an input to support existing customer reporting services.

Customer reporting

A key element of the migration of services to the **nbn**™ network is the ability for the service provider to deliver a level of reporting services to its business end-users.

nbn provides service providers with a series of service management and self-management tools to support core operational functions including ordering, activation, management and assurance across all **nbn**™ product and access technologies, including fibre.

Service management information will be accessible via four methods:

1. Access via the B2B interface
2. An online, browser-based graphical management dashboard
3. Standardised reports with regular delivery timeframes, including technology-specific reports that roll up to the dashboard
4. Customised ad-hoc and incident-based reports including the ability for the service provider to build their own specific reports

Self-Service tools will be accessible by two methods:

1. B2B interface into testing tools and database
2. An online, browser-based graphical dashboard

Customer reporting tools available and in plan as part of the nbn™ NEBS service		
Connection reporting	By status, geography and priority, connection appointment performance	✓
Order and ticket management	Including AVC and CVC MACS performance, fault rectification performance	✓
Network availability	Network availability, sortable by geography, product, volume of service providers impacted (updated hourly)	✓
Operational support tools	• Dashboard reporting on incidents • Monthly trouble ticket reporting • Total active services by product type • Reports on response KPI performance • Port error statistics	✓

Internal reporting, monitoring and diagnostics

The offering based on nbn's NEBS fibre services provides the service provider a range of diagnostics capabilities:

Diagnostics capabilities		
UNI-D NTD status (NEBS-Fibre)	Retrieves information about the UNI-D port from the access network. **Key attributes:** • NTD status Information • UNI-D status Information **Diagnostic uses:** • General information about the NTD/UNI port and its operational status	✓
Loopback connectivity test[7] (NEBS-Fibre)	Ethernet OAM based end-to-end connectivity test (for fibre based FTTP based services only) **Key attributes:** • Loopback test result (i.e. pass/fail) • Number of packets sent vs. number of packets received • Number of out-of-order packets **Diagnostic uses:** • Troubleshooting connectivity issues • Aid in fault localisation (be it in a service provider's or **nbn**'s™ network) in the form of Y.1731 loopback (LBM/LBR)	✓
Performance tests[8] (NEBS-Fibre)	Testing of services over a fixed period of time to provide performance metrics (Frame Delay, Frame Delay Variation, Frame Loss Ratio) **Key attributes:** • Frame delay • Frame delay Variation • Frame loss Ratio **Diagnostic uses:** • Troubleshooting throughput related issues • Ensuring end to end performance of service (Ethernet layer) within the **nbn**™ network according to product specifications as specified in the product specification document using Y.1731 (DMM/DMR)	✓

[7] The Internal loopback test for fibre based FTTN/B is run between the NNI and DSLAM port

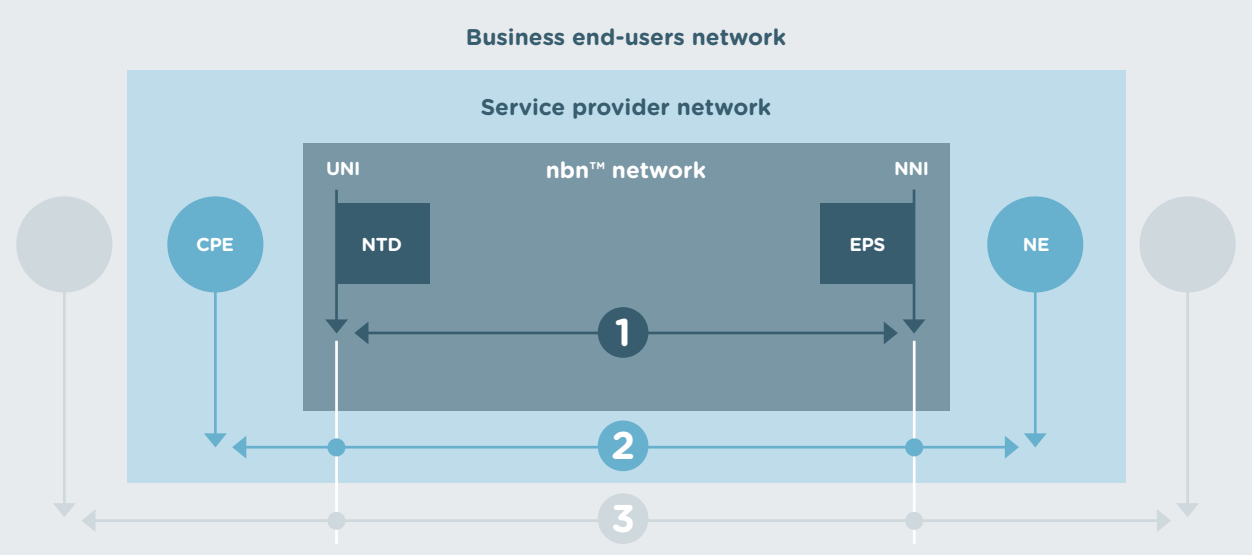
[8] The performance testing capability for fibre-based FTTN/B is planned to be made available to service providers by 2H 2017, as per integrated product roadmap. http://www.nbnco.com.au/content/dam/nbnco/documents/Integrated-Product-Roadmap.pdf

With the introduction of a proposed network demarcation point between the service provider and **nbn**'s infrastructure, a service provider's operational groups will be able to monitor and manage the **nbn**™ infrastructure as another element in their network. **nbn** has implemented an OAM framework in alignment with industry standards, which it plans to further enhance through offering visibility of **nbn**™ service boundaries at the service provider and business end-user level. The diagram below illustrates the monitoring architecture that is available to service providers.

Using the **nbn**™ network to deliver fibre access, the service provider will have monitoring visibility (as per diagram below) of services at a range of points throughout the **nbn**™ network including:

- Point of ingress to the **nbn**™ network via the regional broadband network
- The Access Node
- The **nbn**™ NTD (in the case of fibre-based FTTP)

nbn™ diagnostic capabilities



▼ Diagnostic end point

● Diagnostic intermediate visibility point

1. **nbn** has the ability to perform full diagnoses and monitoring within its network boundaries
2. Service providers have the ability to perform end-to-end diagnostics and monitoring, with visibility of **nbn**'s™ service boundaries
3. Business end-users have the option of performing end-to-end testing across **nbn**™ services, with the option of visibility of **nbn**™ service boundaries

The advanced reporting capabilities available on **nbn**™ NEBS fibre services will provide the service provider with internal reporting capability comparable to current capability. The ability to partition monitoring between **nbn**-provided and service provider-delivered services will enable more accurate root cause analysis of faults, improving the efficiency of fault management and enabling the delivery of a more consistent user experience for business end-users.

Service levels

Network availability

Telstra has an availability target for ISDN of 99.7%. This measure includes short disruptions to the performance of the service, and is measured over one year (24 hours a day, seven days a week).

The **nbn**™ network availability target is a performance objective of 99.90%[9] across all current access technologies. On the basis that **nbn**'s component target network availability is one input into the end-to-end network availability calculation for ISDN comparable services provided to end-users using **nbn**™ fibre-based NEBS services, the **nbn**™ fibre-based NEBS solution can potentially enable service providers to offer network availability target service levels for services using the **nbn**™ fibre-based NEBS services that are comparable to or better than the network availability target currently offered by Telstra for ISDN.

Service installations

For ISDN 2 services, in the case that ISDN infrastructure is available in an urban area, Telstra targets 10 days to deploy a new service, and five days in the case of in-place connections.[10] For ISDN 10,20,30 services, Telstra offers an installation target of 9 working days for connections in metro areas with no external work required for ISDN 10,20,30 services. For ISDN 10,20,30 connections requiring external transmission plan work or third parties consent, Telstra's targets are 19 to 24 days for metro areas. For non-metro areas targets are 19 days to 39 days or not specified.[11]

nbn's service installation targets specified in its arrangements with service providers for fibre-based NEBS are between 1 and 19 business days, depending on service location and available infrastructure.

The following are **nbn**'s end-user connection service levels (install target in business days). All of these service levels are subject to conditions and exceptions set out in **nbn**'s Wholesale Broadband Agreement with service providers.

Service offering	Geographical area	Urban area (days)	Rural area (days)	Remote area (days)
NEBS-FTTP	Service Class 1	14	19	19
	Service Class 2	9	14	19
	Service Class 3	1	1	1
NEBS-FTTN/B	Service Class 10	N/A	N/A	N/A
	Service Class 11[12]	14	19	19
	Service Class 12	9	14	19
	Service Class 13	1	1	1

[9] For full details on the Network Availability target and is calculation methodology please refer to the Service Level Schedule section of the WBA, http://www.nbnco.com.au/sell-nbn-services/supply-agreements/wba2.html

[10] Source: https://www.telstra.com.au/content/dam/tcom/personal/consumer-advice/pdf/isdn-general.pdf

[11] Source: https://www.telstra.com.au/content/dam/tcom/personal/consumer-advice/pdf/business-a-full/bg_wb_prov_times.pdf

[12] Service Class 11 is not applicable to fibre-based FTTB.

End-user service fault rectification[13]

In terms of service restoration targets, the standard and enhanced service level options for NBN NEBS services are comparable with those offered with the existing Telstra ISDN when delivered as part of an Enterprise Data Network solution[14]. The below table illustrates this by comparing the offerings for delivery to urban locations.

Eg. **Urban zone;** with rural and remote zone variations (+1, and +2 days) consistent across Telstra and **nbn**™ offerings	**ISDN2**	**ISDN 10/20/30**	**nbn**™ **fibre-based NEBS**	**Comparison between Telstra ISDN and nbn**™ **fibre-based NEBS**
Default restore time; Hours of operation	• 12 hours • M-S; 7am-9pm	• 12 hours • 24/7	• Enhanced-12; enhanced- 12 (24/7). • 12 Hours; 24/7	• Same or, in the case of ISDN2, better
Default response time	• 120 mins	• 60 mins	• 60 mins	• Same or, in the case of ISDN2, better
Express 8 (Telstra); enhanced-8 (nbn)	• 8 hours restore; • 60 mins response	• 8 hours restore; • 60 mins response	• 8 hours restore; • 60 mins response	• Same
Express 6 (Telstra); enhanced-6 (nbn)	• 6 hours restore; • 30 mins response,	• 6 Hours Restore; • 30 mins Response,	• 6 hours restore; • 30 mins response,	• Same
Express 4 (Telstra); enhanced-4 (nbn)	• 4 hours restore; • 30 mins response	• 4 hours restore; • 30 mins response	• 4 hours restore; • 30 mins response	• Same

[13] For full end-user Service Fault Rectification details please refer to the Service Level Schedule section of the WBA http://www.nbnco.com.au/sell-nbn-services/supply-agreements/wba2.html

[14] These solutions include IP WAN, IP MAN, Ethernet MAN, Business IP, Connect IP, Business Broadband, Telstra Internet Direct, Managed Data Networks (MDN), SIP Connect

Conclusion

nbn's™ Traffic Class 2 technical features and suite of enhanced service levels for assurance provide a solid migration path for the ISDN end-users from exchange-fed copper-based access services to the **nbn**™ fibre-based Ethernet Bitstream Service (NEBS).

These features and capabilities provide service providers with the ability to provide simple, converged solutions that satisfy a migration from legacy products to nbn's solution, and also provide a variety of enhanced service level targets for assurance and network feature capabilities that can be used by service providers to meet the needs and requirements of end-users.

Notes: terms used but not defined in this White Paper have the meaning given in **nbn**'s Wholesale Broadband Agreement, which is publically available on **nbn**'s website, or the Subscriber Agreement between **nbn** and Telstra which is confidential.

Appendix: Telstra ISDN comparison table

Considered area of product equivalence	Feature or function	Telstra ISDN	nbn's product capability
Network architecture and product capability	Dedicated copper TDM line from network switch to NT1	✓	N/A
	Native VC-based, high speed, connection-orientated Ethernet packet switching network	N/A	✓
	In-built low-speed connection to X.25 packet switching network	✓	N/A
	Virtual circuit hand-off models	N/A	✓
	Available transmissions rates	✓	✓
	Native speech bearer services	✓	N/A
	Native teleservices and supplementary (associated) services	✓	N/A
	Multi-service upper-layer protocols, including IP	✓	✓
	Head end handoffs	✓	✓
	Maximum frame size	✓	✓
	UNI operating modes	N/A	✓
	Contention management	✓	✓
	Security against opportunistic eavesdropping	✓	✓
Performance metrics	Performance targets	✓	✓
Reporting capability	Reporting on end user service performance	✓	✓
Network availability	99.7% availability target	✓	✓
Service levels for assurance	Business plus	✓	✓
Service levels for activation	Service installation targets	✓	✓
Commercials and pricing	Price point per service	✓	✓

N/A = Not applicable

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Disclaimer: This document provides general information about the technical requirements for connecting to the **nbn**™ network and is correct as at September 2016. Technical connection requirements may change due to factors such as legislative and regulatory requirements as well as advances in technologies. For any queries about your particular circumstances or requirements, please consult your phone and internet provider or other supplier.