business nbn™

Temporary Special Services White Paper

ISDN FTTC Executive Summary

nbn provides product capability over **nbn**™ Ethernet (FTTC) to enable the industry to develop solutions for the migration of copper-based Integrated Services Digital Network (ISDN) business services to the **nbn**™ broadband access 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 **nbn**™ Ethernet.

The purpose of this White Paper is to outline how **nbn**'s product capabilities called **nbn**™ Ethernet (FTTC) can enable development of 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 ISDN 2 services) within the meaning of the Subscriber Agreement between **nbn** and Telstra.

TSS are a set of telecommunication products delivered on copper, primarily targeted at the business market. The complete list of more than twenty 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** as a suitable migration pathway for TSS. This is a White Paper published by **nbn** in accordance with the Subscriber Agreement between **nbn** and Telstra.

1. **https://www.nbnco.com.au/business/special-services/affected-special-services**
2. Specifically, the SS Classes described as "ISDN10/20/30 – C" and "ISDN2 – C" in Tables 1 and 2 in clause 1 of Schedule 4 of the Telstra Migration Plan.

What is Traffic Classes and how does it work?

Traffic Class 1 (TC-1)

nbn's Traffic Class 1 capability provides Service Providers and their End Users with performance targets covering bandwidth, delay, jitter and packet loss[3]:

Traffic Class	TC-1
nbn™ access network	nbn™ Ethernet (FTTC)
Frame Delay (one-way)	≤ 25ms
Frame Delay Variation	≤ 10ms
Frame Loss	≤ 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.

3. Note: Some speeds, features and capabilities may not be available for nbn™ Ethernet (FTTC) where the Line Rate of the service cannot accommodate this. All performance metrics described in this White Paper are subject to the Service Provider selecting appropriate features of the nbn™ Ethernet (FTTC) product, dimensioning services appropriately and complying with the nbn™ Ethernet 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.

Traffic Class 2 (TC-2)

nbn's Traffic Class 2 capability provides Service Providers and their End Users with performance targets covering bandwidth, delay, jitter and packet loss[3]:

Traffic Class	TC-2
nbn™ access network	**nbn**™ Ethernet (FTTC)
Frame Delay (one-way)	<= 25ms
Frame Delay Variation	<= 16ms
Frame Loss	<= 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 **nbn**™ Ethernet (FTTC) service may be configured to use TC-2 by selecting a bandwidth rate from a flexible menu of standardised profiles.

TC-2 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 Frame Delay Variation (FDV/jitter) and Frame Loss (FLR).

The **nbn**™ Ethernet product is built of four product components, including two key logical components that are dimensioned by the Service Provider to deliver the value proposition desired for their target market.

What is an AVC?

The **nbn**™ Ethernet Access Virtual Circuit (AVC) provides a direct, one-to-one connection at layer-2 between the Service Provider's connection to the POI/NNI and its End User's premises. Traffic crossing the AVC is structured to identify the End User and moves securely through the **nbn**™ infrastructure between the Service Provider's connection to the POI/NNI on one side and the UNI-D which serves the Premises on the other. For **nbn**™ Ethernet (FTTC), the UNI-D port is an Ethernet interface found on the **nbn**-supplied FTTC-NCD. This gives the Service Provider a high degree of control and management over many aspects of service configuration and performance. For **nbn**™ Ethernet (FTTC), the maximum size of an Ethernet frame at the UNI-D is 1,980 bytes (for Default-Mapped and DSCP-Mapped) and 1,984 bytes (for Priority Tagged and Tagged). This value covers the frame from the Destination MAC Address to Frame Check Sequence (FCS) inclusive and reflects standard Ethernet behaviour.

AVC bandwidth options

nbn™ Ethernet 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, a Service Provider 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[4] on **nbn**™ Ethernet (FTTC) 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 different Tag Protocol Identifier (TPID) formats for the Traffic Class 2 AVCs at the UNI, including Default-Mapped, DSCP-Mapped, 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 5 Mbps are available on FTTC which may be used to support a viable migration pathway from legacy voice solutions such as ISDN2.

4. Not all premises will be able to support TC-2 20Mbps. For example premises unable to obtain a 20Mbps committed information rate service prior to migration to the **nbn**™ network are likely to have copper connections that only support lower speeds. A service qualification is required prior to ordering.

What is a CVC?

The **nbn**™ Ethernet 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 **nbn**™ Ethernet product access technologies.[5] The maximum Ethernet frame size at the POI/NNI depends on the UNI to which a particular AVC is presented.

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 **nbn**™ Ethernet 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 **nbn**™ Ethernet (FTTC), 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 **nbn**™ Ethernet (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.

5. Except for Satellite, which uses separate dedicated CVCs.

Traffic Class signalling

nbn™ Ethernet 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).

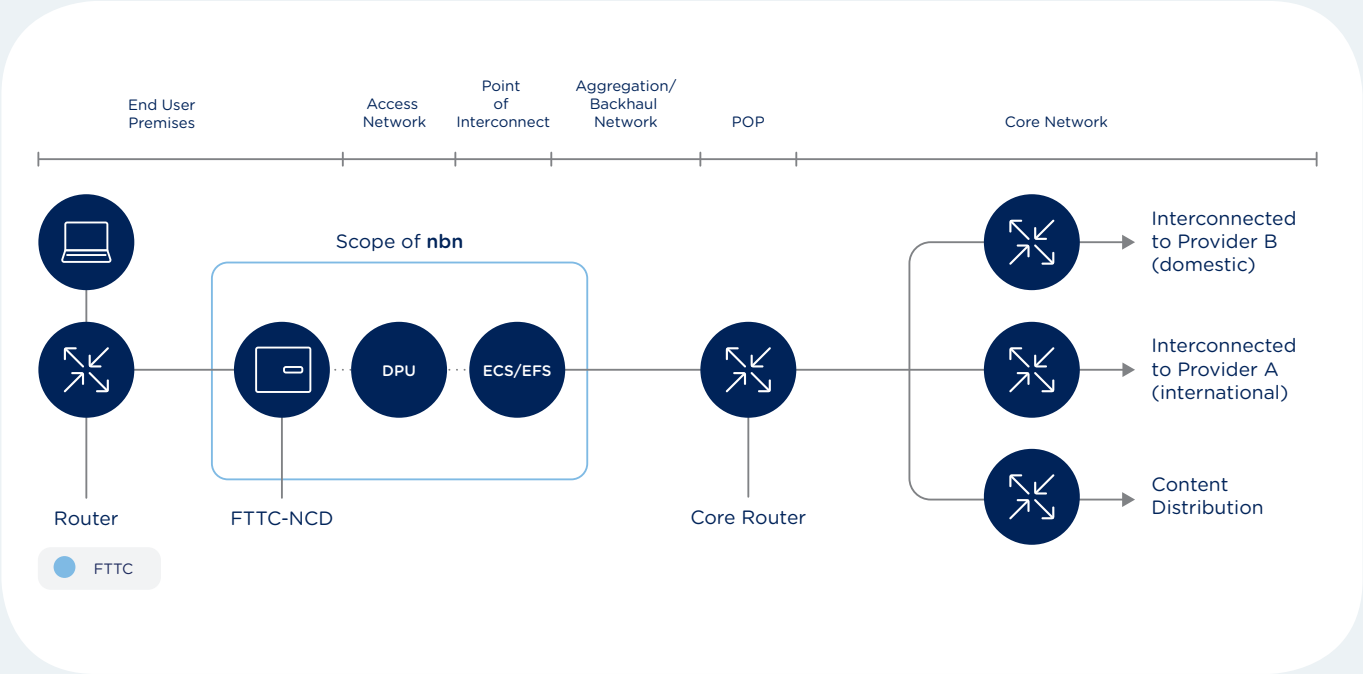
For the purposes of CPE compatibility and/or management simplicity, the Service Provider or End User may prefer to use the IP Precedence/DSCP field in an IP packet, or employ a default class membership for every frame at the UNI. **nbn**™ Ethernet can also support this requirement and **nbn** has published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

Compatible FTTC-NCD and CPE

The impact of a migration to **nbn**™ Ethernet-based services will be dependent on the migration path chosen by the Service Provider. Migration to **nbn**™ Ethernet (FTTC) will see **nbn** provide the FTTC-NCD containing an RJ45-based Ethernet port for connection to Customer Premises Equipment such as a router or switch. If the decision is made to continue delivering ISDN services to End Users, the Service Provider will also need to provide an Ethernet/IP-enabled NT1 which supports Ethernet WAN connectivity at each End User site to enable the delivery of ISDN-over-packet data.

Standardised broadband network architecture

Each variant of an **nbn**™ Ethernet solution 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 technology replacement within a standardised broadband network architecture.



For the Service Provider, the use of an **nbn**™ Ethernet (FTTC) will see the modification, replacement or elimination of certain copper access components:

- The provision of an nbn-supplied FTTC-NCD
- The existing copper access will be modified by **nbn**
- DPU infrastructure is provided by **nbn**.

The result is the following network for the Service Provider::

- One end of the service terminates at the physical Ethernet port (UNI-D) on the FTTC-NCD into which the End User's CPE is connected; and
- The other end of the service terminates at the Network-Network Interface (NNI) at one of **nbn**™'s Points of Interconnection.

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 **nbn**™ Ethernet. The central ISDN network would be bypassed, possibly allowing the retirement of legacy equipment; or

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 RSP Point of Presence.

Whichever of the two options above is selected, the TC-2 or TC-1 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 **nbn**™ Ethernet link, provided the Service Provider and End User configure the **nbn**™ Ethernet link and services running over it appropriately, for example by acquiring sufficient bandwidth in each traffic class and actively managing the use of applications accessing that service.

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 end-to-end solution.

nbn's product provides attractive capabilities and commercial pricing for Service Providers to deliver an end-to-end 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 elects to deploy a migration that maintains the use of ISDN over Packet Data, the Service Providers will remain responsible for ensuring that the end-to-end service complies with the Communications Alliance Standard and ETSI standards for ISDN Basic Rate and Primary Rate.

Network demarcation

A migration of ISDN services to **nbn**™ Ethernet (FTTC) 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:

1. The Ethernet Port on the **nbn**-supplied FTTC-NCD installed at the End User remises: Service Providers would then connect the CPE as required.

2. 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.

Service levels

Network availability

The **nbn**™ Ethernet network availability target is a performance objective of 99.90%[6].

Service installations

nbn's service installation targets specified in its arrangements with Service Providers are between 1 and 19 business days, depending on service location and available infrastructure. The following are **nbn**'s connection service levels (installation target in business days) for standard installations at an End User premises. These are subject to conditions and exceptions set out in **nbn**'s Wholesale Broadband Agreement with Service Providers.

Traffic Class	Urban area (days)	Major/minor rural (days)	Remote area (days)
nbn™ Ethernet (FTTC) Service Class 31	14	19	19
nbn™ Ethernet (FTTC) Service Class 32	9	14	19
nbn™ Ethernet (FTTC) Service Class 33	9	14	19
nbn™ Ethernet (FTTC) Service Class 34 (FTTC-NCD Shortfall)	9	14	19
nbn™ Ethernet (FTTC) Service Class 34	1	1	1

End User service fault rectifications[7]

The following are **nbn**'s End User fault rectification service levels at an end user premises.

nbn	Standard	nbn™ Enhanced 12	nbn™ Enhanced 8	nbn™ Enhanced 6	nbn™ Enhanced 4
Coverage[8]	Mon-Fri, 8am- 5pm	Mon-Sun, 7am-9pm, or optional 24x7	Mon-Sun, 7am-9pm, or optional 24x7	Mon-Sun, 7am-9pm, or optional 24x7	Mon-Sun, 7am-9pm, or optional 24x7
Fix Urban	5pm Next Business Day	12 hours	8 hours	6 hours	4 hours
Fix Rural	5pm 2nd Business Day	26 hours	22 hours	20 hours	18 hours
Fix Remote	5pm 3rd Business Day	40 hours	36 hours	34 hours	32 hours

6. For network availability details please refer to the **nbn**™ Ethernet Service Levels Schedule in the WBA - **https://www.nbnco.com.au/sell-nbn-services/supply-agreements/wba**
7. For fault rectification service level details please refer to the **nbn**™ Ethernet Service Levels Schedule in the WBA - **https://www.nbnco.com.au/sell-nbn-services/supply-agreements/wba**
8. For service levels that do not include 24x7 coverage, rectification timeframes are only counted against operational coverage hours.

Conclusion

The **nbn**™ Ethernet (FTTC) technical features and suite of service levels provide a solid migration path for the ISDN End Users from exchange-fed copper-based access services to **nbn**™ Ethernet.

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 solutions, 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 publicly available on nbn's website, or the Subscriber Agreement between nbn and Telstra which is confidential.

July 2019

business **nbn**™