

Broadbanding
Australia

Multicast

**FEATURE , TECHNOLOGY & PRICING OVERVIEW
FOR MULTICAST OVER FIBRE**



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This document should be read in conjunction with:

[1] NBN Co Limited, [Fibre Product Overview: 2010](#).

[2] NBN Co Limited, [Product Technical Specification – Fibre Access Services; 2010](#).

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1. Document Purpose

This document provides an overview of the NBN Co Multicast feature, which can be used by Access Seekers to deliver video content over the NBN Co fibre access network. The document includes the orderable elements of the Multicast feature, as well as pricing and a technical overview.

This document addresses delivery of Multicast over the NBN Co fibre access network only. NBN Co may offer Multicast over the wireless and satellite access networks in the future. Delivery of Multicast over these access technologies is out of scope of this document.

This document is intended as a guide for Access Seeker Product, Marketing and Strategy/Planning groups - to help them develop retail offers on the NBN.

Technical details on the implementation of Multicast within the NBN Co fibre network will be released in an updated version of the existing 'Product Technical Specification - Fibre Access Service' document.

2. Introduction

Historically, distribution of video content to consumers has been via broadcast technologies – be it free-to-air television or subscription television over cable and satellite networks. More recently, video content is increasingly being consumed through the internet, resulting in telecommunications and internet service providers seeking to add video offerings to their traditional broadband and voice product sets.

This shift is being driven by vendors and media owners on the supply side, as well as consumers on the demand side. On the supply side, the media and consumer electronics industries are driving a shift towards internet-connected devices which deliver content directly to televisions and other video-enabled devices, eg. internet-enabled TVs, gaming consoles and tablets. On the demand side, consumer surveys point to increasing video usage and consumption over the internet.

This growth in demand for video over the internet is creating ever-growing bandwidth requirements, especially as content increasingly moves to higher definition formats, and End-Users add more video-enabled devices which receive content via broadband in their homes. The construction of the NBN is expected to provide the vast majority of Australian households and businesses with the ability to purchase a communications channel capable of simultaneous delivery of significant amounts of innovative, interactive, high-definition content. The NBN Co Multicast feature is designed to enable Access Seekers to deliver this content more cost effectively compared to the traditional unicast delivery methodology.

3. Feature Overview

Multicasting is a feature which enables content to be transmitted simultaneously to multiple parties, but is carried as a single stream as far into the network as possible, before being replicated and forwarded to End Users. Multicast technology is uni-directional: traffic flows one way to the end user.

The Multicast feature can achieve significant bandwidth savings for the delivery of one-to-many services, allowing more efficient use of Access Seeker backhaul. This enables more cost effective delivery of services such as Internet Protocol Television (IPTV) and other video content.

To illustrate this, Figure 1 shows 180 End-Users, each receiving a 20 Megabits per second (Mbps) media stream. Multicast enables the Access Seeker to inject the media streams only once at the Point-of-Interconnect. Without Multicast, the Access Seeker would need to inject each individual End-User's media stream 180 times, consuming 3600 Mbps of bandwidth, compared to the 100 Mbps required when using the Multicast feature.

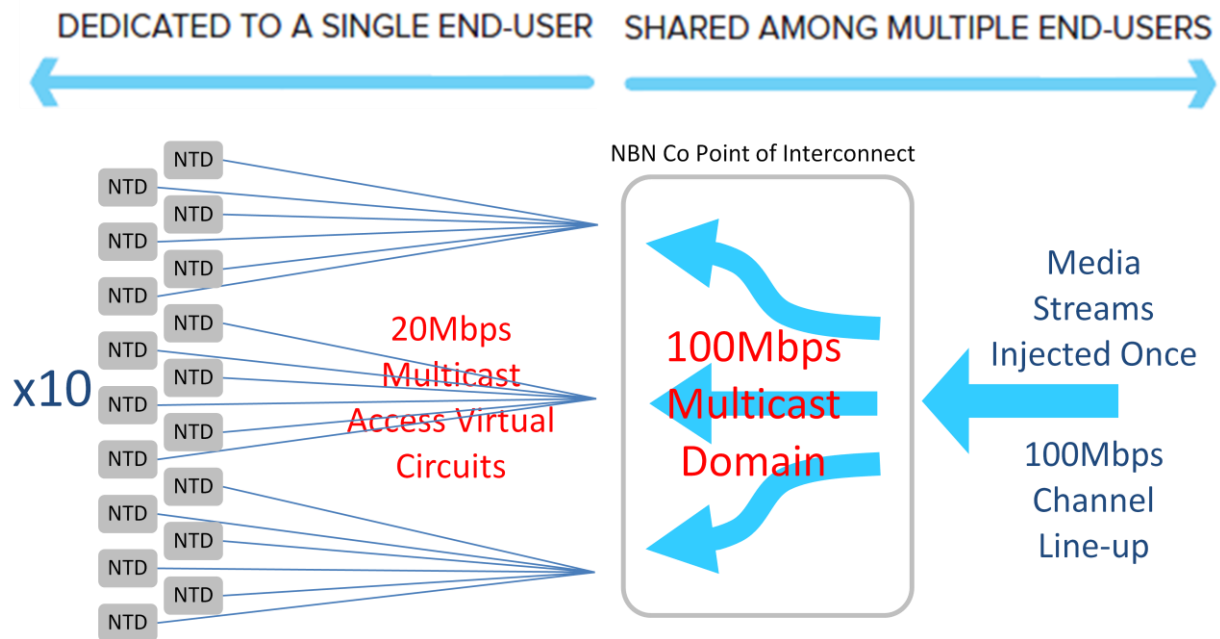


Figure 1: Multicast Replication

Overview of the Feature Construct

The NBN Co Multicast feature is similar to the standard NBN Co Fibre Access Service, in that it consists of the same four product components (ie UNI, AVC, CVC and NNI) working in conjunction with each other to deliver a service to an End-User. The major difference is that Access Seekers will need to purchase a Multicast variant of the Access Virtual Circuit (called a 'Multicast Access Virtual Circuit'), as well as a Multicast variant of the Connectivity Virtual Circuit (called a 'Multicast Domain') **in addition** to the standard AVC and CVC products purchased with the standard Ethernet bitstream service.

Therefore, to provide a Multicast offering to End-Users, an Access Seeker requires the following four components:

	Component	Description
1.	User Network Interface – Data	A port on the End-User Network Termination Device
2.	Multicast Access Virtual Circuit	A Multicast variant of the Access Virtual Circuit
3.	Multicast Domain	A Multicast variant of the Connectivity Virtual Circuit. Multicast Media Streams are associated with the Multicast Domain
4.	Network-to-Network Interface	A port at the Point-of-Interconnect

Table 1: Multicast Feature Components

It is important to note that Multicast is a feature that must be acquired ***in addition*** to a standard Ethernet Bitstream service. A Multicast service can only be provided to an End-User in conjunction with a standard Ethernet Bitstream service supplied by the same Access Seeker who is providing the Multicast service.

This requirement is based upon the following:

- **Technical:** A Multicast service requires a small upstream path to send channel-change requests. This upstream path is carried as part of the standard Ethernet Bitstream service.
- **End-User Experience:** NBN Co wish to avoid a situation where an End-User’s Multicast offering would be discontinued if that End-User cancelled their Ethernet Bitstream offering from a different Access Seeker – hence the requirement to have the standard Ethernet Bitstream service provided by the same Access Seeker who is offering the Multicast service.

The ‘User Network Interface – Data’ (UNI-D) port and the ‘Network-to-Network Interface’ (NNI) port being used to deliver the standard Ethernet Bitstream service are also used to supply the Multicast service. Access Seekers are not required to purchase an additional UNI-D port or NNI port in order to supply a Multicast service to an End-User.

The following diagram shows which of the 4 product components are shared between the Multicast feature and the standard Ethernet Bitstream service, and which components are required to be purchased separately:

User Network Interface – Data (UNI-D) Port:

- A separate/additional UNI-D port is not required for delivery of Multicast traffic.
- Multicast traffic is delivered over the same UNI-D port being used for delivery of the standard Ethernet Bitstream product.

Multicast Domain:

- A separate Multicast Domain is required for delivery of Multicast traffic.

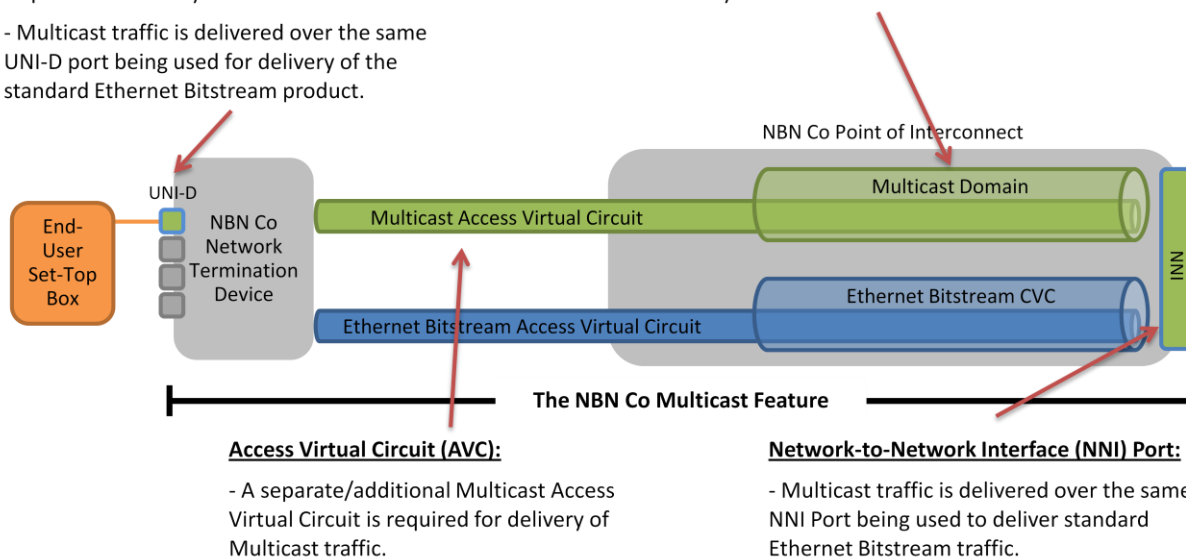


Figure 2: Relationship between Multicast & Ethernet Bitstream Components

Content that is distributed via the Multicast feature is defined as a ‘Media Stream’. A Media Stream can be a broadcast channel (whether Standard Definition, High Definition, 3D or Interactive/EPG) or any other type of data stream. An Access Seeker with 150 ‘channels’ could define 150 ‘Media Streams’, or package together multiple channels within a larger ‘Media Stream’.

Whilst the Media Stream capacity of the NBN Co Multicast platform is large, it is not infinite. Therefore, while Access Seekers will be able to offer various types of media using the Multicast feature, the pricing construct has been developed with the aim of encouraging Access Seekers to utilise the platform for higher bandwidth media (ie. standard definition, high definition and 3D high definition video content) as opposed to lower bandwidth media (ie. internet-quality video and music/sound Media Streams). This is designed to ensure that the media stream capacity of the platform is utilised more efficiently.

Multicast Access Virtual Circuit

Access Seekers will need to order a Multicast Access Virtual Circuit for each End-User UNI-D receiving Multicast content. This is in addition to the Ethernet Bitstream Access Virtual Circuit being used by the same Access Seeker for delivery of broadband services. This Multicast Access Virtual Circuit will terminate on the same ‘User Network Interface – Data’ (UNI-D) port being used for delivery of broadband services. Multicast Access Virtual Circuits can be ordered at specific bit rates to suit the package of content being delivered - for example, Standard Definition or High Definition video Media Streams.

Each Multicast Access Virtual Circuit should be dimensioned at the required combined simultaneous viewing and/or recording capacity of the premises (see ‘Multicast Dimensioning Example’ section of this document for more detail).

The initial Multicast Access Virtual Circuit size is 20 Mbps. It can be purchased in additional increments of 10 Mbps, up to a maximum of 60 Mbps.

Multicast Domain

The Multicast Domain enables Access Seekers to efficiently distribute content from a Point-of-Interconnect, by injecting traffic (ie. a Media Stream line-up) only once at the Network-to-Network Interface (NNI), irrespective of the number of End-User premises being served from that Point-of-Interconnect.

Multicast Domain charges are based on the total Multicast bandwidth required per Point-of-Interconnect, which directly relates to the Media Stream line-up being offered by the Access Seeker. The Multicast Domain will be dimensioned by NBN Co at the total size of all Media Streams injected by an Access Seeker in that particular Point-of-Interconnect area.

See the 'Multicast Dimensioning Example' section of this document for additional detail.

The initial Multicast Domain size is 100 Mbps, and it can be purchased in additional increments of 100 Mbps, up to 1000 Mbps.

Individual Media Streams must be injected - each with a specified bandwidth – into the Multicast platform. NBN Co stipulates a minimum Media Stream size of 3 Mbps. Media Stream bandwidths may be specified in increments of 0.1 Mbps above this minimum, and different Media Streams can be assigned different bandwidths (ie. the Access Seeker is able to define the bandwidth for each separate Media Stream). Any Electronic Programme Guide (EPG) or picture-in-picture streams offered by Access Seekers will be treated as simply another Media Stream.

Multicast Dimensioning Example

The Multicast feature will be ordered based on the type and quantity of Media Streams to be delivered simultaneously to an End-User, for example:

- If an Access Seeker has a Standard Definition Media Stream which averages 3 Mbps, with peaks to 4.95 Mbps, a 5.0 Mbps Media Stream should be purchased.
- If an Access Seeker has a High Definition Media Stream which averages 6 Mbps, with peaks to 9.91 Mbps, a 10.0 Mbps Media Stream should be purchased.

Therefore, Access Seekers will have the ability to dimension their Multicast Access Virtual Circuits as follows (excluding EPG or other media streams)

- A package consisting of a single set-top box with dual high-definition streams may require a 20 Mbps Multicast Access Virtual Circuit (ie. enough bandwidth to allow the End-User to watch a single high-definition video Media Stream while simultaneously recording another).
- A package consisting of two set-top boxes, each with dual high-definition streams may require a 40 Mbps Multicast Access Virtual Circuit (ie. enough bandwidth for each of the 2 set-top boxes to show a single high-definition video Media Stream while simultaneously recording another).

Multicast Domains will be dimensioned based on the total size of the Media Streams being simultaneously injected at each Point-of-Interconnect, for example :

- An Access Seeker has a Media Stream line-up consisting of 20 standard definition Media Streams (at 5 Mbps each) and 8 high-definition Media Streams (at 10 Mbps each) – totalling 180 Mbps, the Access Seeker would require a 200 Mbps Multicast Domain.

The remaining components required to deliver a Multicast service to End-Users are the ‘User Network Interface – Data’ (UNI-D) port and the ‘Network-to-Network Interface’ (NNI) port. As mentioned earlier, both of these components are unchanged – in terms of function, operation and orderable attributes – from what is described in the ‘NBN Co Fibre Access Service: Product and Pricing Overview’ document. The Access Seeker must deliver the Multicast and standard Ethernet bitstream service over the same ‘User Network Interface – Data’ (UNI-D) port.

4. Technical Overview

The NBN Co fibre access network provides a Multicast feature for the support of an Access Seeker’s higher-layer, IP-based Multicast architectures - as used for Internet Protocol Television (IPTV) applications.

This feature enables Access Seekers to deliver a wide variety of media content more efficiently to a large number of End-Users. It has the following characteristics:

- The Access Seeker is able to inject their entire Media Stream line-up once per Point-of-Interconnect.
- The NFAS network dynamically distributes the content streams to End-Users.
- Each End-User subscribed to the Access Seeker’s Multicast service is able to simultaneously view the desired content, whilst also enjoying uninterrupted, parallel services (such as voice and broadband).
- The Multicast service can be dimensioned to handle a variety of high-definition and standard-definition media streams.

The NBN Co fibre access network implements Multicast capabilities as shown in Figure 3.

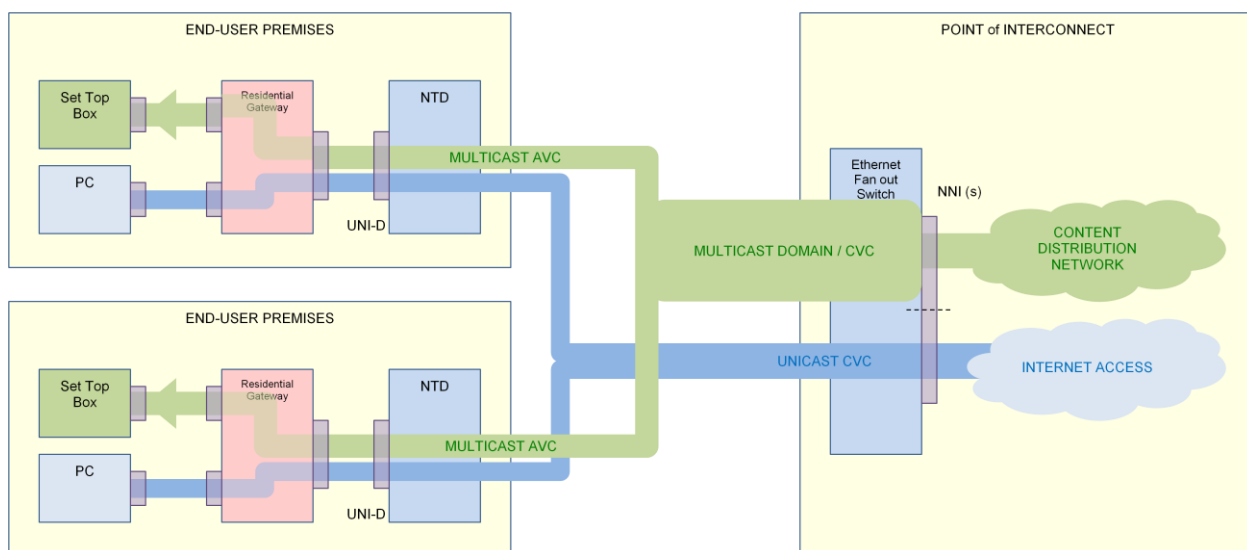


Figure 3: NFAS Multicast Feature - High Level Overview

Multicast Architecture

The NBN Co Multicast capability is based on IEEE802.3 Ethernet Multicast addressing and operation, using an IGMPv3 proxy for interaction with the Access Seeker's IP-layer Multicast services.

The network will "proxy" an End-User's upstream IP-layer IGMP messages. These IGMP messages are interpreted as Media Stream-change events in an End-User's Internet Protocol Television (IPTV) service, and are used by the network to determine which of the Access Seeker's individual media streams to transmit to the End-User, in the downstream Multicast Access Virtual Circuit.

Currently, only IPv4 Multicast services are supported by the NFAS Multicast capability. Future enhancements to NFAS will extend support to IPv6.

Multicast Service Requirements

Each Access Seeker is required to undergo thorough interoperability testing with NBN Co prior to activation of any Multicast services within the NFAS network. This will involve the definition of a Configuration Template for use within the access network (AVC and UNI), which accommodates the Multicast capability - as well as any other UNI/AVC components being delivered as part of the same service.

In addition, the Access Seeker must provision a Multicast Domain, which must be specified for each Multicast AVC order.

Multicast Operation

The Multicast capability is implemented using a dedicated Multicast Access Virtual Circuit, operating in the downstream direction only. This Multicast Access Virtual Circuit requires the presence of a bi-directional,

standard Ethernet Bitstream Access Virtual Circuit for the communication of Media Stream-change and control information from the End-User back into the Access Seeker's network.

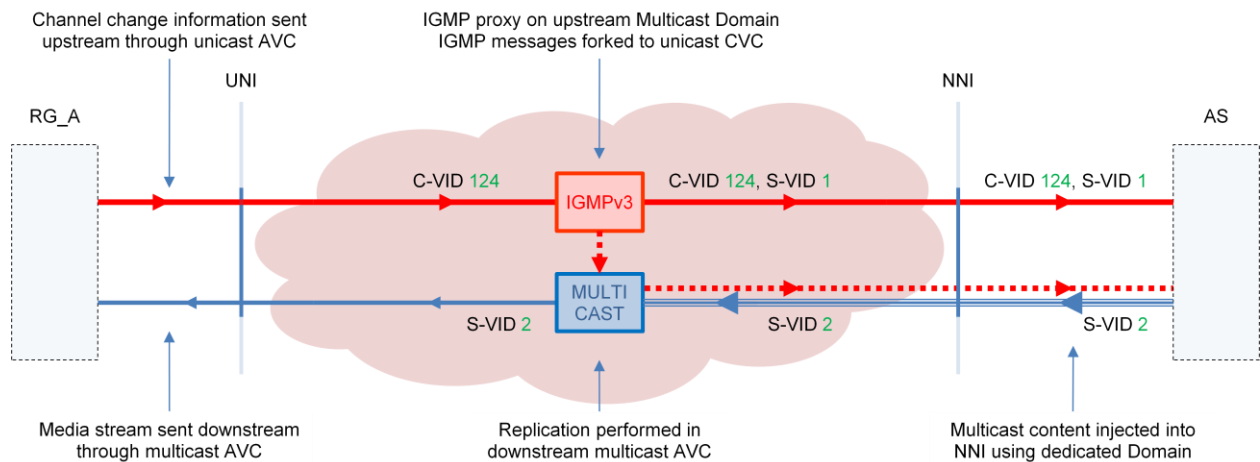


Figure 4: Multicast Operation

Figure 4 depicts the operation of a single Multicast service. The upper (red) data flow represents an existing, standard Ethernet Bitstream Access Virtual Circuit that supports bi-directional data services. This Access Virtual Circuit carries the Media Stream change information from the End-User, back into the network. The NFAS network examines this information to detect any changes to the Multicast data flow, requested by the End-User, and proxies this information to the Access Seeker.

The lower (blue) data flow represents the downstream Multicast traffic flow. This data is injected at the Network-to-Network Interface port on a Multicast Domain. It is then replicated to End-Users, in accordance with the IGMP information as intercepted in the upstream Access Virtual Circuit.

UNI-D Interfacing

The Multicast Access Virtual Circuit is currently supported on 'User Network Interface – Data' ports (UNI-D) that are operating in DSCP-mapped or Default-Mapped mode only.

Whilst the Multicast Access Virtual Circuit is carried within the fibre network separately from the standard Ethernet Bitstream Access Virtual Circuit, it is presented at the UNI-D as a single, merged data flow. It should be noted that the standard Ethernet Bitstream service may also be used for other purposes (eg. general internet usage, etc.).

In the downstream direction, Multicast and unicast service frames are expected to be identified by the Access Seeker's residential gateway or set-top box at the IP level.

Likewise, in the upstream direction, the NFAS network will identify service frames that are associated with the Multicast service, within the unicast Access Virtual Circuit, based on IP-level packet information (IGMP).

The Access Seeker may utilise DSCP-mapping at the UNI-D in order to allow the efficient scheduling of Multicast service frames at egress to the UNI-D.

The Multicast feature inserts a public IPv4 address as the source IP address in periodic IGMP Query messages.

Connectivity VC Interfacing

NFAS Multicast services are required to be serviced with a dedicated Connectivity Virtual Circuit, known as the Multicast Domain.

At the Network-to-Network Interface (NNI), Multicast services are addressed using NNI Addressing Mode D (Refer to the 'NFAS Product Technical Specification' document).

The Access Seeker is able to nominate a source IP address to be inserted by the NFAS service in IGMP Report messages.

Multicast IGMP Reporting

Upstream IGMP information may be passed through the NFAS network, and passed to the Access Seeker through the Network-to-Network Interface, through both the unicast and the Multicast Domain.

The access seeker will receive IGMP messages over both the unicast CVC and Multicast Domain. The unicast CVC will deliver all IGMP messages for successful Join/Leave operations and Membership Reports. The Multicast Domain will deliver a subset of IGMP messages for successful operations including the first Join and last Leave per media stream at each Multicast replication point in the network, and Membership Reports. No IGMP messages will be received on either unicast CVC or Multicast Domain for unsuccessful operations.

Network Performance

Video traffic carried as part of the Multicast feature at a high definition or standard definition quality is expected to be of sufficient quality to deliver an End-User experience commensurate with the current free-to-air and pay-TV experience provided that the Access Seeker dimensions its services in accordance with the recommendations in this document. The solution design is configured to downstream Multicast data using a 'TC_MC ('Traffic Class – Multicast') with performance Frame Delay Variation and Frame Loss parameters aligned with the TC_2 traffic class.

Capacity Allocation

The amount of capacity purchased in the Multicast Access Virtual Circuit must take into account the number of simultaneous Media Streams to be viewed, and the amount of capacity required for each stream. Any requests to simultaneously view Media Streams above the subscribed maximum will be rejected.

5. Pricing Overview

Pricing of the NBN Co Multicast feature is based on separate monthly charges for the following components:

1. Multicast Access Virtual Circuit
2. Multicast Domain
3. Media Stream

Multicast Access Virtual Circuit

The Multicast Access Virtual Circuit is priced at \$5.00 per month for the first 20Mbps allocation and can be ordered in additional increments of 10 Mbps up to a maximum of 60 Mbps.

Multicast Access Virtual Circuit	
Initial Recurring Charge per 20Mbps initial allocation	Monthly recurring charge per 10Mbps increment
\$5.00	\$5.00

Table 2: Multicast Access Virtual Circuit Pricing Component

A Multicast Access Virtual Circuit must be purchased for each UNI-D receiving Multicast from the Access Seeker. The Multicast Access Virtual Circuit should be dimensioned at the desired combined simultaneous viewing and/or recording capacity of the premises (see 'Multicast Dimensioning Example' section of this document for more detail).

Multicast Domain Pricing

The Multicast Domain is priced at \$2.50 per Mbps per month. The Multicast Domain can be dimensioned at an initial size of 100 Mbps, and in additional increments of 100 Mbps up to a maximum of 1000 Mbps.

Multicast Domain
Monthly Recurring Charge per 100Mbps Increment
\$250.00

Table 3: Multicast Domain NBN Pricing Component

An appropriately sized Multicast Domain must be purchased for each of the Points-of-Interconnect where the Access Seeker is offering Multicast content to End-Users. The Multicast Domain will be dimensioned by NBN Co to be at least equivalent to the total size of the Media Streams injected by an Access Seeker in a Point-of-Interconnect serving area (see 'Multicast Dimensioning Example' section of this document for more detail).

To ensure fair use of the Media Stream capacity for the Multicast feature a minimum bandwidth of 3 Mbps per Media Stream will be applied. Each Access Seeker's Multicast Domain will then be dimensioned by NBN Co at the sum capacity of all Media Streams being injected at each Point-of-Interconnect.

Example: NBN Co stipulates a minimum Media Stream size of 3 Mbps. An Access Seeker has 60 Media Streams, each dimensioned at 3 Mbps – totalling 180 Mbps – at each of the 121 Points-of-Interconnect. The Access Seeker Multicast Domain would therefore be dimensioned at 200 Mbps at each of the 121 Points-of-Interconnect and priced according to the Multicast pricing construct detailed earlier.

Multicast Media Stream Pricing

An Access Seeker may inject up to 200 Media Streams per Point Of Interconnect without any additional charges. Any Media Streams injected above 200 will incur a monthly recurring Media Stream fee of \$50 per additional Media Stream.

Multicast Media Stream
Monthly Recurring Charge per each Media Stream Above 200 at each POI
\$50.00

Table 4: Multicast Media Stream Pricing Component

Example: An Access Seeker has 260 Media Streams injected at a single Point of Interconnect. The first 200 Media Streams will incur no charge, Media Streams numbered 201 – 260 will be charged at \$50 each per month, per Point of Interconnect.

6. Release Schedule and Next Steps

The Multicast feature is scheduled to be delivered as part of NBN Co’s ‘Product Release 2’, which is expected to have a network release for testing in late 2011 and a General Release in mid 2012.

NBN Co is committed to ongoing industry and customer consultation. After the release of this paper, NBN Co is keen to consult with Access Seekers to get their feedback on the feature, technical and pricing constructs outlined in this document. Please contact your relevant NBN Co Account Director, Solution Architect or Industry Consultation Manager if you wish to arrange a time to give your feedback, alternatively please send your feedback to **feedback@nbnco.com.au**.

Technical details on the implementation of Multicast within the NBN Co fibre network will be released in an updated version of the existing ‘Product Technical Specification - Fibre Access Service’ shortly.



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