National
Broadband
Network

# NBN Co
# Fibre Access
# Service **Multicast**

**Feature, technical & pricing overview
for Multicast over fibre**

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# Table of contents

**This document should be read in conjunction with:**

[1]  Wholesale NBN Co Fibre Access Service – Product Overview Fibre Access Services, August 2010.

[2]  NBN Co Fibre Access Service Technical Discussion Paper (Multicast), November 2011

# Overview

This document provides an overview of the NBN Co Multicast feature, which can be used by Service Providers to deliver video content over the NBN Co Fibre 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 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 Service Provider Product, Marketing and Strategy/ Planning groups - to help them develop retail offers on the NBN Co Fibre Network.

Technical details on the implementation of Multicast within the NBN Co Fibre Network were released in November 2011 in a technical discussion paper which can be accessed via this link:

*http://www.nbnco.com.au/our-network/industry-consultation/nfas-technical-discussion-paper-multicast.html*

Capitalised terms and abbreviations used in this document have the meaning given to those terms and abbreviations as set out in this document or in the Dictionary of the Wholesale Broadband Agreement or the Wholesale Broadband Agreement Product Catalogue. Any capitalised terms or abbreviations used throughout this document that are not otherwise defined have the ordinary meaning commonly accepted in the industry.

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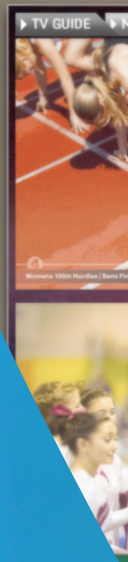
# What is **Multicast**?

**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 Co Fibre Network is expected to provide the vast majority of Australian households and businesses with the capability to purchase the ability to simultaneously deliver significant amounts of innovative, interactive, high definition content. The NBN Co Multicast feature is designed to enable Service Providers to deliver this content more cost effectively compared to a Unicast delivery methodology and with dedicated quality of service.

**Multicast** is the future of television

Image above: an artists impression of the future of television.

# Multicast feature overview

Multicasting is a feature which enables content to be transmitted simultaneously to multiple End Users, 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 over the NBN Co Fibre Network, allowing more efficient use of Service Provider backhaul. This enables more cost effective delivery of services such as Internet Protocol Television (IPTV) and other video content over the NBN Co Fibre Network.

To illustrate this, Figure 1 shows 180 End Users, each receiving a 20 Megabits per second media stream over the NBN Co Fibre Network. Multicast enables the Service Provider to inject the media streams only once at the Point of Interconnection. Without Multicast, the Service Provider would need to inject each individual End User's media stream 180 times at the Point of Interconnection, consuming 3600 Megabits per Second of bandwidth, compared to the 100 Megabits per Second required when using the Multicast feature.
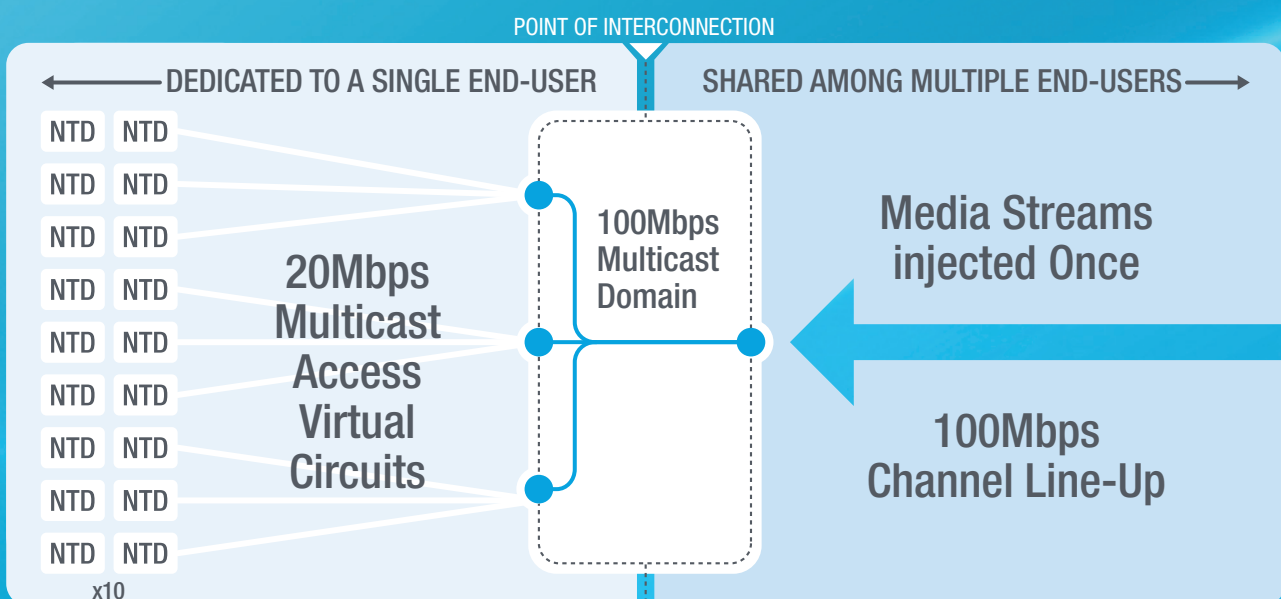
POINT OF INTERCONNECTION

DEDICATED TO A SINGLE END-USER ◄————  ————► SHARED AMONG MULTIPLE END-USERS

NTD NTD
NTD NTD
NTD NTD
NTD NTD
NTD NTD
NTD NTD
NTD NTD
NTD NTD
NTD NTD
x10

20Mbps Multicast Access Virtual Circuits

100Mbps Multicast Domain

Media Streams injected Once

100Mbps Channel Line-Up

**Figure 1: Multicast Replication**

# Overview of the feature construct

**At the outset, it is important to note two significant requirements of the Multicast feature offered by NBN Co:**

1. To function, the Multicast feature requires the purchase of two new product components by Service Providers, in addition to an underlying NBN Co Fibre Access Service; and

2. The NBN Co Fibre Access Service will need to be provided by the same Service Provider that is providing the Multicast Feature to the End User premises.

With respect to the first requirement, Service Providers 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'). These will need to be purchased in addition to the Access Virtual Circuit and the Connectivity

Virtual Circuit which form part of the NBN Co Fibre Access Service which the Service Provider must also purchase or have purchased. This requirement is necessary because the Multicast feature requires a small upstream path to send channel-change requests. This upstream path is carried as part of the NBN Co Fibre Access Service. The NBN Co Fibre Access Service can either already be operative at the end user premises or purchased by a Service Provider at the same time as the Multicast feature is purchased.

With respect to the second requirement, a Service Provider that wishes to provide the Multicast feature to an End User must supply a corresponding NBN Co Fibre Access Service. It will not be possible for an End User to acquire a Multicast product from one Service Provider that is supported by a Fibre Access Service provided by another Service Provider. While this limitation exists primarily due to technical constraints, it

also enables Service Providers to retain full control over the operation and reliability of their Multicast product, as well as facilitating a simplified fault management process.

Therefore, in scenarios where an End User wishes to acquire multicast offerings from two or more Service Providers, a separate NBN Co Fibre Access Service will need to be acquired by each Service Provider to support the associated Multicast feature.
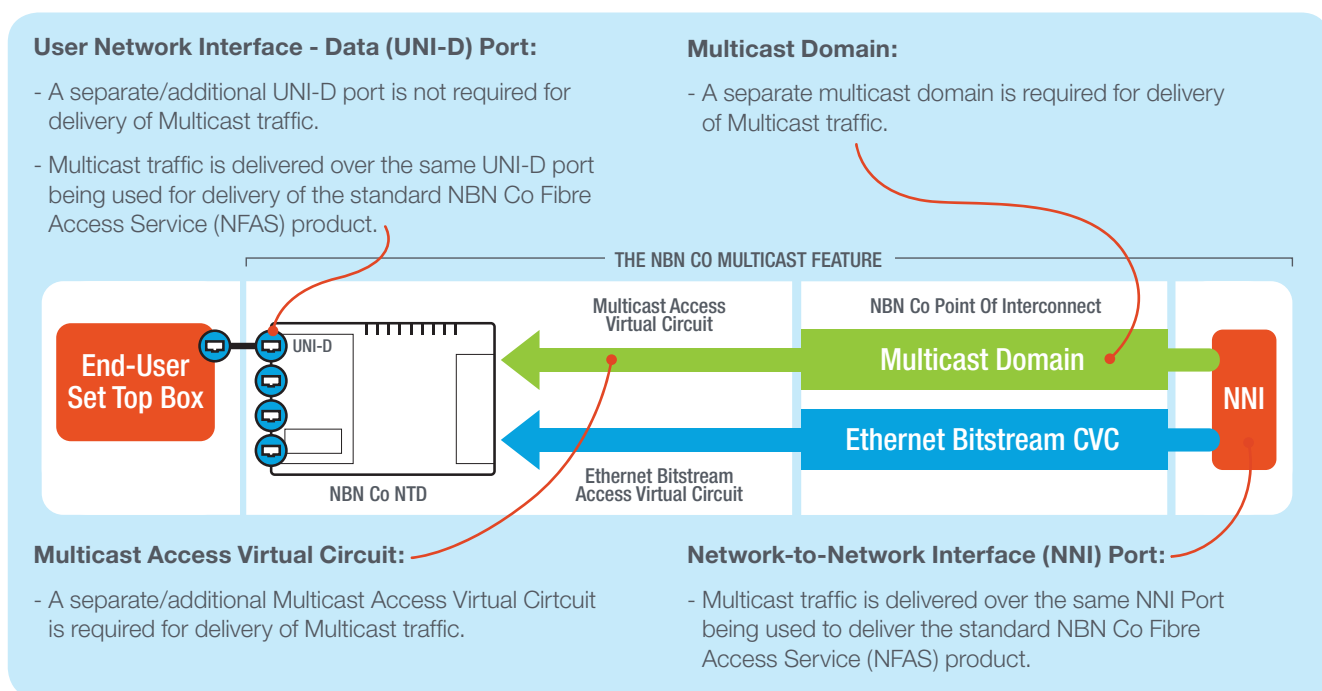
The 'User Network Interface – Data' (UNI-D) port and the 'Network-to-Network Interface' (NNI) port being used to deliver a NBN Co Fibre Access Service are also used to supply the Multicast feature. Service Providers are not required to purchase an additional User Network Interface – Data (UNI-D) port or 'Network-to-Network Interface' (NNI) port in order to supply the Multicast feature to an End User.

**In summary, to offer Multicast to an End User, a Service Provider must have purchased the following six components:**

| Product Component | NBN Co Fibre Access Service | Multicast |
| --- | --- | --- |
| User Network Interface – Data | SHARED COMPONENT: A port on the End-User Network Termination Device | |
| Access Virtual Circuit *(Both these components must be purchased)* | NBN Co Fibre Access Service Access Virtual Circuit | Multicast Access Virtual Circuit |
| Connectivity Virtual Circuit *(Both these components must be purchased)* | NBN Co Fibre Access Service Connectivity Virtual Circuit | Multicast Domain |
| Network-to-Network Interface | SHARED COMPONENT: The physical interface (and associated ports) between the NBN Co Network and the Customer Network at the Point of Interconnection | |

**Table 1: Multicast feature components**

The following diagram shows which of the 4 product components are shared between the Multicast feature and the NBN Co Fibre Access 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 NBN Co Fibre Access Service (NFAS) product.

**Multicast Domain:**

- A separate multicast domain is required for delivery of Multicast traffic.

THE NBN CO MULTICAST FEATURE

Multicast Access Virtual Circuit

NBN Co Point Of Interconnect

Multicast Domain

End-User Set Top Box

UNI-D

NNI

Ethernet Bitstream CVC

Ethernet Bitstream Access Virtual Circuit

NBN Co NTD

**Multicast Access Virtual Circuit:**

- A separate/additional Multicast Access Virtual Cirtcuit is required for delivery of Multicast traffic.

**Network-to-Network Interface (NNI) Port:**

- Multicast traffic is delivered over the same NNI Port being used to deliver the standard NBN Co Fibre Access Service (NFAS) product.

**Figure 2: Relationship between Multicast & NBN Co Fibre Access Service 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/Electronic Programme Guide) or any other type of data stream. A Service Provider with 150 'channels' could define 150 Media Streams, or package together multiple lower bandwidth channels into a single Media Stream.

Whilst the total number of Media Streams supported on the NBN Co Multicast platform is large, it is not infinite. Therefore, while Service Providers will be able to offer various types of media using the Multicast feature, the pricing construct has been developed with the aim of encouraging Service Providers to utilise the platform for higher bandwidth media, for example standard definition, high definition and 3D high definition video content.

# Multicast feature availability

**Upon its launch, the Multicast feature will be progressively rolled out across the existing NBN Co fibre footprint.**

It will become available for purchase in each area once NBN Co completes appropriate upgrades in the area to support the operation of the Multicast feature. In addition, the Multicast feature will only be deployed in a Connectivity Serving Area once it is serviced by one of NBN Co's permanent Points of Interconnection. Further details on the timing and coverage of the Multicast feature availability are scheduled to be published by NBN Co in Quarter 3 of 2012.

# Multicast Access Virtual Circuit

Service Providers will need to order a Multicast Access Virtual Circuit for each End User to be used with the User Network Interface-Data (UNI-D) receiving Multicast content. This is in addition to the NBN Co Fibre Access Service Access Virtual Circuit being used by the same Service Provider 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 the 'Multicast Dimensioning Example' section of this document for more detail).

The entry Multicast Access Virtual Circuit size is 5 Megabits per second. It can be purchased in additional increments up to a maximum of 50 Megabits per Second, as set out in Table 2 below.

| Multicast Access Virtual Circuit Megabits per Second (Mbps) |
|:---:|
| 5 |
| 20 |
| 30 |
| 40 |
| 50 |

**Table 2: Multicast Access Virtual Circuit Sizes**

# **Multicast** Domain

The Multicast Domain enables Service Providers to efficiently distribute content from a Point of Interconnection, 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 Interconnection.

Multicast Domain charges are based on the total Multicast Domain bandwidth required per Point of Interconnection, which directly relates to the Media Stream line-up being offered by the Service Provider. The Multicast Domain is required to be dimensioned by the Service Provider to encompass at least the combined total size of all Media Streams injected by a Service Provider associated with the Multicast Domain for that particular Point of Interconnection.

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

**The entry Multicast Domain size is 100 Megabits per Second, and it can be purchased in additional increments of 100 Megabits per Second, up to a maximum of 1000 Megabits per Second.**

Individual Media Streams are each configured by the Service Provider with a specified bandwidth. The minimum allowed Media Stream size is 2.5 Megabits per Second and the maximum allowed Media Stream size is 20 Megabits per Second. Media Stream bandwidths may be specified in increments of 0.1 Megabits per Second, and each Media Stream can be assigned its own bandwidth (ie. the Service Provider is able to define the bandwidth for each separate Media Stream). Any Electronic Programme Guide (EPG) or picture-in-picture streams offered by Service Providers will be treated as another Media Stream if not included in the 'content' Media Streams.

# Media Stream policing

Configuring individual Media Stream peak bandwidth is important. NBN Co will be monitoring Media Stream bandwidth at each Point of Interconnection.  If an individual Media Stream is seen to go above its configured peak bandwidth, a 30 second 'go to black' will be enforced for all content within that specific Media Stream to protect other Media Streams from being affected. The affected Media Stream will continue to be tested and will not be reinstated until it has been tested to be below peak configured bandwidth for a full 30 seconds. This 'go to black' period will not adversely impact on any other Media Streams being delivered from the same Point of Interconnection.

# **Multicast** dimensioning example

Service Providers may order the Multicast feature based on the type and quantity of Media Streams to be delivered simultaneously to an End User, for example:

- If a Service Provider has a standard definition Media Stream which averages 2.5 Megabits per Second, with peaks to 4.95 Megabits per Second, a 5.0 Megabits per Second Media Stream should be dimensioned by the Service Provider.

- If a Service Provider has a high definition Media Stream which averages 6 Megabits per Second, with peaks to 9.91 Megabits per Second, a 10.0 Megabits per Second Media Stream should be dimensioned by the Service Provider.

Therefore, Service Providers will have the ability to dimension their Multicast Access Virtual Circuits as follows:

- A package consisting of a single set-top box with dual high definition streams may require a 20 Megabits per Second 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 Megabits per Second 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 should be dimensioned based on the total size of the Media Streams being simultaneously injected at each Point of Interconnection, for example:

- A Service Provider has a Media Stream line-up consisting of 20 standard definition Media Streams (at 5 Megabits per Second each) and 8 high definition Media Streams (at 10 Megabits per Second each) – totalling 180 Megabits per Second, the Service Provider would therefore require a Multicast Domain dimensioned at 200 Megabits per Second or above.

The remaining components required to deliver the Multicast feature 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 the same – in terms of function, operation and orderable attributes – as for the NBN Co Fibre Access Service. The Service Provider must deliver the Multicast feature and NBN Co Fibre Access Service to an End User over the same 'User Network Interface – Data' (UNI-D) port.

# Technical overview

**The NBN Co Fibre Network provides a Multicast feature for the support of a Service Provider's higher layer, Internet Protocol (IP)-based Multicast architectures.**
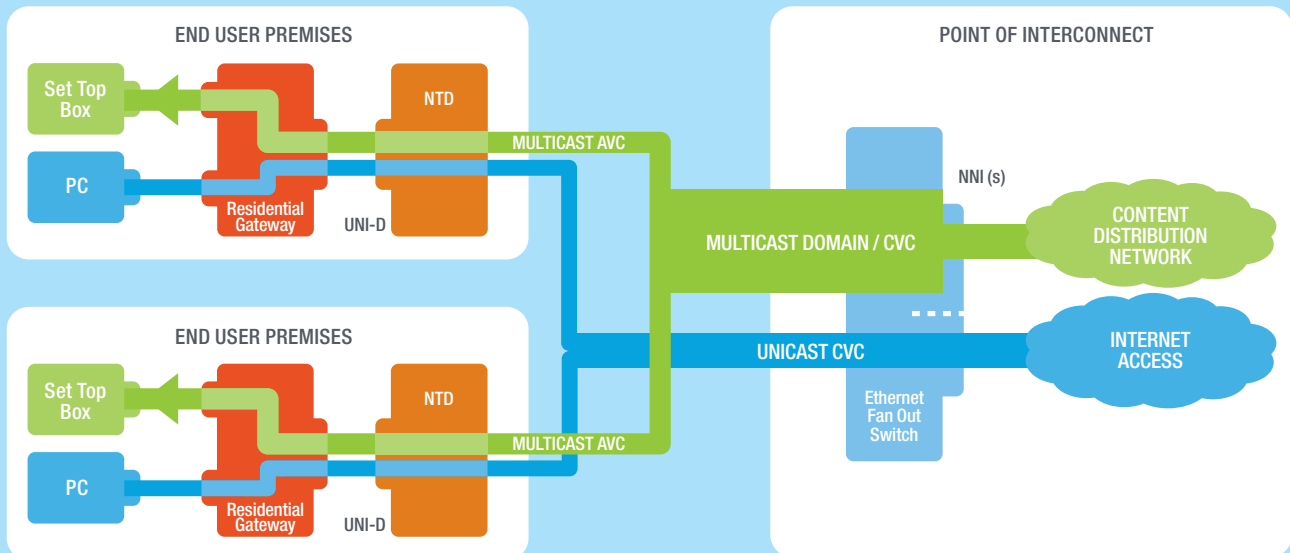


**Figure 3: NFAS Multicast Feature - High Level Overview**

## Multicast architecture

The NBN Co Multicast capability is based on Institute of Electrical & Electronics Engineers (IEEE) 802.3 Ethernet Multicast addressing and operation, using an Internet Group Management Protocol (IGMP) v3 proxy for interaction with the Service Provider's Internet Protocol (IP) -layer Multicast services.

The network will "proxy" an End User's upstream Internet Protocol (IP) -layer Internet Group Management Protocol (IGMP) messages. These 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 Service Provider's individual Media Streams to transmit to the End User, in the downstream Multicast Access Virtual Circuit.

**Currently, only Internet Protocol v4 (IPv4) Multicast services are supported by the Multicast feature. Future enhancements to NBN Co Fibre Access Service will extend support to Internet Protocol v6 (IPv6)**

# Multicast feature requirements

Each Service Provider is required to undergo interoperability testing with NBN Co prior to ordering of the Multicast feature within the NBN Co Fibre Network. This will involve the definition of a configuration template for use within the access network (NBN Co Fibre Access Service Access Virtual Circuit and User Network Interface), which accommodates the Multicast capability - as well as any other User Network Interface / NBN Co Fibre Access Service Access Virtual Circuit components being delivered as part of the same service.

**It is a pre-requisite of ordering Multicast that a Service Provider must also have been successfully on-boarded for the NBN Co Fibre Access Service and the Multicast feature.**

In addition, the Service Provider must provision a Multicast Domain before it may order a Multicast Access Virtual Circuit. The relevant Multicast Domain must be specified for each Multicast Access Virtual Circuit 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, NBN Co Fibre Access Service Access Virtual Circuit for the communication of Media Stream change and control information from the End User back into the Service Provider's network.
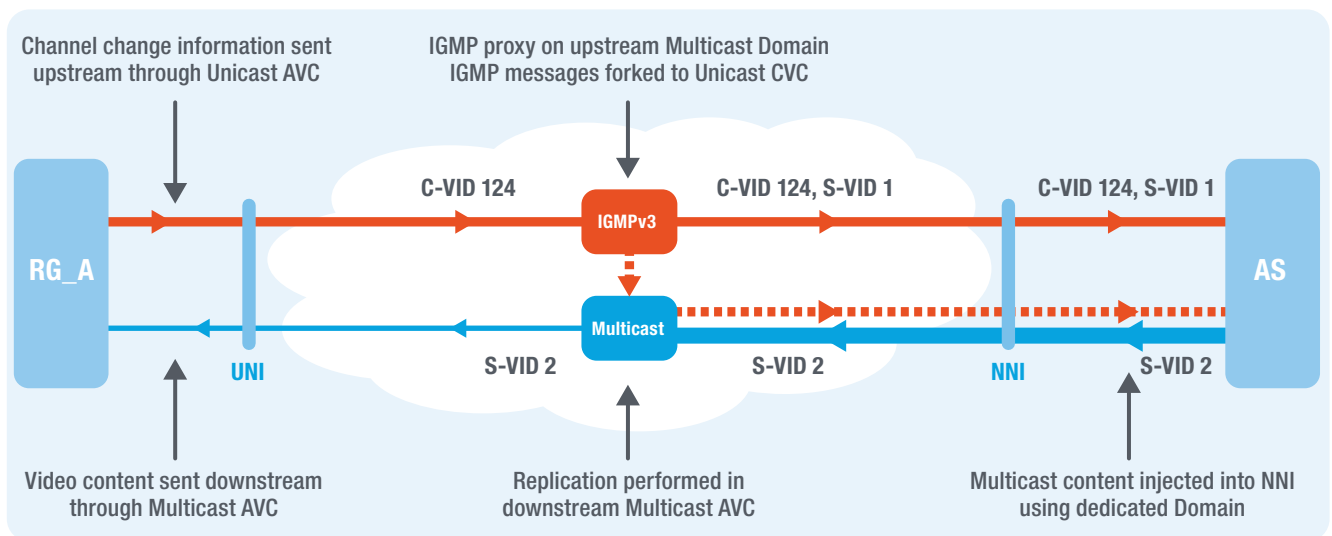


**Figure 4: Multicast Operation**

# UNI-D interfacing

*Figure 4* depicts the operation of a single instance of the Multicast feature. The upper (red) data flow represents an existing, NBN Co Fibre Access Service Access Virtual Circuit that supports bi-directional data services. This NBN Co Fibre Access Service Access Virtual Circuit carries the Media Stream change information from the End User, back into the network. The NBN Co Fibre Network examines this information to detect any changes to the Multicast data flow, requested by the End User, and proxies this information to the Service Provider.

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 Multicast Access Virtual Circuit.

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

Whilst the Multicast Access Virtual Circuit is carried within the NBN Co Fibre Network separately from the NBN Co Fibre Access Service Access Virtual Circuit, it is presented at the User Network Interface-Data (UNI-D) as a single, merged data flow. It should be noted that the NBN Co Fibre Access Service may also be used for other purposes (e.g. general internet usage, etc.).

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

Likewise, in the upstream direction, the NBN Co Fibre Network will identify service frames that are associated with the Multicast feature, within the (unicast) NBN Co Fibre Access Service Access Virtual Circuit, based on Internet Group Management Protocol (IGMP) packet information.

The Multicast feature uses a network-wide public Internet Protocol v4 (IPv4) address as the source Internet Protocol address in periodic Internet Group Management Protocol (IGMP) Query messages.

# Connectivity Virtual Circuit interfacing

The NBN Co Fibre Access Service Multicast feature is required to be serviced with a dedicated Connectivity Virtual Circuit, known as the Multicast Domain.

At the Network-to-Network Interface (NNI), the Multicast feature is addressed using NNI Addressing Mode D (refer to the 'NBN Co Fibre Access Service Product Technical Specification' document).

The Service Provider is able to nominate a source IP address to be inserted by the NBN Co Fibre Network in Internet Group Management Protocol (IGMP) report messages.

# Multicast Internet Group Management Protocol (IGMP) reporting

Upstream Internet Group Management Protocol (IGMP) information may be passed through the NBN Co Fibre Network, and passed to the Service Provider through the Network-to-Network Interface, through both the (unicast) NBN Co Fibre Access Service Connectivity Virtual Circuit and the Multicast Domain.

The  NBN Co Fibre Access Service Connectivity Virtual Circuit will deliver all Internet Group Management Protocol (IGMP) messages for successful 'join'/'leave' operations and membership reports as received by the Multicast network through the User Network Interface-Data (UNI-D) port.

The Multicast Domain will deliver only the first 'join' and last 'leave' per Media Stream for the Network to Network Interface port, and Membership Report responses to Membership Queries presented to the Multicast Domain through the Network to Network Interface port.

No Internet Group Management Protocol (IGMP) messages will be received on either the NBN Co Fibre Access Service Connectivity Virtual Circuit or the 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 Service Provider 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 scheduled to be announced by NBN Co in Q3 of 2012.

# 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.

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# 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 pricing

The Multicast Access Virtual Circuit is priced from an entry level of $2.00 per month for 5 Megabits per Second and can be ordered in additional increments up to a maximum of 50 Megabits per Second, as set out in *Table 3* on the right.

A Multicast Access Virtual Circuit must be purchased for each User Network Interface-Data (UNI-D) receiving Multicast from the Service Provider. 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 Access Virtual Circuit | |
| --- | --- |
| Monthly Recurring Charge per Multicast Access Virtual Circuit | Mbps (Megabits per second) |
| $2 | 5 |
| $5 | 20 |
| $10 | 30 |
| $15 | 40 |
| $20 | 50 |

**Table 3: Multicast Access Virtual Circuit Pricing Component**

## **Multicast** Domain pricing

The Multicast Domain can be dimensioned at an entry size of 100 Megabits per Second and in additional increments of 100 Megabits per Second up to a maximum of 1000 Megabits per Second, at $250 per 100 Megabits per Second per month as set out in *Table 4* below.

| Multicast Domain |
| --- |
| Monthly Recurring Charge per 100 Megabits per Second Increment |
| $250 |

**Table 4: Multicast Domain NBN Pricing Component**

An appropriately sized Multicast Domain must be purchased for each of the Points of Interconnection where the Service Provider 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 a Service Provider in a Point of Interconnection serving area (see the '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 2.5 Megabits per Second per Media Stream will be applied. Each Service Provider's Multicast Domain will then be dimensioned by NBN Co at the total capacity of all Media Streams being injected at each Point of Interconnection.

Example: NBN Co stipulates a minimum Media Stream size of 2.5 Megabits per Second. A Service Provider has 75 Media Streams, each dimensioned at 2.5 Megabits per Second – totalling 187.50 Megabits per Second – at each of the 121 Points of Interconnection. The Service Provider Multicast Domain would therefore be dimensioned at 200 Megabits per Second at each of the 121 Points of Interconnection and priced according to the Multicast pricing construct detailed in *Table 4* above left.

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# **Multicast** Media Stream pricing

A Service Provider may inject up to 200 Media Streams per Point of Interconnection without any additional charges for the Multicast feature. Any Media Streams injected above 200 will incur a monthly recurring Media Stream fee of $50 per additional Media Stream per Point of Interconnection.

| Multicast Media Stream |
|---|
| Monthly Recurring Charge per each Media Stream above 200 at each Point of Interconnection |
| $50 |

Table 5: Multicast Media Stream Pricing Component

**Example:** A Service Provider has 260 Media Streams injected at a single Point of Interconnection. The first 200 Media Streams will incur no additional charge. Media Streams numbered 201 – 260 will be charged at $50 each per month, per Point of Interconnection (ie. a total charge of $3000 per month for the 60 Media Streams above 200).

# What is the National Broadband Network?

The National Broadband Network (NBN) is designed to provide high speed broadband access to 100 per cent of Australian premises. The NBN is a nation-building program with the potential to lift Australia's productivity and will provide a broadband network to serve Australia for decades to come.

To reach everyone in our vast country, the NBN will be delivered via an optimal mix of fibre optic cabling, fixed wireless and satellite technologies. These fixed wireless and satellite technologies represent a significant improvement over services currently available to many Australians living in regional and remote communities.

# For more information

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