WHOLESALE REFERENCE OFFER*

ETHERNET PRODUCT SPECIFICATION

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1. Introduction

This is the Product Specification for Fibrus Ethernet Wholesale products as defined in the table below. The document defines a set of processes that encompasses Network Deployment, Order Handling, Wholesale Billing and Service Management. Fibrus provides an active Ethernet pure fibre broadband access service to homes and businesses in Northern Ireland providing ultrafast connectivity with downstream speeds from 100Mb/s up to 1000Mb/s.

This handbook is designed for use by Retail Service Providers (RSPs) who are Wholesale customers of Fibrus. For information on how to become a Wholesale customer with Fibrus please see our guide *How to Become a Wholesale Customer* available at [e.g. FibrusWholesale.com].

This document should be read in conjunction with the Fibrus' current Wholesale Price List which also defines Service Level Agreements, and is available on the Fibrus website at: [e.g. FibrusWholesale.com].

Fibrus' approach is to enable our wholesale customers to self-serve your customer requirements via direct digital access to the systems capability required for high volume transactions alongside dedicated relationship management to ensure your needs are met and to deal with specific requirements. The Operator Wholesale Gateway (OWG) is the ordering and fault management system for Fibrus Wholesale products and services.

2. Wholesale Ethernet Product

Overview

Fibrus Wholesale is a homegrown Northern Irish company providing full fibre connectivity to premises across NI. Our aim is to provide high quality services to Retail Service Providers (RSPs) who wish to avail of the benefits of our network.

Code	Wholesale Residential Broadband	Description
RFFL	Residential Full Fibre Lite	50 Mb/s downstream; 20 Mb/s upstream Residential broadband
RFFE	Residential Full Fibre Entry	100 Mb/s downstream; 30 Mb/s upstream Residential broadband
RFFM	Residential Full Fibre Median	300 Mb/s downstream; 100 Mb/s upstream Residential broadband
RFFB	Residential Full Fibre Best	1000 Mb/s downstream; 300 Mb/s upstream Residential broadband
Code	Wholesale Business Broadband	Description
BFFE	Business Full Fibre Entry	100 Mb/s downstream; 100 Mb/s upstream Business Broadband
BFFE+	Business Full Fibre Entry Plus	200 Mb/s downstream; 200 Mb/s upstream Business Broadband
BFFP	Business Full Fibre Plus	300 Mb/s downstream; 300 Mb/s upstream Business Broadband
BFFS	Business Full Fibre Super	350 Mb/s downstream; 350 Mb/s upstream Business Broadband
BFFS+	Business Full Fibre Super Plus	600 Mb/s downstream; 600 Mb/s upstream Business Broadband
BFFB	Business Full Fibre Best	1000 Mb/s downstream; 1000 Mb/s upstream Business Broadband

Our Ethernet Product has been developed by Fibrus to provide RSPs with ultrafast services for 'last mile' reach into areas of Northern Ireland where Fibrus has built networks. The customer last mile services are delivered using GPON technology via full fibre active Ethernet service. Connectivity from end customers is delivered back to Network to Network Interfaces (NNIs) at handover points in one of our two Data Centre locations [Telehouse North and BT Exchange, Belfast]. The Wholesale service provides a tunnelled Layer 2 service between the Fibrus network and the RSP network.

Our Ethernet Product provides the ability for RSPs to connect end customers via Layer2 Ethernet allowing appropriate control of network protocols. The Ethernet Product provides end to end connectivity between your end customers and our handover points in defined Telehouse locations. The wholesale customer provides the Layer 3 service to the customer (IP address, routing, transit etc.), including appropriate Customer Premises Equipment (CPE).

Ethernet Product Features

Fibrus Wholesale Ethernet utilises GPON Access Network technology to provide full fibre connectivity to each premise via designated cabinet locations across NI with a resilient backhaul solution as shown in Figure 1 below.
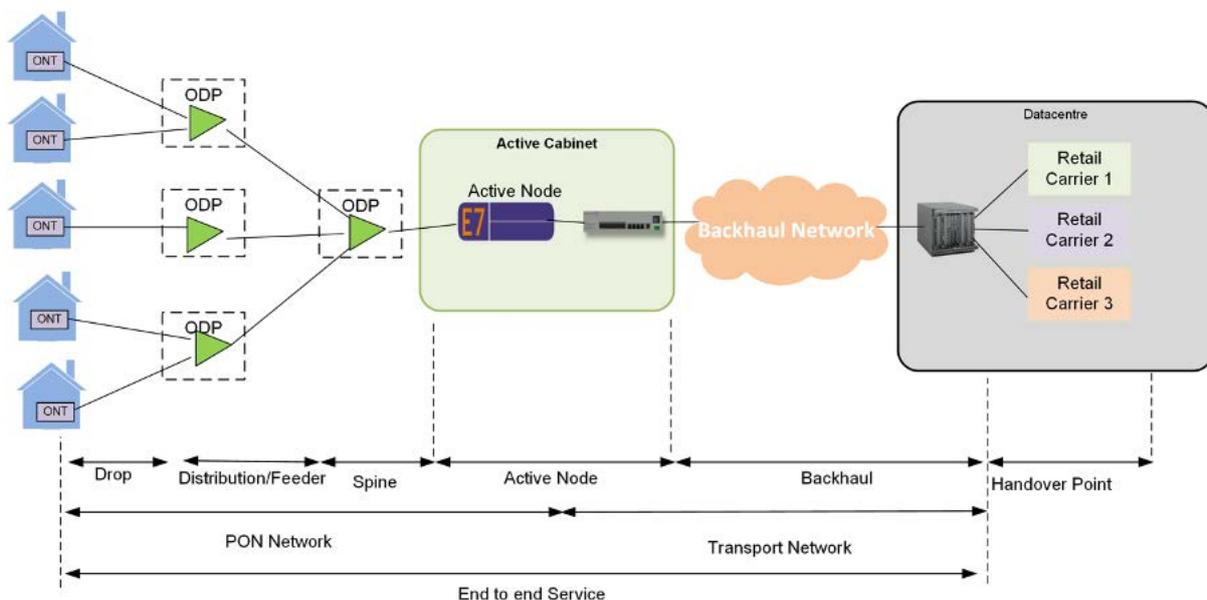
Figure 1 – Bitstream Overview

Each Ethernet virtual circuit (E Line) provides a seamless end to end broadband access service between the service termination point in the end customer premises and the Fibrus Network to Network Interface (FNNI) at the defined handover point. The service termination in the customer premises is the Optical Network Terminal (ONT) which acts as the demarcation point between Fibrus and the RSP responsibilities.

Fibrus Wholesale supports four Residential and three Business customer speed profiles to meet the varying needs of end customers.

The Ethernet Product supports the following features:

- Layer 2 Ethernet access allowing RSPs to manage services at the IP layer and above
- Geographically diverse handover points available to support resilience and traffic management
- Fibrus managed backhaul to handover points assuring no network congestion
- Self service capability for Retail Service Providers via GUI or API
- Provision of service into the customer premises supporting RSP preference for end-customer service delivery e.g. in-home install, post-out, etc.

Operators can manage their own Customer Premise Equipment (CPE) over the Fibrus network utilising a communication protocol e.g. TR69 Remote Device Protocol.

To utilise the Ethernet Product RSPs must have in place a working FNNI connection between the Operator network and Fibrus Wholesale.

Operator FNNI

The standard FNNI product is the handover point between the Fibrus Wholesale network and the RSPs network. An FNNI must be in place before Ethernet products can be ordered. As the FNNI is a complex product please contact Fibrus Wholesale at [e.g abcd@fibrusWholesale.com] to order or amend your FNNI product.

There is currently a single size NNI available to RSPs: 10Gb. The Fibrus Core strategy has been developed with much greater capacity in mind and will also be able to support 40Gb and 100Gb FNNI connections in the future.

Ethernet circuits, should be ordered with an adequate MTU available. An MTU of 1600 is a minimum and an MTU of 2000 is recommended by Fibrus.

FNNI connectivity is currently available in the following Fibrus Data Centre locations:

- Telehouse North – Coriander Avenue, London, E14 2AA, UK

- BT Exchange, Belfast

Bandwidth Management and Oversubscription

Customer connections are built over the NNI links with a specified amount of bandwidth allocated to each connection. The total interface bandwidth can run in one of two models; either dedicated bandwidth or oversubscribed bandwidth. In the dedicated bandwidth model, the total of all customer bandwidth allocations must not exceed the total interface bandwidth. In the oversubscribed bandwidth model, the RSP can elect to have more customers using the connections, taking into account the actual utilisation of the circuit, rather than its potential utilisation. Utilisation and oversubscription are managed by the RSP.

FNNI Specifications

Fibrus' NNI specification for the physical and logical connectivity required over the NNI connections is shown below.

The RSP should order the NNI cross-connect at the appropriate Data Centre using the following details to locate the Fibrus cabinets. Once the NNI delivery date is known the RSP should contact the Wholesale Relationship Manager to arrange the commissioning and configuration of the NNI.

Type	Description
Type of interconnect	Layer 2 Ethernet link (with QnQ)
Interface Bandwidth	10G
Physical Interface	Single mode fibre.
Presentation	Data Centre: Telehouse North/ BT Exchange Meet Me Room. Fibrus: Armagh ISH (In span Hand off). Fibrus will present in a fibre optic enclosure with the ISH chamber.
Optical Wavelength	1310nm
Optical power budget	Interface Type - 10GBASE-LR - 10BASE-ER to be agreed as part of onboarding.
Fibre Specification	G652D
Full Duplex Support	Yes

NOTE: The only device to connect to the NNI must be the Partner QinQ termination device. Loop testing must NOT be performed on the FIbrus network, as this will disrupt services for other customers and result in Fibrus shutting down the RSP NNI.

Ethernet E-line

Fibrus currently offer a single Wholesale Ethernet service, E-Line, presenting a Layer 2 connection from the customer site to the RSP via either of the FNNI connection points. These circuits will be delivered as a QinQ packet (as defined in the VLAN section below) and RSPs will need to utilise this type of frame.

VLAN Identification

To segregate the services offered by Fibrus and to ensure that RSPs have control over the circuits delivered, we utilise a method for both service specification and FNNI selection. This method is based on an "S" (service or outer) VLAN with a "C" (circuit or inner) VLAN behind it in the frames sent to the partner network over FNNI circuits.

- The S-VLAN defines the service family and the NNI over which a circuit is built (e.g. Residential, Business, Enterprise)
- The C-VLAN identifies an individual customer connection.

A unique S-VLAN will be allocated to each WSP/RSP. The S-VLAN will be allocated from a pre-defined range. All customer traffic will be tagged with the unique S-Tag on entry to the PON network. It will be stripped from the traffic at handover on the carrier NNI. The figure below shows examples of "S" and "C" VLAN definition for a customer taking NNI connections from Fibrus:
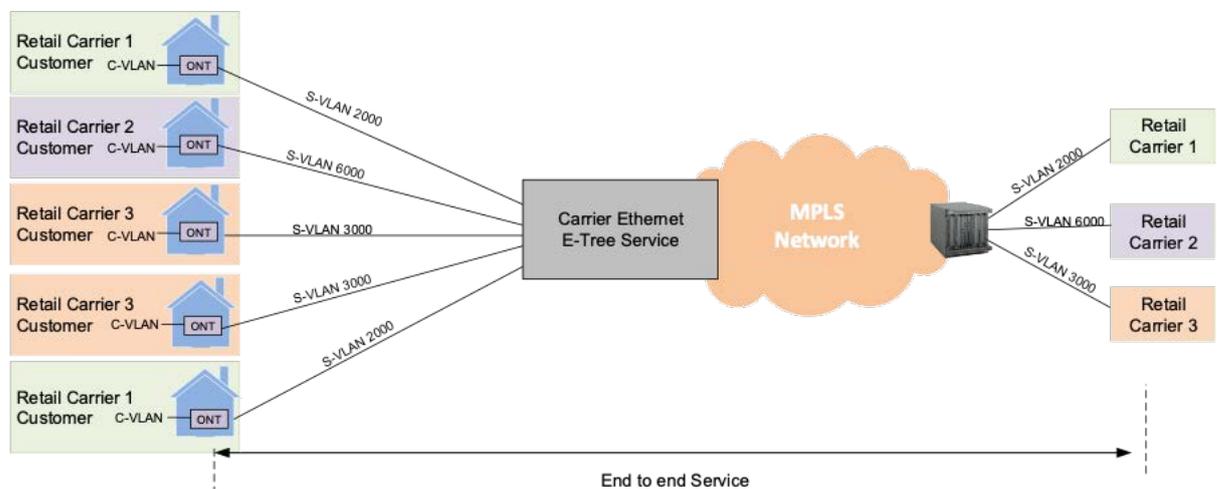

Figure 2

Class of Service

Fibrus will implement three forwarding classes:

- Expedited Forwarding (EF) Class
- Assured Forwarding (AF) Class
- Best Effort (BE) Class

End-customer Service Presentation

End-customer presentation will be the Calix 801Gv2 ONT, a standards-based Full Service access (FSAN), ITU-T GPON Compliant.

It is a 2.5 Gbps GPON small form factor service delivery terminal that delivers broadband connectivity to the subscriber. This high-performance terminal features one gigabit Ethernet (GE) interface.

The GigaPoint terminates a GPON fiber optic link at the subscriber's premises and provides an industry-standard interface for the customer premises equipment. The GigaPoint enables residential subscribers to receive gigabit broadband data and IP video on a single fiber. The GigaPoint establishes a strategic network termination point for the delivery and control of broadband services.

## 3. Fibrus Wholesale Ethernet Ordering & Installation

Fibrus Wholesale has developed the Operator Wholesale Gateway (OWG) to provide functionality for Service Fulfillment and Service Assurance processes to Retail Service Providers (RSPs). Ethernet Products are available in designated location across Northern Ireland as published and updated on the Fibrus Wholesale site and communicated to Fibrus Wholesale customers in the Wholesale Ethernet Availability File.

Overview of Operator Wholesale Gateway (OWG)

The OWG is the interface for Retail Service Providers (RSPs) to manage all orders related to provision and amending service for Ethernet products to end customers.

RSPs can access the OWG via a Portal or defined API giving direct access to the same status and customer service information that is available to Fibrus Wholesale. This approach avoids operators being lost in a 'black hole' without access to the vital information they require to effectively manage their customers.

RSPs will be provided access to the relevant order types to provide, cease, upgrade and downgrade end customers. Management of access will be provided by Fibrus Wholesale and it is the RSPs responsibility to administer and assure appropriate use by their personnel.
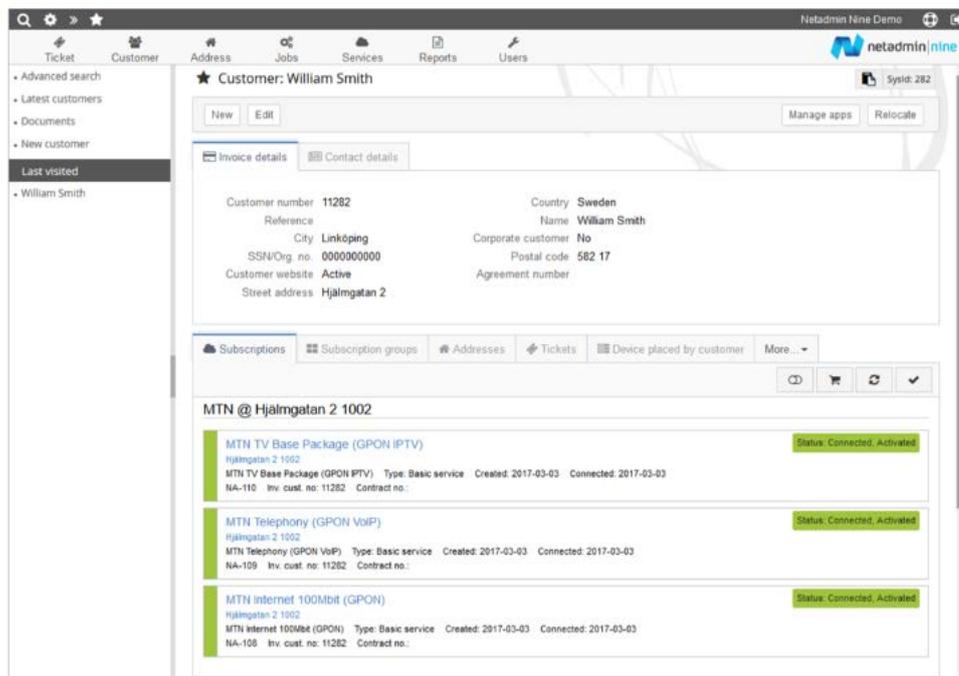
Sample Netadmin Screenshot

Service Fulfilment Process

The Service Fulfilment process has five key elements for successful completion:

- Collate the mandatory required information to complete the order - RSP
- Enter the complete data into the OWG - RSP
- Validate and accept the order - Fibrus
- Complete the validated order (including field or in-home work as required) - Fibrus
- Update the RSP on order status – Fibrus

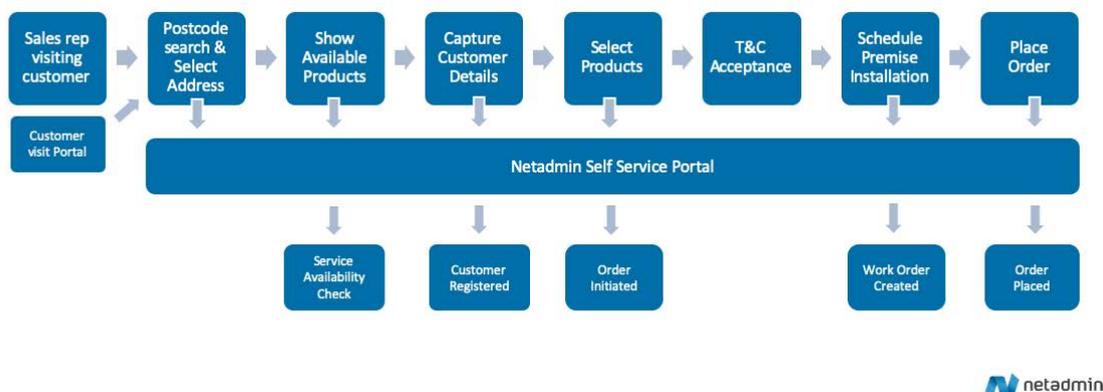Figure 3 below shows the order process flow for Ethernet Products.

Figure 3 –Ethernet Order Flow - Netadmin example

Order Data

The mandatory data required to complete an order is defined in the table below:

Field	Information
Name	Customer Name
Address	Customer Address
Postcode	Postcode
Contact #	Customer Contact Number
Etc.	

Order Types

The different order types are defined in the table below:

Code	Description
PFF100	Provide New Service – 100 Mb/s

CFF100	Cease Service – 100Mb/s
Etc.	Etc.

[*Sample fields pending final system configuration*]

Customer Premise Installation

On successful completion of the order entry and validation sub-processes the appropriate network and service activations will be completed by Fibrus systems and a field engineer will be despatched to complete the connection (unless an in-situ connection already exists). Figure 4 outlines the premise installation flow.

Figure 4 – Premise Installation Flow – Netadmin example

To connect the end customers premises to our network, we need to bring a fibre optic cable from the Fibrus Distribution Point (DP) located closest to the property to the location in the property where the customer requires our Optical Network Termination (ONT) to be located. The ONT must be fixed to a wall inside the property, close to a power socket. Our fibre optic cable runs through a hole we will drill in the wall, down into the ground or up to the eaves where it will then run back to connect to our network.

ONT Location

If the ONT is located away from the point of entry into the property, we will run internal cable to the point where the ONT is to be fixed. This cable will be up to 3m in length (unless you have placed a special order which may incur additional cost).

Before commencing the installation, the technician will ask the customer representative (who must be authorised to make the decision and over 18 years of age) to agree the route of the fibre optic cable into the property. The technician will record the agreed plan for the installation on a form and ask the customer present to sign to confirm that they accept the route.

Please ensure that the route of the installation is within the boundaries of the property. If we are asked to install across a route where we do not believe we have the necessary consents or permission, we will not be able to carry out the installation and there may be a cancellation charge to the wholesale partner for a failed installation.

There must be someone over the age of 18 at the property during the installation.

Escalation Process

Where an RSP requires to escalate a service order it must contact the Relationship Manager. Orders may only be escalated where they are beyond SLA parameters.

4. Ethernet Service Management

Fibrus Wholesale operates to a principle of enabling RSPs to manage their customers directly. The OWG provides RSPs with direct access to monitor end customer service and network performance, initiate, track and close trouble tickets via the OWG Portal or defined API. As such, it is a fundamental principle that RSPs must prove any service issues or faults are outside its own network and equipment before raising a trouble ticket.

Operators will be provided with access to assist them in trouble shooting service problems for end customers with direct access to the same information available to Fibrus Wholesale.

Where an RSP cannot identify and remediate the customer issue, a trouble ticket can be raised within OWG for the attention of Fibrus Wholesale. Each trouble ticket should contain the following information:

Field	Information
Circuit Number	Unique circuit ID in Fibrus OSS
Name	Customer Name
Address	Customer Address
Postcode	Postcode
Contact #	Customer Contact Number
Trouble	Description of the problem
Etc.	

[*Sample fields pending final system configuration*]

Trouble Ticket Resolution Process

Trouble tickets should only be raised when the RSP has identified the trouble as being within the Fibrus network or cannot localise the source of the customer trouble. The five key steps in trouble ticket resolution are:

- Trouble ticket reported – RSP
- Trouble diagnosis and isolation – Fibrus
- Trouble repair - Fibrus
- Trouble ticket updated and closed – Fibrus
- Customer updated - RSP

To complete diagnosis and repair Fibrus Wholesale may be required to contact the end customer directly e.g. for access. Fibrus Wholesale will not open or close tickets directly with end customers.

Escalation Process

Where an RSP requires to escalate a trouble ticket for resolution it must contact the Relationship Manager. Trouble tickets may only be escalated where they are beyond SLA parameters.

Outages

Planned Outages

It is recognised that Planned Outages are a necessary, normal and regular occurrence. Where a Planned Outage will impact on the Ethernet Product services provided to an RSP, the RSP will be notified by email, including a description of the outage, customer impact, date, time and expected duration. Fibrus will endeavour at all times to carry out Planned Outages during the preferred hours of 00:00 to 06:00.

Unplanned Outages

Where an outage occurs that impact on multiple end-customers, Fibrus Wholesale will inform RSPs to enable them manage operations and customer expectations effectively.

5. Billing

All connection, usage and recurring charges associated with the provision of the Ethernet Product are charged on the next billing cycle following completion of an order. All charges are as defined in the contractual agreement with the RSP and/or as published where appropriate.

Queries regarding billing and charges must be raised with the Wholesale Relationship Manager for resolution.