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WHOLESALE REFERENCE OFFER

Connected Gigabit Full Fibre Product Specification

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1.0 Introduction

Connected Gigabit (CGB) is the wholesale division within Quickline Communications Limited, responsible for operating the Network and providing wholesale services to RSPs, including Quickline's own retail arm.

This document outlines the Wholesale Reference Offer for CGB's wholesale Ethernet Full Fibre Access Services, which is intended to be used by Communication Providers and Retail Service Providers (to be collectively referred to as RSPs) who are registered wholesale partners of Quickline.

Any RSP interested in becoming a registered wholesale partner or discussing wholesale opportunities, should in the first instance complete the online application form at www.connectedgb.co/partners. This will provide CGB with the necessary details to better understand the RSP's needs and align them with CGB's services. CGB's Partner Account Management Team (PAM Team) can also be contacted via email wholesale@connectedgb.co

Once an RSP's application has been submitted, the PAM Team will follow up in accordance with our "Becoming a Connected Gigabit Wholesale Partner" process, ensuring an efficient onboarding experience. RSPs must first sign up to non-disclosure agreement (NDA) and Wholesale Framework Agreement (WFA) before being able to access the CGB product portfolio. The WFA details all contractual requirements and will be facilitated by CGB's PAM Team.

This document should be read in conjunction with other wholesale reference documents available at www.connectedgb.co/partners. Any defined term which is not defined within this document, is a reference to a defined term in the WFA.

2.0 Wholesale Ethernet Service

2.1 Overview

CGB offer a suite of symmetric Ethernet access products which afford RSPs the opportunity to create a range of retail broadband services with the ability to select the speed, bandwidth, contention and other aspects to underpin their retail service.

These wholesale Ethernet access products are delivered over full fibre infrastructure capable of speeds up to 10Gb/s, using XGS PON technology with an ONT designed to support up to a 10Gb/s service.

The Layer2 service provides an end-to-end datastream between the CGB ONT and the Network-to-Network interface (NNI), enabling an RSP to provide a Layer3 service to their end customers including appropriate customer premise equipment e.g. Router.

2.2 Product Variants

The following product derivatives outlined in Table 1 below are available for registered RSPs to order via the CGB wholesale gateway. The standard symmetric services are typically aimed at RSP residential customers, whilst the symmetric services aimed at RSP business customers come with an enhanced service level, which is also available with the standard symmetric services at an additional cost, if selected upon ordering or via a subsequent upgrade order.

Code	Wholesale Symmetric Broadband (residential)		Minimum Term	Service Level
QFFA 200	Full Fibre 200	200 Mb/s downstream; 200 Mb/s upstream	12 months	Standard

QFFA 500	Full Fibre 500	500 Mb/s downstream; 500 Mb/s upstream	12 months	Standard
QFFA 1000	Full Fibre Gold	1000 Mb/s downstream; 1000 Mb/s upstream	12 months	Standard
QFFA 2300	Full Fibre Gold+	2300 Mb/s downstream; 2300 Mb/s upstream	12 months	Standard
Code	Wholesale Symmetric Broadband (business)		Minimum Term	Service Level
QFFS 200	Full Fibre Symm200	200 Mb/s downstream; 200 Mb/s upstream	12 months	Enhanced
QFFS 500	Full Fibre Symm500	500 Mb/s downstream; 500 Mb/s upstream	12 months	Enhanced
QFFS 1000	Full Fibre Symm Gold	1000 Mb/s downstream; 1000 Mb/s upstream	12 months	Enhanced
QFFS 2300	Full Fibre Symm Gold+	2500 Mb/s downstream; 2500 Mb/s upstream	12 months	Enhanced

Table 1: CGB Wholesale Services

2.3 Product Description

CGB Ethernet products provide end-to-end active services between the Network to Network (NNI) handover point and the customer premise optical Network terminal (ONT) which becomes the demarcation point for the CGB wholesale service and RSP/CGB responsibilities, as illustrated in Figure 1 below. To utilise the Ethernet Product RSPs must have in place a working NNI connection between their Network and the CGB Network.

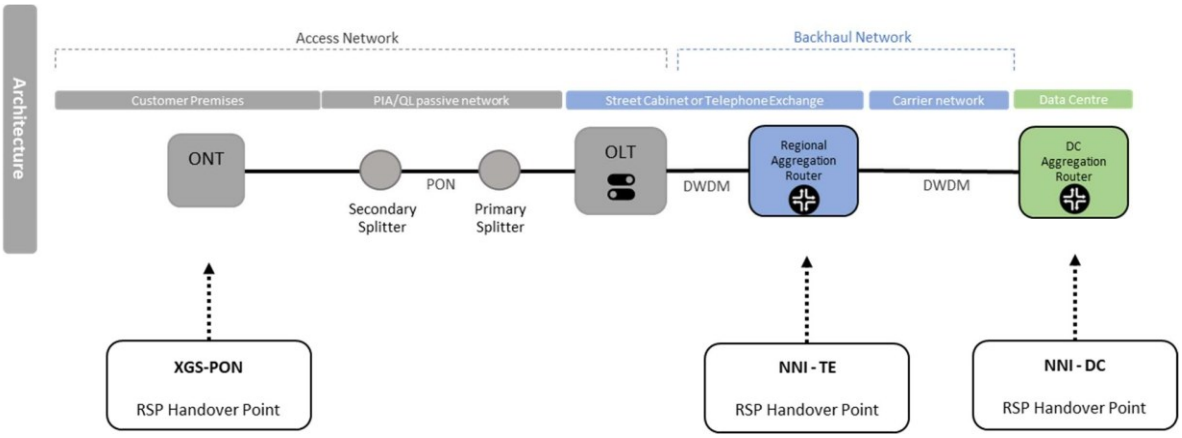

Figure1: Wholesale Ethernet Network architecture

Architecture:

- ONT – Optical Network terminals are utilised to terminate XGS-PON connectivity and deliver up to 2.5Gb/s or 10Gb/s at the customer's premise.
- OLT – Optical line terminal devices, housed within street cabinets and telephone exchanges aggregate XGS-PON customer connections.
- Splitters – Primary and Secondary splitters distribute the fibre access from OLT to ONT.
- Access Network Backhaul – Dense Wave-Division Multiplexing (DWDM) optical equipment, along with high performance backhaul, connect street cabinets and telephone exchanges to the core Network utilising Ethernet Virtual Private Line (EVPL) and carrier grade MPLS/VPLS technologies.
- Network to Network Interface (NNI) – RSPs connect to the CGB Network at the agreed Handover Point, which is usually at one of the agreed Data Centre locations and can be delivered to Telephone Exchanges and Street Cabinets (subject to survey and customer volumes).

The Ethernet Product is based on NICC ND 1030 Access Line Standards and 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
- CGB managed backhaul to handover points assuring no network congestion
- Self-service RSP order and servicing capability via the wholesale gateway
- Provision of service into the customer premises
- Both TR-101 & TR-156 within the system intermediate agent function on Access Platforms

Bandwidth Management and Oversubscription

Customer connections are built over the NNI links (see Section 2.7) with a specified amount of bandwidth allocated to each connection. The total interface bandwidth can run in one of two models;

- Dedicated Bandwidth
- Oversubscribed Bandwidth.

In the Dedicated Bandwidth model, the total of all customer bandwidth allocations must not exceed the total interface bandwidth. Whilst in the Oversubscribed Bandwidth model, an RSP can elect to have more customers using the connections, taking into account the actual utilisation, hence utilisation and oversubscription would be managed by the RSP. Ethernet circuits, should be ordered with an adequate MTU available.

2.4 Ethernet E-LAN Description

CGB offer a single Wholesale Ethernet service, E-LAN (based on E-VPN), presenting a Layer 2 connection from the customer site to the RSP via one of the NNI 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.

CGB presents an E-LAN on the NNI towards the RSP and all the RSP's ONTs reside within the E-LAN. CGB provide RSPs with a point to multi-point N>1 architecture (as defined in NICC ND 1030) and prevents direct communication between the RSPs ONTs. This means RSPs can securely host their customer ONTs within one E-LAN rather than use point to point connections.

To segregate RSP traffic across the Core Network, CGB utilise E-LAN Tagging (ethertypes 0x88a8 and 0x8100). CGB has built the Network based on the standards of Ethernet Access Standard NICC ND 1030 and will provide a unique outer "S-TAG" for each RSP (this could also be a 2C-TAG").

All the RSP sites will be delivered under this Outer-TAG, however, an RSP may request a second C-TAG for client differentiation to enable them to host their customers on one of two ELANs. The RSP can use inner TAGs to segregate traffic across their network.

- The unique RSP S-TAG is to be presented at the NNI by the RSP for downstream packets, whilst CGB insert this near the end customer for upstream packets. The S-TAG identifies the RSP across the core Network.
- The C-TAG is inserted by the RSP and can identify both individual customer connections and segregate traffic at a site level, i.e. voice & data. The C-TAG is assigned by the RSP and carried transparently over the Network.
- An RSP can send packets without C-TAGs (0x8100) if they wish.

A unique Outer-TAG will be allocated to each RSP from a pre-defined range by CGB. All customer traffic will be tagged with the unique S-TAG on entry to the CGB Network. It will be stripped from the traffic at handover at the customer ONT. At this point only Customer C-TAGs are visible.

2.5 Quality of Service

CGB has designed the Network to be low latency and underutilised. It supports Quality of Service (QoS) industry best practices, e.g. utilising Differentiated Services Code Point (DSCP) markings and Class of Service (CoS) profiles, supporting time sensitive services such as voice and video.

RSPs will be able to use the Differentiated Services Code Point markings to prioritise their traffic using Class of Service queue mapping, which in the unlikely event of congestion, the CGB Network prioritises the data accordingly.

2.6 End Customer Site Description

CGB deliver to an end customer site using either overhead fibre from a nearby pole, or underground via ductwork, which may be new CGB duct or existing third party (e.g. Openreach) duct where applicable, see Figure 2 below.

Non-standard site installations, are subject to survey and the process may differ slightly due to site conditions, e.g. a multi-dwelling unit (MDU), multi-occupancy (HMO) or a business unit and may be subject to additional costs. These will be confirmed following survey and relayed to the RSP.

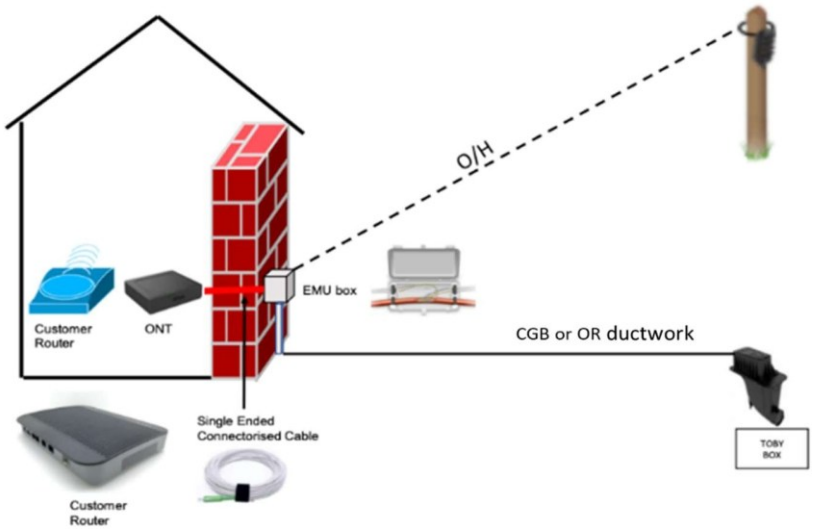

Figure 2: CGB Customer Premise connection

- O/H (Overhead) - customer drop cables are delivered from a PIA or CGB owned telegraph pole, attached to the premises and then securely fitted to the perimeter wall. An EMU (External Multi-purpose Utility) box is fitted externally containing an individual fibre cable, which is spliced onto a fibre connector, giving an external testing point for our fibre service should future testing/fault diagnosis be required without the customer being present.

- OR (Openreach) Ductwork - customer drop cables are delivered from a nearby fibre enclosure within the Openreach PIA duct network. Cables are fed from, typically, a swept tee lead-in duct to the premises and fed from ground-level up to the CGB EMU box externally. This contains an individual fibre core which is spliced onto a fibre connector in the same manner as O/H.

- CGB Ductwork - customer drop cables are delivered from a nearby fibre enclosure within the CGB or Openreach PIA duct network. A new trench is excavated (in line with NRSWA and HUAC standards) from an existing structure to the customer premises. Once excavated, a tube is installed through which fibre is delivered to the EMU box for splicing.

Connectorised fibre cables are delivered through the exterior wall (via a small drill hole), spliced and connected to the CGB Optical Network Terminal (ONT) device inside. The RSP must ensure permission is granted for the drilling and installation route, with a responsible adult present to agree the specific installation route on the day. Failure to do so, may mean a repeat installation visit and abortive costs raised to the RSP.

The Optical Network Termination unit (ONT) will be the point of CGB service demarcation, from which testing is undertaken by the CGB engineer. A typical example of the ONT is shown below in Figure 3.

Figure 3: Example ONT – Adtran SDX621i or SDX 631Q

RSP in-home WiFi routers can then be connected, fed by a copper patch cable from the ONT. The RSP is responsible for the supply and installation of their customer router, unless otherwise agreed.

2.7 Network to Network Interface Description

The CGB NNI product is the handover point between the CGB and RSP networks. A NNI must be in place before an RSP can place an Ethernet product Order, and should be ordered with the support of their PAM Team.

RSPs would physically access CGB's Network via one of the Data Centre handover points or by agreement at an appropriate Telephone Exchange or 'Meet Me' chamber, and would typically interconnect at 10Gb/s, with options to connect at either 40Gb/s or 100Gb/s as demand requires. The recommended NNI location is within one of the agreed Data Centres.

Active services can be handed off via a VLAN at layer 2, having been transported across the CGB backhaul Network via layer 2 VPN at a maximum transmission unit (MTU) of 9000 bytes. A depiction of these three options is shown in Figure 4.

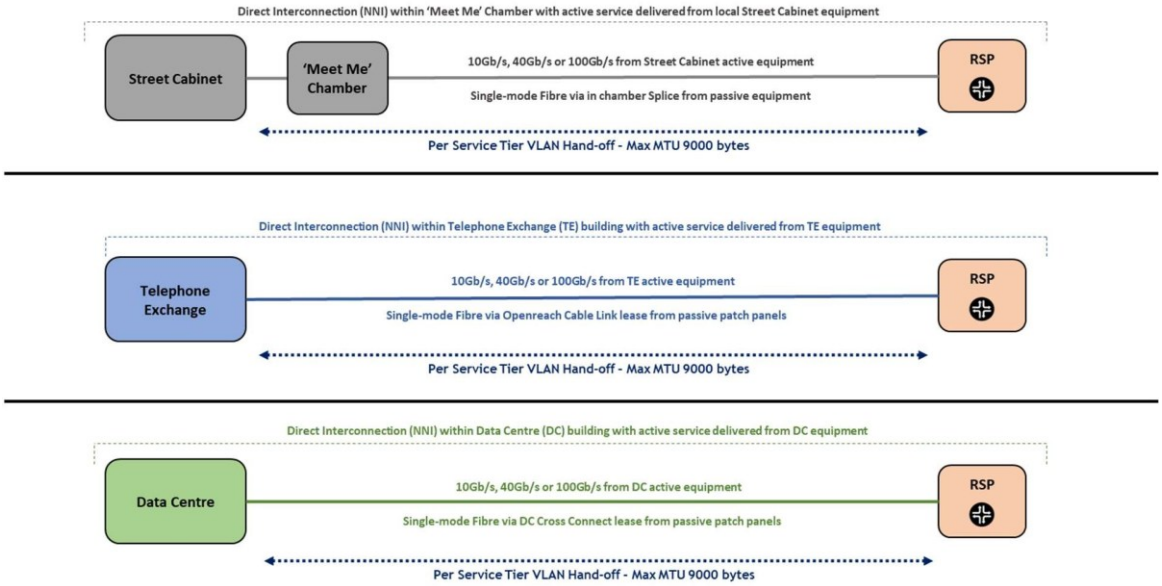

Figure 4: NNI Configurations

Typical CGB NNI Data Centre Handover Locations:

- Teledata, Manchester
- Atlas (Cornelius House), Leeds
- AQL, Leeds (DC3 and DC5)
- Proximity, Nottingham
- THN, London

Please note that additional Handover Locations may become available from time to time, RSPs should contact the PAM Team for more information and details of local handover points.

Once the RSP has their equipment installed, the key steps for the Data Centre connections are:

- A Letter of Authority (LOA) is provided by CGB to give the RSP access to the CGB (Quickline) co-location point to install the physical interconnect Fibre cable.
- The RSP contracts with the Data Centre, or Openreach for Telephone Exchange connections, to install a Fibre Cable between the CGB (Quickline) co-location point and the Network Services Supplier location
- CGB will provide a 10Gb/s, 40Gb/s or 100Gb/s port presented as a single mode LR optic.

3.0 CGB Order Servicing

CGB servicing processes are detailed in the CGB Access Order & Servicing Guide and summarised below.

Ethernet Access Services are available in designated locations as published and updated via the CGB wholesale partner website and locations are communicated to CGB partners in the CGB Ethernet Availability File.

To provide self-service functionality for service fulfilment and service assurance processes for RSPs, CGB has developed a wholesale gateway and OSS/BSS ecosystem, known as QForce, which delivers self-service, automated Order, provisioning, billing, and support services across the Network footprint. There are three gateway options for RSPs to connect to CGB systems; the QForce portal, API direct and API mediated (Middleware).

This enables RSPs access to the vital information they require to manage their customers effectively. RSPs can access relevant Order types; provide, cease, upgrade and downgrade services for their end customers. Alongside QForce, RSPs can contact the PAM Team for support.

The wholesale API and middleware platform is connected into CGB back-end systems for CRM, billing, and automated provisioning. This provides functionality such as CRM, Inventory, IP Address Management, Ticketing, Provisioning, Monitoring, Appointment scheduling and Billing. This allows a Lead-to-Cash processing capability which automates the wholesale account transactions.

3.1 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 data and place the Order via the API - RSP
- Validate and accept the Order – CGB
- Complete the validated Order (including field survey if required) – CGB
- Update the RSP on Order status – CGB

3.2 Customer Premise Installation

On successful completion of the Order entry and validation sub-processes, the appropriate Network and service activations will be completed by CGB systems following which a field engineer will be dispatched to complete the connection (unless an in-situ connection already exists).

To connect the end customer premise to the Network, CGB need to bring a fibre optic cable from the CGB (or PIA) Distribution Point located closest to the property to the location in the property where the customer requires the ONT to be located. The external fibre will be terminated within the EMU (see Figure 2) as the external fibre termination point, which is to be fixed to the outside wall of the premise. The ONT must be fixed to a wall inside the property, close to a power socket. CGB fibre optic cable runs from the ONT to through a hole drilled in the wall, to the EMU and then down into the ground or up to the eaves where it will then run back to connect to the Network.

3.3 ONT Location

CGB will run internal fibre to the point where the ONT is to be fixed. This cable will be up to 10m in length from the external fibre termination point on the outside of the customer premise, unless the RSP has placed a special Order which may incur an additional cost.

Before commencing the installation, the engineer 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 engineer will record the agreed plan for the installation on a form and ask the customer representative 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 CGB are asked to install across a route which is not believed to have the necessary consents or permission, CGB will not be able to carry out the installation and there may be a cancellation charge to the wholesale partner for a failed installation.

4.0 Ethernet Service Management

CGB operates a self-serve principle enabling RSPs to manage their customers directly. The wholesale gateway provides RSPs with direct access to monitor end customer service and Network performance, and to initiate, track and close trouble tickets via the defined API. As such, it is a fundamental principle that RSPs must confirm any service issues or faults to be outside its own network and equipment before raising a trouble ticket.

RSPs will be provided with access to assist them in trouble shooting service problems for end customers with direct access to the same information that is available to the CGB team.

Where an RSP cannot identify and remediate the customer issue, a trouble ticket can be raised via the Wholesale gateway for the attention of CGB team.

4.1 Trouble Ticket Resolution Process

Trouble tickets should only be raised when the RSP has identified the trouble as being within the CGB 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 – CGB
- Trouble repair – CGB
- Trouble ticket updated and closed – CGB
- End customer updated - RSP

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

4.2 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 Access Services provided to an RSP, the RSP will be notified by email, including a description of the Planned Outage, customer impact, date, time and expected duration. CGB will endeavour at all times to carry out Planned Outages during the preferred hours of 00:00 to 06:00.

Unplanned Outages

Where an unplanned Outage occurs that impacts on multiple end-customers, CGB will inform RSPs to enable them to manage operations and customer expectations effectively.

5.0 Escalation Process

Where an RSP needs to escalate an Order or trouble ticket for resolution this can be done by contacting the PAM Team. Orders and trouble tickets may only be escalated where they are beyond SLA parameters.

Orders and trouble tickets may only be escalated where they are beyond Service Level parameters with the following criteria that RSPs must be able to show in order to raise an escalation successfully:

- Evidence that the Order has failed or is currently failing, against any SLA or CCD
- Evidence of a previous case into the PAM team, without a response within 2 Business Days.

Reasons for escalations can include validation issues, Charge related queries, Quality of Work issues and failed Service Levels. See table below.

Case Type	Case Category	Subcategories	Examples
Active Order Escalations	Evidence that the Order has failed or is currently failing, against any SLA or CCD	• Failed/at risk Service Level Failed/at risk CCD • Unhappy with job quality • Work not completed as requested • Other	• May be beyond CCD with no update / not completed. • RSP has returned to site and has found a quality issue with CGB or their supplier work.
Active Service Escalations	Evidence of previous case into the PAM team, without a response within 2 Business Days	• Validation Query • Reworks Query • NA Execution query • Escalations Query • Other	Any query that has come into CGB that has not responded to within the Service Level timeframe

6.0 Pricing & Billing

An online payment processing solution is in place to facilitate automated direct debit mandates which has been integrated with both middleware and CRM platforms to ensure billing is handled appropriately. This operates in accordance with PCI-DSS standards, with automated processes and self-service access to wholesale account information

All connection, usage and recurring charges associated with the provision of Full Fibre Access Services are charged on the next wholesale billing cycle following completion of an Order. All charges are as defined in the contractual agreement with the RSP and/or as published in the CGB Wholesale Price List.

Any queries regarding billing and Charges must be raised with the PAM Team for resolution.

In-life service and billing changes can also be handled within this platform and automatically reconciled and provisioned in real-time.