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Suppliers' Trial Information Note

For The BT Network

GEA-NGA2 G.fast Pilot

Service and Interface Description

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1. Service Outline

1.1 Introduction

Openreach is developing its Next Generation Access programme (NGA2) based on G.fast technology.

1.2 NGA2 G.fast Pilot Scope

Openreach will be conducting a limited deployment (LD) pilot of NGA2 G.fast across the UK.

The purpose of the pilot will be to test deployment, technology capabilities, capture learning and customer experiences of the two technology variants.

The pilot will be available in the locations announced via the Copper and Fibre Products Commercial Group (CFPCG). The pilot service will be delivered over existing access infrastructure and will not be separated from the rest of the access network apart from dedicated layer 2 switches and cablelinks in local exchanges or appropriate Handover Nodes.

1.3 General

Openreach will provide an NGA2 G.fast product variant for the limited deployment (LD) pilot from hereon referred to as Generic Ethernet Access (GEA-NGA2 G.fast).

This Suppliers' Trial Information Note (STIN) provides details for Communications Providers (CPs) regarding connectivity and interfaces for the limited deployment pilot of NGA2 G.fast technology.

The interface presentation at the End Customer premises (User to Network Interface, or UNI) will use an Openreach supplied and maintained Network Termination Equipment (NTE) and will provide an Ethernet interface to be consumed for the pilot service unless a CP can demonstrate that they have a suitable G.fast modem/router which meets the essential requirements of this STIN. This NTE will terminate a copper delivery and will be used throughout this document to describe either an Openreach provided G.fast modem or a CP provided G.fast modem. Both modem options will initially be deployed via an engineer installation although there may be some customer self-installation deployment options as part of a trial within the pilot.

A GEA-NGA2 Fibre on Demand (FoD) product will NOT be offered as part of this pilot.

It should be noted that the information contained within this STIN is subject to change due to BT developments, changes in global industry standards or due to feedback from customers, including CPs. Please check with the http://www.btplc.com/sinet/SINs/ site to ensure you have the latest version of this document.

In the event of a discrepancy between this document and referenced documents, this document takes precedence.

Further information regarding the product pilot can be obtained by contacting your Openreach Sales and Relationship Manager.

1.4 High Level Architecture

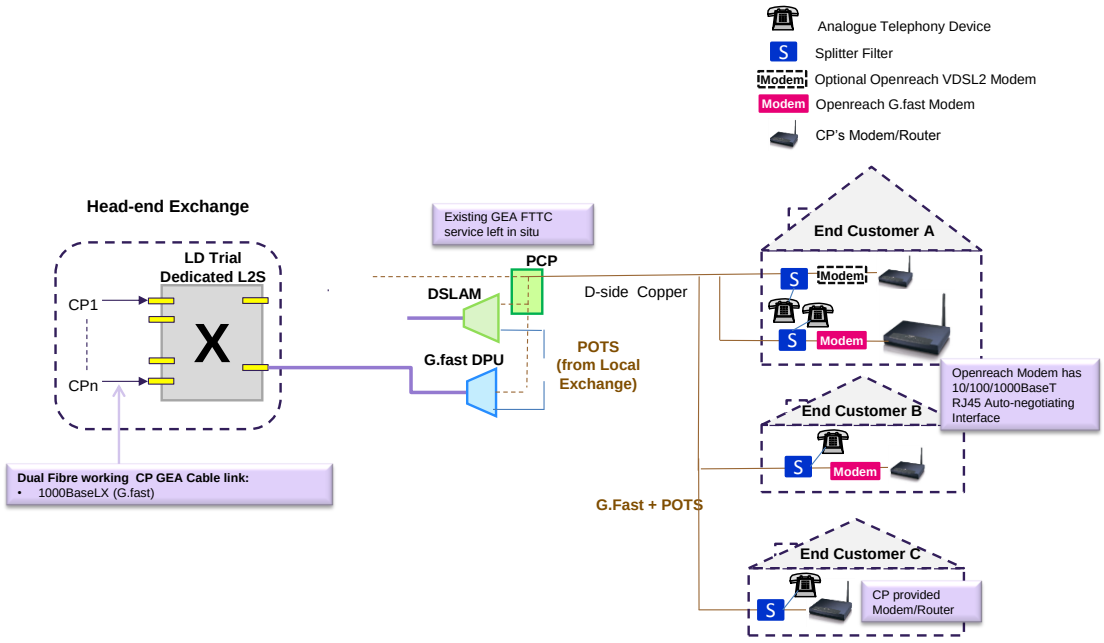

Figure 1 outlines the high level architecture for the G.fast limited deployment pilot.

Openreach will provide GEA-NGA2 G.fast as an 'always on' Virtual LAN (VLAN) between a dedicated Layer 2 Switch Optical Line Termination (L2S) equipment in the exchange and the End Customer premises.

The GEA-NGA2 G.fast service delivered will use a copper connection between the Distribution Point Unit (DPU) and the customers premise.

At the Point of Handover in each of the pilot areas, the GEA-NGA2 G.fast service will be delivered to the CP via a GEA Cablelink product. The GEA Cablelink will transport multiple GEA services from the same pilot L2S to a location within the same Point of Handover specified by the CP. These Cablelinks will be dedicated to GEA-NGA2 G.fast (i.e. no mixing of NGA1 and NGA2 services).

The VLAN will be able to carry data communication signals after the CP has registered for service activation for their End Customer.

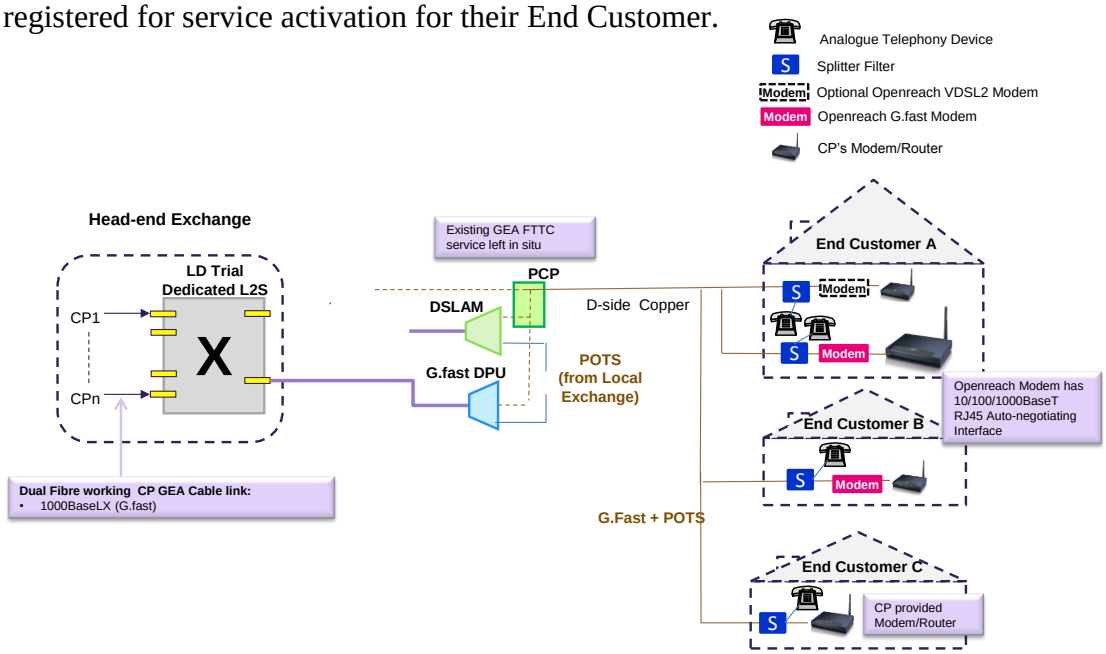

Figure 1 – High Level Architecture for LD Pilot

1.4.1 G.fast Rates

The GEA-NGA2 G.fast product will offer the following Ethernet product rates when delivered using G.fast:

Pilot product 1

- A peak downstream (from CP to End Customer) rate of up to 330 Mbit/s,
- A downstream prioritisation rate of TBC 110Mbit/s.
- An upstream (from End Customer to CP) rate of up to 50 Mbit/s.

Pilot product 2

- A peak downstream (from CP to End Customer) rate of up to 160 Mbit/s,
- A downstream prioritisation rate of TBC 110Mbit/s.
- An upstream (from End Customer to CP) rate of up to 30 Mbit/s.

CPs should also be aware of the following:

- There will be occasional internal Openreach management traffic on the G.fast line due to management activities. This traffic will take priority over user traffic but the impact will be negligible.
- There will be occasional firmware upgrades which will involve reasonable volumes of traffic (M bytes). Openreach will report to CPs when these are scheduled across the GEA-NGA2 G.fast network.

1.4.2 G.fast Noise Margins

Currently the default target signal-to-noise ratio margin is set to 3dB in the both the upstream and the downstream directions. The actual value shall be determined by the Dynamic Line Management (DLM) algorithm based on line stability and can vary between 3 and 28dB (in 1 dB steps). The upstream and downstream margin settings are independent of each other.

Lines may also have higher margins when they are at the rate cap for the product.

1.4.3 Rate Reporting

Rates will be reported via PPPoE intermediate agent insertion or DHCP option 82 [4] (some limited DHCPv6 support, detailed in Section 2.1.7). These will need to be interpreted by the CP in order to allow payload traffic to be transmitted optimally.

The upstream and downstream NGA2 G.fast data rate is reported to the CP BRAS/Radius upon PPP discovery (a similar mechanism exists for DHCP – see Section 2.1.7). The data rate states the upper rate at which Ethernet traffic can be transmitted on the link. This traffic comprises of:

- A 4 byte per frame overhead added by Openreach for internal routing,
- A degree of overhead introduced by G.fast Packet Transfer Mode (PTM) layer
- The End Customer traffic sent from the CP, or from the End Customer.

As a result of these overheads, the actual achievable throughput in bits per second is dependent on the line rate and frame size of the data being transmitted. Openreach advise CPs to consider carefully how they interpret the reported rates in relation to the services they sell, the specifics on an individual End Customer's use of the service, and any impacts of their own network.

If GEA-NGA2 G.fast Multicast is used (which does not transit the same equipment (e.g.BRAS)), the CP will need to take account of this traffic on the End Customer's line.

Note: the line rate may change due to seamless rate adaptation (SRA) and fast rate adaptation (FRA) events without the rate reporting being updated (see Section 2.1.6).

1.5 GEA-NGA2 G.fast Cablelink

The GEA-NGA2 G.fast Cablelink product will be offered to the CP to order for connectivity to the NGA2 L2S in the same Point of Handover building.

This will comprise:

- Either a 1 Gbit/s or a 10 Gbit/s Ethernet port into the L2S, 1000Base-LX (Single Mode only) for 1 Gbit/s and 10GBase-LR (Single Mode only) for 10Gbit/s.
- Fibre connection from the port on the L2S to the location within the same Point of Handover specified by the CP.

CPs will need to specify the location of their equipment/presence to which the connection should be made as part of the order journey for each GEA-NGA2 G.fast service ordered.

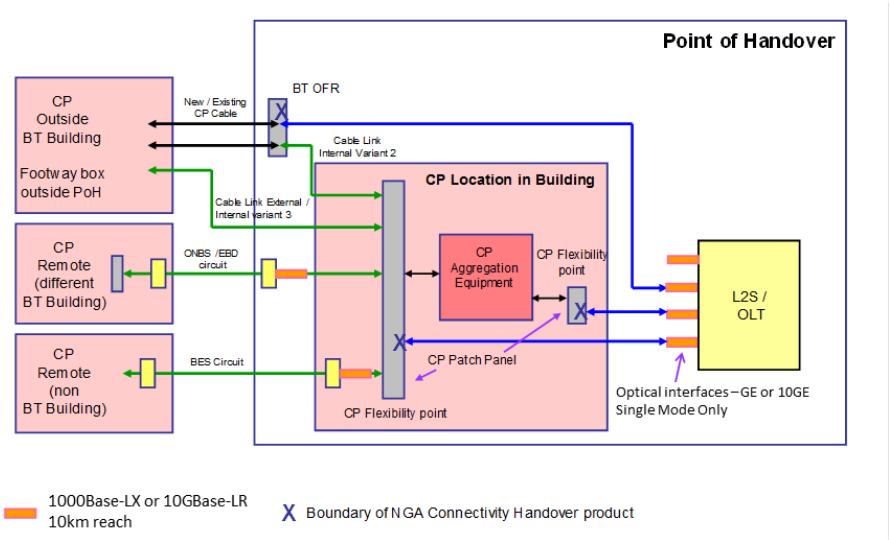

Figure 2 : GEA-NGA2 G.fast Head End Handover Connectivity

1.6 G.fast Physical Layer

The G.fast physical layer will comply with the mandatory requirements of ITU-T Recommendations G.9700 [7] and G.9701 [8] and their ammendments and corrigenda. The following feature set will be implemented for the pilot:

Feature	Status
Spectrum compatibility with VDSL2	Enabled
Vectoring	Enabled
Retransmission	Enabled
Seamless Rate Adaptation (SRA)	Enabled
Fast Rate Adaptation (FRA)	Enabled
Headline Line Rates (Pilot product 1)	DS: 330Mbit/s US: 50Mbit/s
Headline Line Rates (Pilot product 2)	DS: 160Mbit/s US: 30Mbit/s
Ability to implement RF notching if required	Enabled
Changes to MinETR EoC (Corrigenda 3)	Enabled
Support of Profile 106b	Enabled

Table 1 : G.fast Physical Transmission Layer Features

2. Interface Descriptions

The following sections define the interface descriptions for the various components used in GEA-NGA2 G.fast.

2.1 GEA-NGA2 Cablelink

2.1.1 Physical connection

The identified interface option and location for the GEA-NGA2 Cablelink will need to be specified by the CP, either:

- CP owned and provided Interface Panel, or
- CP owned and provided equipment interface (Ethernet port).

The interface is the connector on the end of the Openreach fibre tail.

The following physical optical interface connector types only are supported for connection to the CP provided identified interface:

- FC/PC
- LC
- SC

Note – Angled connectors are NOT supported.

The physical interface must be specified on the order request. Any conversion of interfaces is the CP's responsibility, i.e. the CP must provide interface converters on its card or at the interface panel, if necessary. Openreach engineers must be provided with access to the identified interface point (whether that is an interface panel or the CP's actual interface card itself) for both fulfilment and assurance purposes.

1 Gbit/s and 10 Gbit/s Single-Mode interfaces are described in SIN 360 [1].

More information about the GEA-NGA1 Cablelink product can be found in the GEA Cablelink Product Description on the Openreach Portal (see http://www.openreach.co.uk).

2.1.2 Ethernet Frame Size

The maximum supported Ethernet frame size is 1530 bytes (excluding IFG and pre-amble and single/double tag – see 2.1.3).

2.1.3 VLAN Tagging Options at the GEA Cablelink for GEA-NGA2

2.1.3.1 Openreach added tags

On the GEA Cablelink, all traffic will be presented using single tagging or double tagging on a per VLAN basis. Both options can be used on the same GEA Cablelink on a per GEA order basis. The tagging option to use for a specific GEA order is explicitly selected by the CP when ordering.

The VLAN used for End Customer traffic is referred to as a Customer VLAN or "C-VLAN".

A CP may optionally choose to use an additional level of VLAN tagging so that C-VLANs can be grouped within another VLAN, referred to as a Service VLAN or "S-VLAN". Figure 3 shows how numbering is aligned between Single and Double tagged handover.

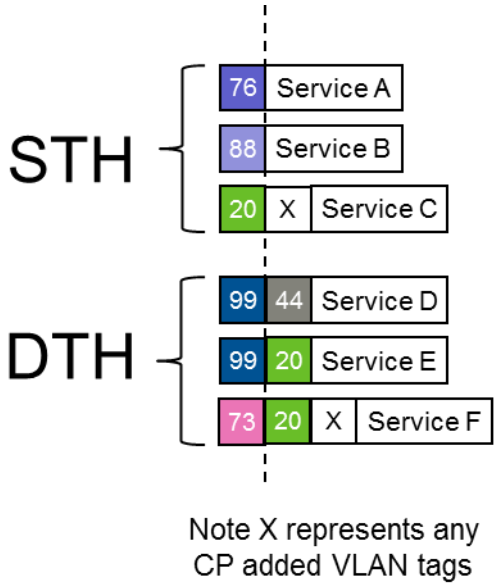

Figure 3 : GEA Cable Link VLAN tagging numbering alignment

- Single Tagged Handover (STH)
  - The Outer VLAN is the C-VLAN.
  - The Outer VLAN will carry the End Customer traffic and will have a tag in the range 2 to 3000 or 3071 to 4094*. Openreach will allocate the lowest available unused tag.
- Double Tagged Handover (DTH)
  - The Outer VLAN is the S-VLAN, and the Inner VLAN is the C-VLAN.
  - Outer VLAN tag(s) must be ordered via the Lead to Cash Modify process against a GEA Cablelink (GEA Cablelink provision must be complete) before they can be used in a GEA order.
    - The Outer VLAN will have a tag in the range 2 to 3000 or 3071 to 4094.
      - The CP can specify the tag to be added; or
      - Openreach will allocate the lowest available unused tag if the CP does not specify the tag.

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* *Please note - values between 3001 and 3070 are reserved for GEA Multicast.*

- Where double tagging is required the CP must include the Outer VLAN tag value in the GEA order.
- The Inner VLAN will carry the End Customer traffic and will have a tag in the range 2 to 4094. Openreach will allocate the lowest available unused tag.

2.1.3.2 CP added tags

The following is true for Openreach provided NTE (see also Figure 3):

- CPs can optionally add tags in the downstream direction (commonly referred to as X-tags) and these will be transported transparently through to the UNI of the Openreach modem.
- End Customer CPE such as set top boxes (STB) and PCs may add X-tags in the upstream direction and these will be transported transparently through to the CP. An exception to this is tag 0 which will be removed by Openreach (see section 2.1.5.2) – for more detail).

2.1.4 Ethertype

The CP can specify whether the Outermost VLAN Ethertype on the Cablelink will be set to 0x81-00 or 0x88-A8. This applies to the GEA-NGA2 G.fast Cablelink as a whole and irrespective of single or double tagging of the GEA-NGA2 G.fast services carried.

2.1.5 Quality of Service (QoS)

2.1.5.1 Downstream

Figure 4 outlines the downstream QoS for GEA-NGA2 G.fast.

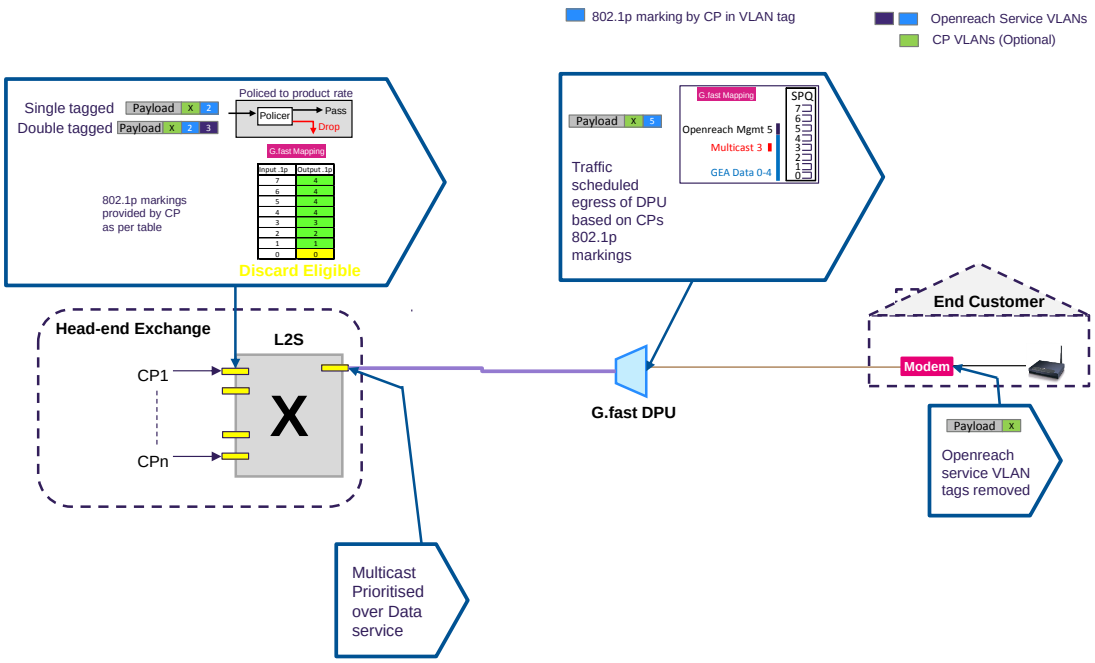


Figure 4 : Downstream QoS

CPs can use the C-VLAN Priority as per IEEE 802.1p on downstream GEA-NGA2 G.fast traffic. For G.fast, 802.1p values 0, 1, 2, 3, and 4 are supported. 802.1p values 5, 6 and 7 are not supported and will be re-marked to 4.

GEA-FTTC will make use of these markings in two ways:

- Scheduling traffic from the L2S/DPU to the NTE; and
- In the event of congestion within the Openreach network, the markings will be used to identify which frames can be dropped first for a particular End Customer.

802.1p traffic marking is optional but strongly recommended to ensure traffic is scheduled according to CP requirements.

Frames with higher markings are delivered first using strict priority. Note that downstream GEA Multicast, which has a 802.1p value of 3, converges with GEA-NGA2 G.fast Data at the DPU/ port. It is therefore possible to prioritise selected GEA-NGA2 G.fast Data traffic above Multicast (but only at the DPU G.fast port) by sending GEA-NGA2 G.fast Data with a 802.1p value of 4. CPs should be aware this could impact the Multicast service for the End Customer receiving high rates of priority 4 GEA-NGA2 G.fast data traffic.

2.1.5.1.1 Per End Customer/ Intra End Customer frame drop prioritisation

The C-VLAN PCP markings are used to identify the order in which traffic can be dropped.

- For G.fast, 802.1p = ‘4,3,2,1’ = “Should Not Drop”
  (no drop priority differentiation between these 4 markings until the egress DPU G.fast port)
- 802.1p = ‘0’ = “Can Drop”

Where Double Tagging is used, the markings must be applied to the Inner C-VLAN.

The 802.1p priority field allows the CP to influence which frames are dropped first under congestion, thus allowing loss sensitive applications to have greater protection and at the same time allow best-efforts applications to benefit from full network capacity when it is available, but at the risk of frame loss. Openreach will re-mark the 802.1p priority field to ensure each End Customer has fair access to the available network capacity as follows:

- When an End Customer's "Should not drop" marked traffic is supplied below the prioritised rate, then some of that end-users "Can drop" frames will be arbitrarily promoted to "Should not drop" so that, if possible, the "Should not drop" traffic rate equals the prioritised rate.
- Where an End Customer's traffic is marked "Should not drop" and exceeds the prioritised rate, then some of that end-users frames will be arbitrarily demoted to "Can drop" so that the rate of "Should not drop" traffic equals the prioritised rate.

Therefore for optimal performance the CP should ensure loss-sensitive traffic is marked "Should not drop" and kept within the prioritised rate of the end-user's service. Where the line rate is below the service prioritised rate, the CP should also note Section 2.1.6 on downstream shaping.

2.1.5.2 Upstream

Figure 5 below outlines the upstream QoS for GEA-NGA2 G.fast.

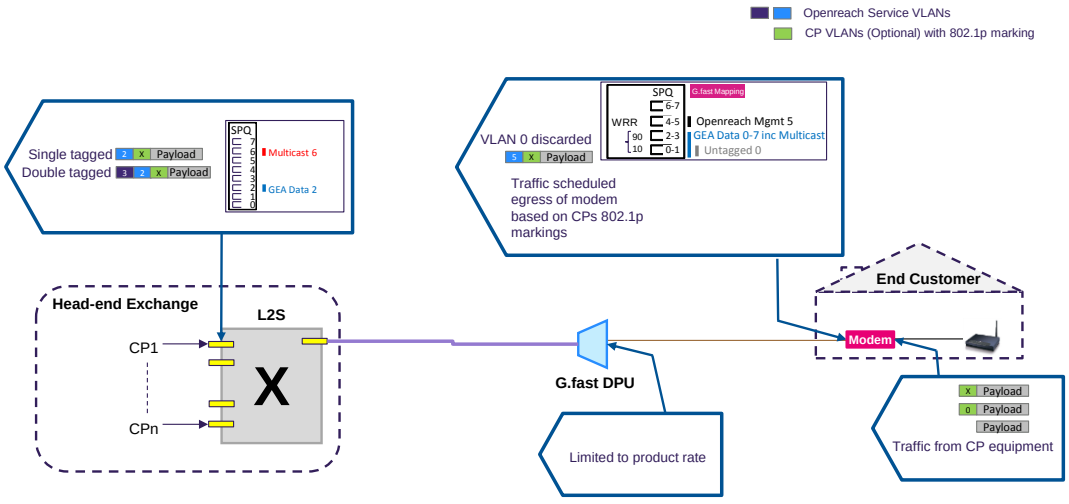


Figure 5 : Upstream QoS

CPs can (optionally) select the priority for each Ethernet frame via a VLAN PCP field sent into the Openreach NTE.

- For G.fast, Weighted 90:10 (High Priority: Low Priority)
  - 802.1p = 2 or 3 (4-7 will be treated as 3) → High priority

- 802.1p = 0 or 1 or unmarked (no VLAN) → Low priority

Handling of the VLAN tag varies:

• Tag = 0 → VLAN tag is stripped out by the Openreach NTE (802.1p field is still used for prioritisation)

• Tag ≠ 0 → VLAN tag will be forwarded to the CP (where this tag is forwarded, the CP must be able to handle this additional tag).

2.1.6 Shaping

As SRA is active at the physical transmission layer for G.fast then any actual rate insertion cannot be relied upon by CP equipment as the active line rate will vary without any notification method to CP equipment. The CP is therefore expected to shape, per End Customer service, the downstream traffic to match the product rate or maximum attainable line rate (whichever is lower) and use prioritisation via 802.1p bits (per user) to ensure correct scheduling and prioritisation of traffic egress to the G.fast DPU interface. Suitable buffering will be available for the pilot, which in conjunction with QoS should deal with traffic rate mismatches.

The CP can use the performance metrics they receive from Openreach to update the traffic shaping.

See Section 2.1.7 for detailed rate insertion details.

As G.fast deployments are relatively immature, the variability of the maximum attainable rate needs further study and analysis of the pilot data. CPs may therefore be cautious and shape their downstream traffic to the product rate. However maximum attainable rate will provide a view as to what the line may achieve.

Shaping equally applies upstream and CPs should shape to the product rate or maximum attainable rate as discussed for downstream shaping, (see section 2.1.7 Intermediate Agent/DHCP Relay Agent). In addition, CPs should consider the impact of upstream capacity on their GEA-NGA2 G.fast Cablelink.

- Openreach will shape traffic into the GEA-NGA2 G.fast Cablelink. This shaping will treat all GEA-NGA2 G.fast data traffic equally. Specifically, it will not make use of any markings applied by the CP Equipment.
- Openreach will explicitly not manage traffic at an individual inner tag or outer tag level.

2.1.7 Intermediate Agent / DHCP Relay Agent / DHCP for IPv6

Where PPPoE is detected, additional tags will be inserted into the upstream flow (PADI) by the Intermediate Agent (IA) in the DPU. Any existing tags of the same type from the CPE will be overwritten. The IA tags will be removed by the DPU or L2S in the downstream direction (i.e. from the PADO, PADS messages).

Where DHCP is detected, the DPU will insert Option 82 information field into the upstream flow (DHCP Discover). The Option 82 field will be removed by the DPU in the downstream response (DHCP Offer).

In addition where DHCPv6 (i.e. DHCP for IPv6) is detected, the DPU will insert and remove Options 18 (Circuit ID), 37 (Remote ID) and 17 (Vendor-specific Information; includes sub-options for reporting line characteristics such as line rate)

2.1.7.1 Supported Options

The following information will be supplied.

Note – any information in these fields from the End Customer will be over-written.

- ***Agent Remote ID*** – 63 character field – value is either
  - Value supplied by CP during provide / modify
    - From character set – a~z A~Z 0~9 @ . _ - ( ) / + : (Note space character is NOT supported)
    - Invalid characters in the order will cause order rejection

  or

  - DeviceName/S-VLAN ID/Frame No_Slot No_Port No/uservlan/C-VLAN ID if the CP does not set a value to be used
    - Changes if the port is changed for any reason – cannot be guaranteed to be constant
    - Any value supplied directly from any modem will be over-written
- ***Agent Circuit ID***
  - access-Node-Identifier eth frame/slot/port:c-vlan-id
    - The "frame/slot/port" value will change if the port used is changed after a port or card failure
- ***Access Loop characteristics***
  - As per TR-101 R-161[4]: Access Nodes (i.e. G.fast DPU) must be configurable to send only sub-options 0x81 and 0x82, or to send the entire list. Therefore for the pilot the entire list shall be inserted. The product and max attainable rates that the CP should shape to are highlighted below:

Sub Option.	Message Type	Information
0x81	Actual data rate Upstream	Actual data rate of a synchronized DSL link
0x82	Actual data rate Downstream	Actual data rate of a synchronized DSL link
0x83	Minimum Data Rate Upstream	Minimum data rate desired by the operator
0x84	Minimum Data Rate Downstream	Minimum data rate desired by the operator
0x85	Attainable Data Rate Upstream	Maximum data rate which can be achieved.
0x86	Attainable Data Rate Downstream	Maximum data rate which can be achieved.
0x87	Maximum Data Rate Upstream	Maximum data rate desired by the operator.
0x88	Maximum Data Rate Downstream	Maximum data rate desired by the operator.
0x89	Minimum Data Rate Upstream in low power state	Minimum data rate desired by the operator during the low power state (L1/L2).
0x8A	Minimum Data Rate Downstream in low power state	Minimum data rate desired by the operator during the low power state (L1/L2).
0x8B	Maximum Interleaving Delay Upstream	maximum one-way interleaving delay
0x8C	Actual interleaving Delay Upstream	Value in milliseconds which corresponds to the inter leaver setting.
0x8D	Maximum Interleaving Delay Downstream	maximum one-way interleaving delay
0x8E	Actual interleaving Delay Downstream	Value in milliseconds which corresponds to the inter leaver setting.

Max Attainable Rate

Product Rate

Table 2 : Access loop characteristics sub-options

- ***Access Loop Encapsulation***
  - 0x90 – gives data link type, tagging, protocol info as per R-132 in TR-101 = "eth" for GEA-NGA2.

All of the above are formatted in accordance with Broadband Forum TR-101[4]

2.1.7.2 Inverted DHCP/PPPoE

The scenarios shown in the diagram below, where a DHCP Server or BRAS is located at an End Customer's premises served by GEA-NGA2 are not currently supported by the GEA-NGA2 data service. This may result in dropped session initiation frames and will result in the scenarios below not being able to successfully operate.

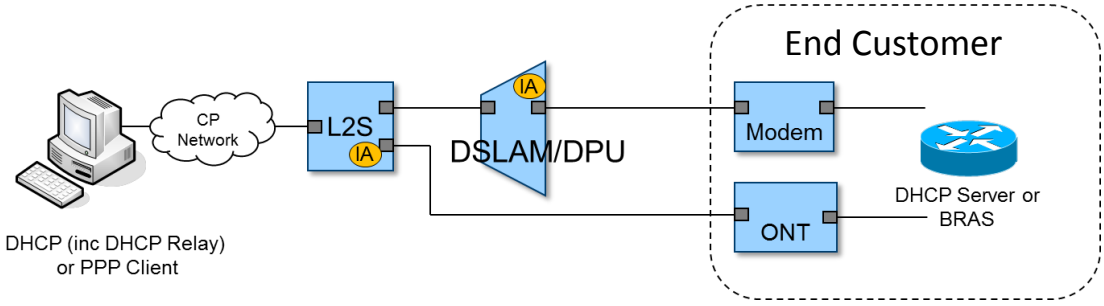


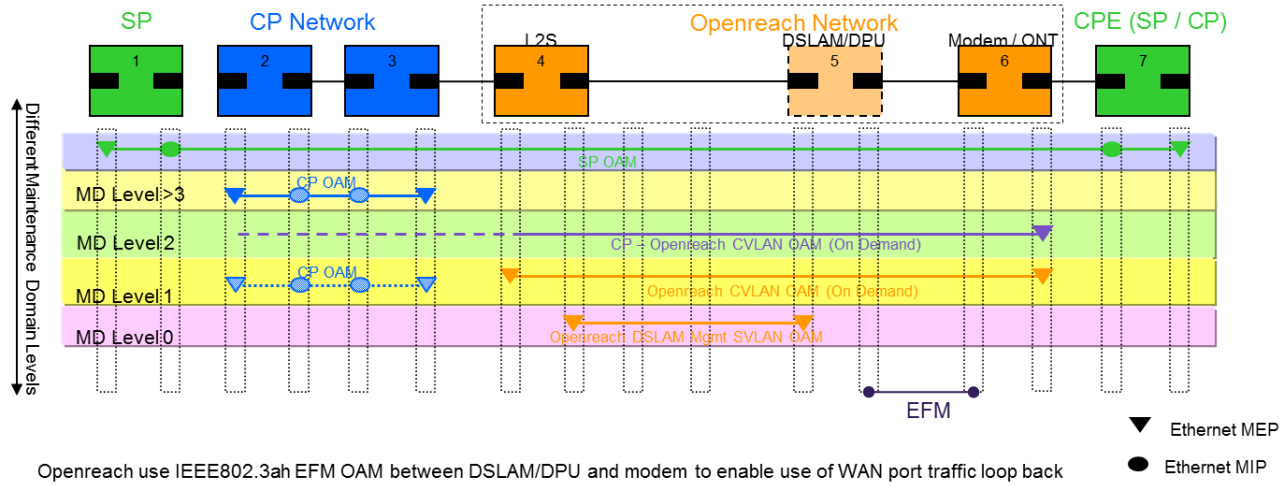
Figure 6 : Inverted DHCP/PPPoE

2.1.8 Ethernet OAM

Openreach provides CPs with the ability to test their GEA-NGA2 G.fast circuits end-to-end between the CP's equipment and the Openreach provided NTE. To do this CPs need to use Multicast Loopback Messages (MC LBMs) as described in Y.1731 [11] At Maintenance Domain (MD) Level 2 with a destination MAC address of 01-80-C2-00-00-32.

In addition, CPs can send Ethernet OAM information end-to-end across their GEA-FTTC connection at MD Levels 3 and above.

An interworking overview of OAM is shown in Figure 7 and Figure 8 below.



- Openreach use IEEE802.3ah EFM OAM between DSLAM/DPU and modem to enable use of WAN port traffic loop back
- Openreach use IEEE802.1ag /Y.1731 OAM at service layer
  - Openreach to use Level 0 and Level 1 OAM internally
  - Openreach to use Level 2 OAM for interworking with CP OAM

Note1: Openreach network is transparent to CP OAM at MD Level 3 and above
Note 2: Diagram is for illustrative purposes only

Figure 7 : OAM Interworking – Maintenance Domain Levels

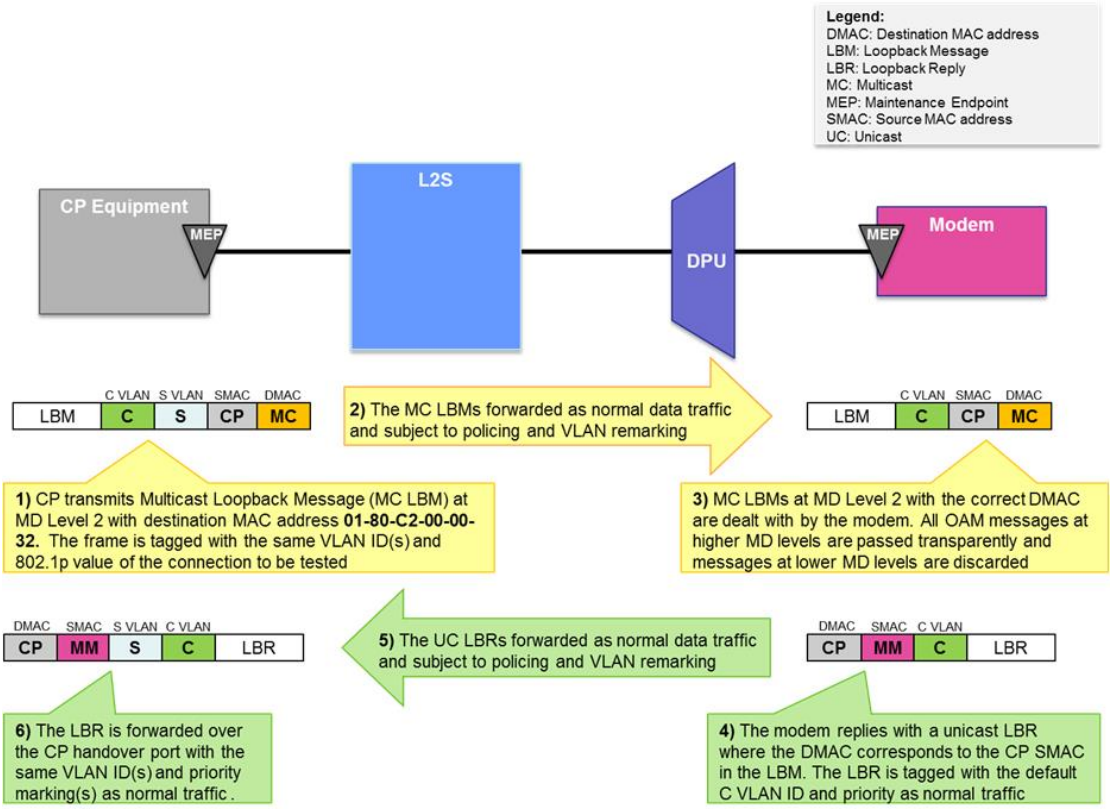


Figure 8 : OAM Interworking – Operation

2.1.9 Transparency

GEA-NGA2 G.fast will not be transparent to:

- 802.3x PAUSE – Local link flow control protocol
- Slow Protocols – Set of protocols that includes LACP and 802.3ah OAM
- 802.1X Authentication – Authentication protocol
- Physical layer signalling such as auto-negotiation

2.1.10 Frame Duplication

CP equipment must observe Ethernet bridging rules. In particular frames sent from Openreach to the CP must not be reflected back to the Openreach network with source MAC unaltered. This applies both downstream at the Cablelink port and upstream at the modem or DSL port. This applies both downstream at the Cablelink port and upstream at the modem or DSL port.

2.1.11 Multicast

The IP source address of IGMP queries sent downstream towards the End Customer equipment will be 0.0.0.0 (this is 172.17.17.17 in some instances on the NGA1 FTTC (VDSL) network). Otherwise the multicast service will support the same features as detailed in SIN498[9] and SIN503[10].

2.1.12 Network Timing Reference (NTR)

Openreach is currently investigating the support of synchronisation on G.fast. This will require, at high level the CP G.fast modem to support:

- G.fast NTR on the network side
- Sync support on the Ethernet side (SyncE + 1588v2)
- Any environmental outdoor usage specification depending on what synchronisation is used for.

A complete description of these requirements will be included in a future revision of this document if synchronisation is required.

2.1.13 Single Order G.fast

Openreach is consulting CPs on a potential Single Order G.fast service. Part of this may provide scope for a constrained bandwidth expedited Voice class using a specific 802.1p marking (e.g. 7).

A complete description of this requirement will be included in a future revision of this document if it comes in to scope.

2.2 User Network Interface – General

2.2.1 Dynamic Line Management

Dynamic Line Management (DLM) will be used on G.fast pilot lines. DLM monitors and manages lines to maintain a target link quality (speed and stability). DLM runs once a day based on line performance data collected during the previous day and makes changes in the G.fast line configuration if needed. Two parameters can be varied by DLM within the line configuration; the level of retransmission or the target noise margin. DLM operates independently on the downstream and upstream channels, although the same process is applied in each direction.
For poor lines (i.e. those not meeting the target link quality) increasing the level of retransmission is chosen in preference to increasing the target margin by DLM. Once the highest level of retransmission is reached then target margin is increased until the target link quality is achieved. For good lines (i.e. lines running in excess of the target link quality) a reduction in the target margin is chosen in preference to reducing the level of retransmission. If a line meets the target link quality then DLM will take no action.

Retransmission is applied by default in both the downstream and upstream channels at a low level to all new lines and is then increased by DLM if needed. In addition, maximum line rate caps are applied by default and within the DLM process which align to the selected product (i.e. the 330Mbit/s product will be capped at a maximum Ethernet throughput rate of 330Mbit/s).

Note: It is the DLM system that sets the line profile, and this should not be interfered with by CPs/users setting rates, SNR margins etc. at the modem.

2.2.2 UNI Port Loopback Testing

Test and diagnostic action will require an Ethernet port loopback to be applied to the modem port in order to loop downstream traffic back upstream to the Openreach test head or CP test head. These tests will interrupt upstream traffic from the End Customer and should therefore only be enabled with the End Customer's consent. The End Customer must also agree to stop any downstream Multicast Service traffic and power off their Set Top Box if they have one, as any GEA-NGA2 G.fast Multicast VLAN traffic may interfere with testing on the GEA-NGA2 G.fast Data VLAN.

In addition, once the port loopback has been enabled, unicast test traffic initiated by the user can be used to test connectivity and maximum upstream throughput.

2.3 Openreach Provided and installed Modem Product Variant

2.3.1 Use of NTEs

Openreach engineers will install a "Service Specific Face Plate (SSFP)" to the Openreach line box (i.e. NTE5) and Openreach G.fast modem in the premises as shown in Figure 9.

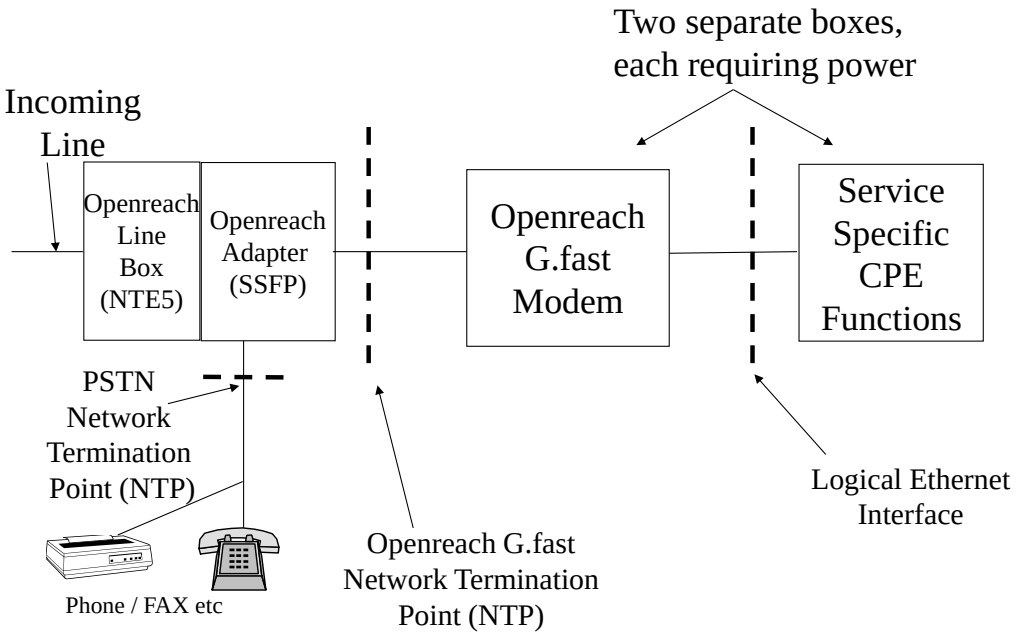


Figure 9 : Openreach Installed Centralised Filter Topology

The purpose of the SSFP is to isolate the high frequency G.fast signals from existing legacy products/wiring within the End Customer premises to prevent service degradation on those products.

The SSFP will fit to an NTE5C only. If any other type of NTE is present at the End Customer premises, the Openreach engineer will change this as part of the service provision visit.

If a CP chooses to offer a self install solution for the Openreach provided modem, then they must in addition adhere to sections 2.4.1and 2.4.2 for filters and Physical Network Termination specifications

The requirements for this SSFP are defined in Section **Error! Reference source not found.**. Openreach are currently redesigning the current SSFP to optimise it's performance for operating at G.fast frequencies.

2.3.2 Openreach NTE

For G.fast the Openreach NTE will be a modem. The active Ethernet End Customer port (i.e. Port LAN1) on the G.fast modem will be set to:

- 10/100/1000 Base-Tx Auto-negotiation (with RJ-45 connectivity)
  NOTE: this necessitates that the CPs Hub or router device shall support 10/100/1000BaseT interface to ensure the interfaces negotiate to 1000BaseT, otherwise the product speeds cannot be supported,
- Auto-negotiation and MDI/MDIX auto-sensing,

Data transfer supported at the G.fast line rate for all frame sizes. The Openreach G.fast NTE shall have a Gigabit Ethernet interface.

The technical specification of the interface connections provided by the NTE device is described in SIN 360[1].

2.3.2.1 Electrical Safety

The Openreach G.fast NTE is compliant with BS EN 60950-1 [2].

2.3.2.2 Location of NTE

The Openreach NTE will normally be wall mounted within the End Customer's premise, although it is safe to operate freestanding in either the horizontal or vertical plane. The NTE should not be stacked under/over other items that would impede air flow or prevent the unit dissipating heat.

2.4 CP provided G.fast Modem product variant

Openreach intend to introduce a GEA-NGA2 G.fast product variant that allows the CP to provide and be responsible for the user's G.fast modem. Typically this modem will be integrated with IP gateway functionality within a single device and connected to a single mains power source. CPs will be responsible for maintaining the firmware of their modems and monitoring their connectivity and performance typically via a TR-069[15] interface using CPE WAN management protocol (CWMP).

The CP provided modem and filtering device(s) must meet the requirements of this specification in order to provide reliable operation and to avoid harm to other VDSL2 and/or G.fast lines sharing the same cable binder. Openreach reserves the right to withhold or limit service where potential violation of the Access Network Frequency Plan (ANFP [17]) or impact to another customer's service is detected.

The detailed technical requirements for CP provided G.fast modems are defined in Section 3 of this document and the related test descriptions required to demonstrate compliance to these requirements are currently being developed.

The terms and conditions associated with the communication and deployment of those network changes for the pilot will be part of a pilot contract that can be requested via the NGA2 Product line. Further information will be shared via bilaterals and through the regular forums.

CPE connected to BT's network will be expected to be upgraded to remain compliant with the evolving BT network, as reflected in changes in this STIN.

2.4.1 Physical Network Termination

Openreach provide a metallic line with a line box, also known as a Network Terminating Equipment (NTE). The physical interface is the standard telephone socket on the line box as described in SIN 351[16].

The CP must supply a suitable filter that plugs into the NTE and a modem device which plugs into the filter. This filter is required to separate PSTN and G.fast signals carried on the same line. Two possible connection topologies exist for these filters:

Using a CP supplied, single, self-installed CPE G.fast centralised filter deployed between the line box and all PSTN CPE (centralised filter topology – see Figure 11).

The requirements for this centralised filter are defined in Section **Error! Reference source not found.**.

Using multiple CP supplied self-installed CPE G.fast in-line micro filters, one for each device plugged into the wired extensions off the line box (distributed filter topology – see Figure 10). The requirements for this distributed filter are defined in Section **Error! Reference source not found.**.

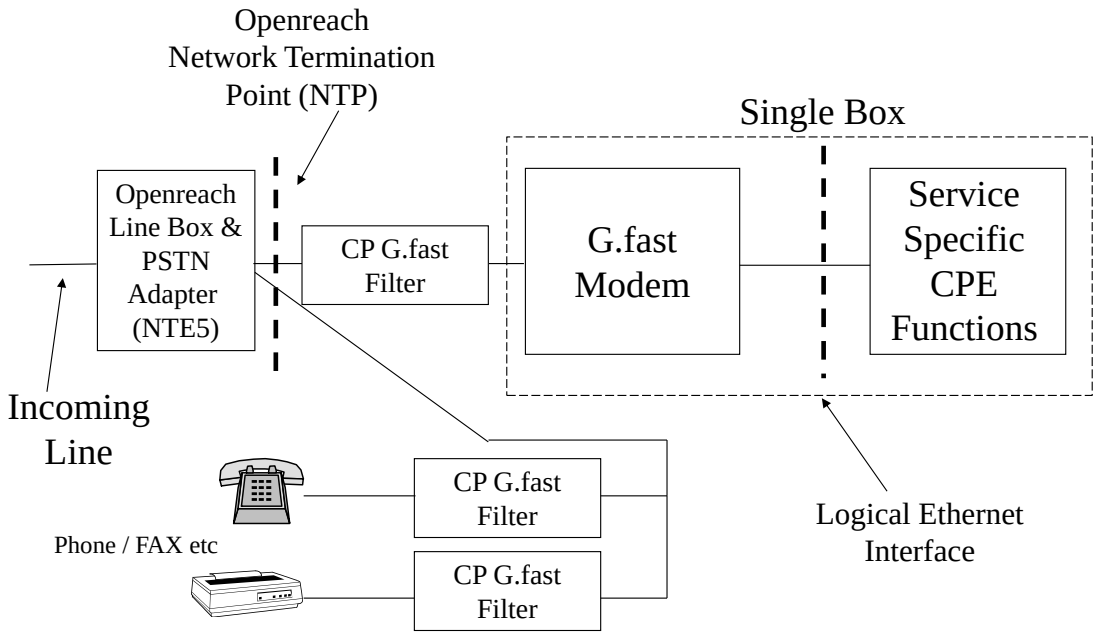


Figure 10 : Distributed Filter Topology

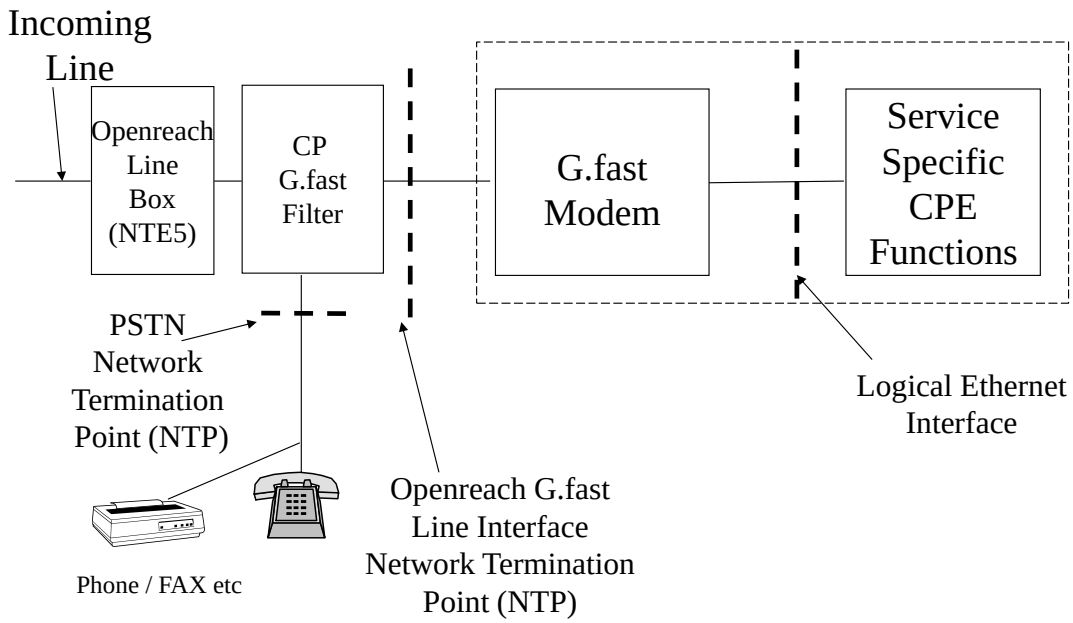


Figure 11 : Centralised Filter Topology

2.4.2 Filter Installation Topology

In the cases outlined in Figure 10 and Figure 11, the filters are classed as Customer Premises Equipment (CPE) and could be deployed in two distinct topologies. Either multiple distributed CP filters can be used as in the arrangement shown in Figure 10, or a single centralised in-line filter can be provided as in the arrangement shown in Figure 11. In all cases, there must be a filter function between the line-box and any item of PSTN CPE, including extension telephones, modems, fax machines, set-top boxes etc.

When CP G.fast filters are used, the network termination point (NTP) for G.fast services to which this STIN relates, is located at the Line-box. However the physical G.fast modem may be connected into one of the G.fast CP filters as shown in Figure 10, or into a centralised filter as shown in Figure 11.

Note that when a centralised CPE G.fast filter is in use as shown in Figure 11, the G.fast modem can ONLY be connected at the line-box, as the filter prevents the G.fast signal reaching the extension sockets.

For either of the above filter deployment scenarios, the CP shall ensure that the lead which is provided to connect the modem to the filter is of a suitable quality to optimise G.fast performance (e.g. a minimum of Category 5 cable).

3. CPE Requirements For GEA-NGA2 G.fast

This section defines the requirements of CP provided modems that must be met for connection to Openreach User network Interface (UNI). These requirements include logical functions within the CPE necessary to support and maintain Openreach services delivered over GEA-NGA2 G.fast.

The nomenclature used for each requirement is R.X.Y where:

R stands for requirement

X is the category (PHY, FAST, ETH, WAN, OAM)

Y is the requirement number

In this section the term "modem" refers to the CP provided modem and "WAN Interface" refers to the interface on the modem connecting to the Openreach GEA-NGA2 network.

3.1 Scope

The protocol layers within this scope are depicted in Figure 12.

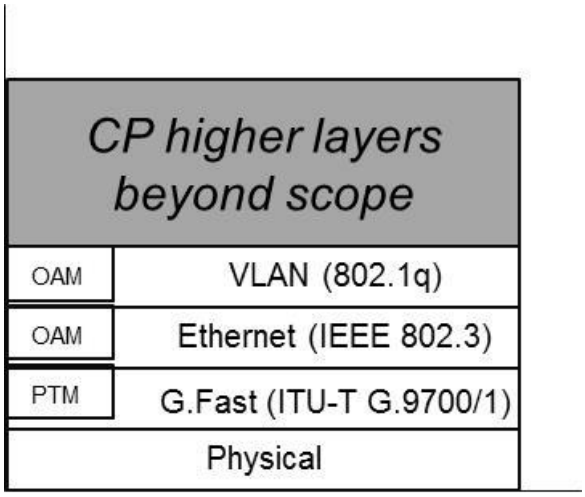


Figure 12 : Protocol Layers in Scope for GEA

3.2 Requirements

The CP provided modem shall support all the requirements as described in the following subsections. Additional guidance is also provided as a "Note" where appropriate.

3.2.1 Physical Connection

R.PHY.1 The socket on the modem connecting to the Openreach UNI (i.e. WAN port) shall be either a RJ11 or RJ45 type to enable it to be connected to the G.fast filter using standard leads. The G.fast connection is presented on the middle two pins (i.e. pins 3&4 (RJ11) or pins 4&5 (RJ45)). The other pins are not connected. Pin numbering is from the left, looking into the socket with the contacts uppermost. Polarity is unimportant.

Note: Openreach do not currently offer a bonded G.fast product (where two or more G.fast lines are connected to one modem device to increase bandwidth). This STIN will be updated if and when Openreach offer this feature.

3.2.2 G.fast Requirements

R.FAST.1 The CP or their equipment supplier shall demonstrate that their G.fast WAN modem chip-set or CPE device has successfully passed BBF G.fast Certification (based around BBF ID-337).

R.FAST.2 CP modems shall support the mandatory requirements of ITU-T Recommendations G.9700 and G.9701 including subsequent Corrigenda and Amendments as consented / approved.

R.FAST.3 CP modems shall support ITU-T Recommendations G.9700 and G.9701 profile 106a and profile 106b. If 106b is not supported, performance may be materially impacted.

R.FAST.4 CP modems shall meet the requirements of the UK Access network Frequency Plan (ANFP) [17] and the specification in Part F.

R.FAST.5 CP modems shall use handshake tone-set AA43C as defined in ITU-T Recommendation G.994.1 [12]. In addition, these tones shall be shaped to comply with the requirements of Sections 4.1 or 4.4 of the UK Access Network Frequency Plan [17]. The use of additional tone-sets (B43, B43c, V43 etc) is not permitted as these may cause adverse interference to other DSL systems operating in the same cable binder.

R.FAST.6 CP modems shall be spectrally compatible with other 17.664MHz VDSL2 services when operating in G.fast mode.

R.FAST.7 CP modems shall be capable of supporting an aggregate (i.e. upstream plus downstream) bandwidth of 1Gbit/s for 2 to 106MHz operation.

R.FAST.8 CP modems shall support downstream and upstream retransmission as defined in G.9701, clauses 9.8.3.3, 11.4.2.6 and 11.4.2.7

R.FAST.9 CP modems shall support vectoring in both upstream and downstream directions as defined in G.9701, clauses 10.3, 10.8 and 11.4.3.

R.FAST.10 CP modems shall support Seamless Rate Adaptation (SRA) as defined in G.9701, clause 13.2.1.1

R.FAST.11 CP modems shall support Fast Rate Adaption (FRA) as defined in G.9701, clause 13.3.1.1.

R.FAST.12 CP modems should have a receiver noise floor of better than -150dBm/Hz.

R.FAST.13 CP modems should support a maximum Aggregate Transmit Power (ATP) of 8dBm in the upstream direction.

R.FAST.14 CP modems shall support a maximum Aggregate Transmit Power (ATP) of 8dBm in the downstream direction.

R.FAST.15 CP modems should be capable of transmitting at PSDs of up to -65dBm/Hz at frequencies up to 30MHz.

R.FAST.16 CP modems shall be capable of supporting a TDD frame lengths of 36 symbol periods as defined in G.9701 clause 10.5. For a 36 symbol frame, the current default downstream to upstream ratio used by Openreach is 77:23 (i.e. 27 downstream symbols to 8 upstream symbols),

NOTE – The ITU-T G.9701 Recommendation also specifies the support of 23 symbol TDD frames. Currently this option is not supported by Openreach. This STIN will be updated if this changes.

R.FAST.17 CP modems shall correctly report DFT output samples (as defined in G.9701 clause 10.3.2.2) and MREFPSDus (as defined in G.9701 clause 7.3.2) to support the correct computation of downstream and upstream Hlog as defined in G.9701 clause 11.4.1.2.1.

R.FAST.18 CP modems shall correctly report DFT output samples (as defined in G.9701 clause 10.3.2.2) to support the correct computation of upstream Quite Line Noise (QLN) as defined in G.9701 Clause 11.4.1.2.3.

R.FAST.19 CP modems shall correctly report Active Line Noise (ALN) as defined in G.9701 Clause 11.4.1.2.4.

R.FAST.20 CP modems shall support low power modes as defined in G.9701 clause 11.2.2.16. In addition, the G.fast modem shall use a traffic driven control method for low power modes as defined in G.9701 clause 11.2.2.16.

R.FAST.21 CP modems shall correctly report inventory information as defined in G.994.1, clause 9.3.3.1 and G.9701, clause 11.2.2.10. Specifically this shall include vendor ID, version number and serial number. Coding for the vendor ID information block is shown in Table 3.

NOTE – This field should typically identify the vendor of the ITU-T G.994.1 functionality, whether implemented in hardware or software. It is not intended to indicate the system integrator.

T.35 country code (2 octets – Note 1)
Provider code (vendor identification) (4 octets – Note 2)
Vendor-specific information (2 octets)
NOTE 1 – If the bits in the first octet are not all set to binary ONE, the bits in the second octet shall be set to binary ZERO by the transmitter and ignored by the receiver. The only purpose of the country code is to identify the country of registry of the provider code. NOTE 2 – Specification of the coding and order of transmission of this field is the responsibility of the regional standards body allocating the provider code. See Appendix II of G.994.1 for provider code contact information.

Table 3 : VendorID information block

R.FAST.22 CP modems shall support a bit loading of at least 14 bits/tone in both upstream and downstream directions.

R.FAST.23 CP modems shall correctly report performance data as defined in Section 7 of G.997.2.

R.FAST.24 CP Modems shall support RFI and IAR (International Amateur Radio) notching as defined in G.9700, clauses 6.5 and 7.2.1 and G.9701, clause 7.3.1.2.

R.FAST.25 CP modems shall support upstream power back-off (UPBO) as defined in G.9701, clauses 7.3.1 and 7.3.1.4.

R.FAST.26 CPE vendor information shall be reported as shown in Table 4.

Attribute (G.997.2 Clause)	**Description (Format)**	**Examples**
FTUR_GHS_VENDOR (7.13.1.2)	FTU-R ITU-T G.994.1 Vendor ID (8 binary octets)	xx:00:11:22:33:44:55:66 (where xx is the ITU-T T.35 country code) and 11:22:33:44 is the Provider code)
FTUR_VERSION (7.13.1.4)	FTU-R Version Number (Up to 16 ASCII characters as: <FTU-R firmware version><space><FTU-R model>). In this context FTU-R refers to the G.9701 chipset	
NT_SYSTEM_VENDOR (7.13.2.2)	NT system G.9701 vendor ID (8 binary octets). Refers to system integrator of smallest field replaceable unit, in this case the CPE.	xx:00:11:22:33:44:55:66 (where xx is the ITU-T T.35 country code)
NT_SYSTEM_SERIALNR	NT system G.9701 serial	

(7.13.2.4	number (Up to 32 ASCII characters as: <NT serial number><space><NT model><space><NT firmware version>). Refers to system integrator of smallest field replaceable unit, in this case the CPE.	

Table 4 : CPE Vendor Information block

NOTE: Once the Broadband Forum has published TR-380 (G.fast performance test suite), Openreach will expect CP modems to deliver or exceed the specified performance targets.

NOTE: Openreach does not currently offer a timing reference source solution over G.fast. CP's seeking to implement a timing reference source for future functionality should consider NTR as per G.9701

NOTE: CP's shall undertake to remotely manage the upgrade and roll-back of their modem firmware to enable mitigation of future network changes on their live modem population.

3.2.3 Ethernet Layer

R.ETH.1 The modem shall support an Ethernet frame size of between 68 and 1534 bytes. For clarity this figure includes 4 bytes for the C-VLAN and excludes bits allocated to pre-amble, Inter-frame Gap and Frame Check Sequenc at the user network interface (UNI). Support for frame sizes above 1534 bytes (inclusive of C-VLAN) is not guaranteed.

NOTE: The CPs G.fast modem shall support a 10/100/1000BaseT interface to ensure any interfaces negotiate to 1000BaseT as otherwise the product speeds cannot be supported

3.2.4 WAN VLAN Layer

R.WAN.1 The modem shall support IEEE 802.1q VLAN encapsulation.

R.WAN.2 All ingress frames to the Openreach UNI shall be encapsulated within an IEEE 802.1q VLAN (C-VLAN) which will be used for routing within Openreach.

R.WAN.3 Where the CP intends to use Multicast for GEA, the modem shall be capable of simultaneously supporting Multicast and Unicast over the same single-tagged VLAN.

R.WAN.4 The Ethertype (Tag Protocol Identifier) field of the Ethernet frame shall be set to 0x8100 on ingress to Openreach UNI. On egress, Openreach will also set this field to 0x8100.

R.WAN.5 The CVLAN Canonical Format Indicator shall be zero on ingress to Openreach UNI. Openreach will set this to zero towards the modem.

R.WAN.6 Where the CP intends to use GEA data and Multicast for GEA services the VLAN ID shall be set to 101 (ingress and egress). Traffic without a correct VLAN ID will be dropped.

R.WAN.7 Where the CP intends to use Multicast, IGMP reports destined for Openreach Multicast for GEA shall be encoded as IGMPv3 or IGMPv2 over C-VLAN ID 101. Source Specific Multicast option within IGMPv3 must not be used.

R.WAN.8 Where the CP is using PPP and intends to use Multicast for GEA, the modem shall be able to detect and process multicast frames differently to unicast. Multicast for GEA frames sent into Openreach (IGMP reports) shall not be encapsulated with PPP otherwise they will passed transparently as normal GEA traffic.

NOTE: In addition to the Openreach requirements set herein, the modem should also support NICC Ethernet ALA Service Definition [20].

NOTE: Scheduling priority to the upstream G.fast line speed is a function within the modem. If different traffic QoS levels are to be supported, careful consideration should be given to the potential for starvation of low priority queues within the modem and the impact this might have on the user experience and fault rates.

NOTE: It is recommended that IGMP membership reports are given a high queue scheduling priority.

NOTE: Where the modem is configured with an IGMP proxy function, it may be useful to know that the Openreach Multicast for GEA will accept IGMP packets with a source address of 0.0.0.0.

NOTE: Modem providers are urged to pay close attention to the challenges of IPv6 support. Openreach currently provide DHCP Option 82 insertion support for IPv4. To ensure the equivalent is supported in future IPv6 networks, namely Lightweight DHCPv6 Relay Agent, modem vendors should implement DHCPv6 in accordance to BBF TR-177 [22] and referenced IETF standards within that document. Close attention to on-going developments of these documents is also recommended.

NOTE: Openreach expect CPs to only configure their devices for and send traffic for GEA Data on VLAN101. No other VLANs should be used and if they are then this may impact service. In addition Openreach may use other VLAN tags on the DSLAM access port for internal use, traffic from any other VLANs apart from VLAN101 should be ignored/dropped.

3.2.5 Ethernet OAM

R.OAM.1 CP modems shall support “Dying Gasp” as defined in G.9701, clause 11.3.3.2.

R.OAM.2 The CP modem shall support EFM OAM as per IEEE 802.3 Clause 57.

R.OAM.3 Openreach require to collect the statistics defined in IEEE 802.3.1-2013 Annex B before and after a speed test (initiated from Central Test Head) to calculate throughput and loss based on the counter increments. Details of the statistics are provided in Table 5.

R.OAM.4 The CPE shall support the EFM OAM loopback feature which allows downstream test traffic to be returned upstream towards the DPU. The loopback shall be initiated and terminated by the DPU via the appropriate EFM OAMPDUs.

R.OAM.5 RX and TX statistics detailed in Table 5 must be collected on the WAN side of the EFM OAM loopback capability in the CPE in order for the statistics counters to increment whilst the loopback is in place.

IEEE Std 802.3 Clause 30 object name	BRANCH	LEAF
aFramesTransmittedOK	7	2
aFramesReceivedOK	7	5
aOctetsTransmittedOK	7	8
aOctetsReceivedOK	7	14
aMulticastFramesXmittedOK	7	18
aMulticastFramesReceivedOK	7	21
aBroadcastFramesXmittedOK	7	19
aBroadcastFramesReceivedOK	7	22
aFrameCheckSequenceErrors	7	6
aFramesTooLong	7	56
aRunts	7	58

Table 5 : OAM Statistics

NOTE: Retrieval of statistics from a CPE will be initiated via the EMS or from Openreach test systems.

NOTE: The DPU will transmit a Variable Request OAMPDU to the CPE as defined in IEEE 802.3-2012 Section 5 Clause 57.4.3.3 containing a list of predetermined set of statistics that are to be retrieved from the CPE.

R.OAM.6 The CPE shall respond with the values for each statistic by transmitting a Variable Response OAMPDU as defined in IEEE 802.3-2012 Section 5 Clause 57.4.3.4 back to the DPU.

NOTE: The statistics are then displayed on the EMS GUI and forwarded to Openreach test systems.

R.OAM.7 The CPE G.fast ports shall have EFM OAM permanently enabled, and configured as Passive in order to maintain a permanent OAM session with the Active DPU.

3.2.6 Filter Requirements

In order to ensure correct operation with BT's GEA-NGA2 G.fast and PSTN networks, filter devices intended for connection to BT GEA-NGA2 G.fast lines shall meet one of two alternative sets of recommendations.

R.FILTER.1 Centralised filters shall comply with the requirements of ETSI Specification TS 101 952-1 extended to 212MHz as set out in Section **Error! Reference source not found.** [18].

R.FILTER.2 Distributed filters shall comply with the following requirements of ETSI Specification TS 101 952-3 extended to 212MHz as set out in Section **Error! Reference source not found.** [19].

3.2.6.1 Centralised Filters

Centralised filters shall comply with the following requirements of ETSI Specification TS 101 952-1 extended to 212MHz:

I. Option B category of TS 101 952-1
II. The option to support metering pulses as described in Section 6.7 of TS 101 952-1 does NOT need to be implemented
III. The option to provide common mode rejection as described in Section 6.14 of TS 101 952-1 does not need to be implemented, although it is known that this option can help to improve service reliability
IV. The applicable tables in Normative Annex A of TS 101 952-1 for VDSL2 filters are:
    - Table A.2 (Dedicated requirements for splitters for xDSL system variants)
    - Table A.3 (Differentiation of IL in the xDSL band between LE and TE side)
    - Table A.6 (Dedicated frequency ranges for splitters for VDSL2 system variants)
    - Table A.9 (Dedicated requirements for passive splitters for VDSL2 over POTS variants at the TE side)

3.2.6.2 Distributed Filters

Distributed filters shall comply with the following requirements of ETSI Specification TS 101 952-3 extended to 212MHz:

I. Option B category of TS 101 952-3
II. The option to support metering pulses as described in Section 6.7 of TS 101 952-3 does NOT need to be implemented
III. The applicable tables in Normative Annex A of TS 101 952-3 for VDSL2 filters are:
    - Table A.2 (Dedicated requirements for splitters for xDSL system variants)

- Table A.3 (Overview of all POTS band requirements for all types of filters and N values)
- Table A.6 (Overview of insertion loss in the xDSL band for all types of filters)
- Table A.7 (Dedicated frequency ranges for distributed filters for VDSL system variants)

Where appropriate the requirements for either the "Standard" filter class (see Section 6.1.1 of TS 101 952-3) with N=3 or the "Enhanced" filter class with N=4 shall be selected from the appropriate column in the tables (N is the minimal number of parallel filters in the test setup – see section 6.4.1 of TS 101 952-3)

IV. If the CP filters are to be used in a multiple filter topology, the filter shall meet the requirements of TS 101 952-3 with up to two other CP filters (Standard) or three CP filters (Enhanced) connected in parallel with the CP filter under test. Each filter shall have its Telephony Port open circuit.

3.2.6.3 Additional notes about CPE filters

The standard BT PSTN CPE interface is a 3 wire circuit (A-line, B-line and bell wire) whereby the bell wire is AC-coupled from the B-line. This bell wire must either be filtered by the filter or left open circuit at the Line Port and recreated at the Telephony Port of the filter. This may be achieved using a 1.8 μF capacitor between the B line (pin 5) and the bell wire (pin 4) at the Telephony Port.

It should be noted that during normal operation of BT PSTN services switching may occur between line states such as line feed, reversed line feed, ringing and dialling (loop disconnect or tone). These changes of state may be associated with large transient voltage excursions. The performance of data circuits operating from the G.fast Port under these conditions is a function of the data modem internal performance. This and other factors may be a cause for specifications outside the scope of this document.

The A-line and B-line may be disconnected, shorted together, taken to earth or connected to standard network conditions (Voltages up to -95 V, PSTN conditions, ringing etc) at any point in the system. No maintenance intervention should be required after such an event to restore normal modem operation.

3.2.6.4 Supplementary Information

The CP shall ensure that the lead which is provided to connect the modem to the filter is of a sufficient quality not to compromise G.fast performance (e.g. a minimum of Category 5 UTP cable).

CPs considering the requirements of their network connectivity devices for the medium to long term future, may wish to consider the applicable General Conditions of Entitlement (see Note 1) for PATS and other services, in addition to other guidance documents such as Ofcom's "Guidelines on the use of battery back-up to protect lifeline services delivered using fibre optic technology" (see Note 2) when specifying their wider modem/router requirements. Should applicable regulation or guidance change, a revised version of this STIN may result.

NOTE 1: http://stakeholders.ofcom.org.uk/telecoms/ga-scheme/general-conditions/

NOTE 2: http://stakeholders.ofcom.org.uk/consultations/superfast-broadband/summary

4. References

[1]	SIN 360	Ethernet Customer Interfaces, Interface Characteristics.
[2]	BS EN 60950-1	Information technology equipment. Safety. General requirements. http://www.bsigroup.com
[3]	IEEE 802.3	Standards for Local Area Networks: CSMA/CD Access Method
[4]	BBF TR-101	Broadband Forum – Migration to Ethernet-Based DSL Aggregation
[5]	IEEE 802.1ad	Virtual Bridged Local Area Networks, Amendment 4: Provider Bridges
[6]	IEEE 802.1D-2004	IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges
[7]	ITU-T G.9700	Fast access to subscriber terminals (G.fast) – Power spectral density specification
[8]	ITU-T G.9701	Fast Access to Subscriber Terminals (FAST) – Physical layer specification
[9]	SIN 498	Fibre to the Cabinet (FTTC) Generic Ethernet Access Service and Interface Description
[10]	SIN 503	Generic Ethernet Access Multicast, Service & Interface Description
[11]	ITU-T Y.1731	OAM functions and mechanisms for Ethernet based networks
[12]	ITU-T G.994.1	Handshake procedures for digital subscriber line transceivers
[13]	ITU-T G.997.2	Physical Layer Management for G.fast Transceivers
[14]	BBF ID-337	G.fast Certification Test Plan
[15]	BBF TR-069	CPE WAN Management Protocol
[16]	SIN 351	BT Public Switched Telephone Network (PSTN): Technical Characteristics Of The Single Analogue Line Interface
[17]	NICC ND:1602	Specification of the Access Network Frequency Plan (ANFP) applicable to transmission systems used on the BT Access Network
[18]	ETSI TS 101 952-1	Access network xDSL splitters for European deployment; Part 1: Generic specification of xDSL over POTS splitters
[19]	ETSI TS 101 952-3	Access. Networks, Transmission and Multiplexing (ATTM); Access network xDSL splitters for European deployment; Part 3: Generic specification of static distributed filters for xDSL over POTS.
[20]	NICC ND:1030	Ethernet ALA Service Definition

Note: For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

5. Abbreviations

Abbreviation	Description
BRAS	Broadband Remote Access Server
CFPCG	Copper and Fibre Products Commercial Group
CP	Communications Provider
C-VLAN	Customer VLAN
DHCP	Dynamic Host Configuration Protocol
DLM	Dynamic Line Management
DPU	Distribution Point Unit
DTH	Double Tagged Handover
EFM	Ethernet in the First Mile
EU	End Customer (previously referred to as End User)
FC/PC	Fixed Connection – fibre optic connector
FEC	Forward Error Correction
FEXT	Far End Crosstalk
FoD	Fibre on Demand
FRA	Fast Rate Adaptation
FTTC	Fibre To The Cabinet
FTU-R	Fast terminating Unit – remote (i.e. customer end device)
GEA	Generic Ethernet Access
GEA-NGA2	Generic Ethernet Access Next Generation Access
GEM	GPON Encapsulation Method
IA	Intermediate Agent
IFG	Inter-Frame Gap
IGMP	Internet Gateway Managed Protocol
IP	Internet Protocol
L2S	Layer 2 Switch (with integrated OLT)
LACP	Link Aggregation Control Protocol
LAN	Local Area Network
LBM	Loopback Message
LC	Lucent Connector/Local Connector – fibre optic connector
MAC	Media Access Control
MD	Maintenance Domain
MDI/MDIX connection	Medium Independent interface (cross-over) – Ethernet port
NTE5	Network Terminating Equipment #5. The point in the customer's premises where the Openreach network terminates.

NGA	Next Generation Access
NGA1	Superfast Broadband
NGA2 G.fast	Ultrafast Broadband
NT	Network Termination
NTR	Network Timing Reference
OAM	Operations, Administration, Maintenance
PADI	PPPoE Active Discovery Initiation
PADO	PPPoE Active Discovery Offer
PADS	PPPoE Active Discovery Session- confirmation
PCP	Priority Code Point aka 802.1p priority. See [19]
PCP	Primary Cross-cconnect Point (aka cabinet)
PON	Passive Optical Network
PPP	Point to Point Protocol
PPPoE	Point to Point Protocol over Ethernet
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RJxx	Registered Jack – a standardised physical network connector
SC	Standard Connector – fibre optic connector
SIN	Suppliers' Information Note (BT publication)
SRA	Seamless Rate Adaptation
SSFP	Service Specific Face Plate
STB	Set-Top Box
STH	Single Tagged Handover
STIN	Suppliers' Trial Information Note (BT publication)
S-VLAN	Service VLAN
UNI	User Network Interface
UTP	Unscreened Twisted Pair
VDSL	Very high-speed Digital Subscriber Line
VDSL2	Second generation VDSL
VLAN	Virtual Local Area Network

6. History

Issue	Date	Changes
1	6th May 2016	First version of STIN
2	September 2017	Updated version including specif technical requirements for CP modems.

Annex A – Self- Certification of CP Provided Modems

The introduction of a self certification option for CPs to use to test their G.fast modem/routers against, will enable CPs to test most of the requirements detailed in this STIN in their own environments, or that of their suppliers. CPs will be able to submit their devices to Openreach for a much shorter G.fast Modem Conformance test, after sharing the results of their self certification testing with Openreach for verification.

It is hoped that introduction of this process will enable faster acceptance of devices onto the Openreach network, reducing costs and time to market for G.fast devices.

The following Table shows which requirements can be verified by CPs and which would be verified by BT. Verification should be demonstrated using one of the Openreach G.fast flight cases (contact flightcase.bookings@bt.com for details).

Requirement	Description	Verification by
R.PHY.1	Physical Connector	CP
R.FAST.1	BBF G.fast Certficiation	CP
R.FAST.2	Compliance with mandatory sections of G.9700 and G.9701	CP
R.FAST.3	Support of Profile 106a and 106b	CP
R.FAST.4	Compliance with Part F of the UK ANFP	BT
R.FAST.5	Support of AA43C handshake tones (i.e. A43 and A43 only)	BT
R.FAST.6	Compatibility with 17MHz VDSL2	BT
R.FAST.7	Aggregate 1Gbps capacity (2 to 106MHz)	CP
R.FAST.8	Support of upstream and downstream retransmission	CP
R.FAST.9	Support of upstream and downstream vectoring	BT
R.FAST.10	Support of seamless rate adapation (SRA) in both upstream and downstream directions	BT/CP
R.FAST.11	Support of fast rate adapation (FRA) in both upstream and downstream directions	BT
R.FAST.12	CPE noise floor ≤ -150dBm/Hz	CP
R.FAST.13	Support of 8dBm aggregate downstream transmit power	CP
R.FAST.14	Support of 8dBm aggregate upstream transmit power	CP
R.FAST.15	Capable of transmitting at PSDs of up to -65dBm/Hz at frequencies up to 30MHz.	BT
R.FAST.16	Support of TDD frame lengths of 36 symbol periods	CP
R.FAST.17	Correct reporting of Hlog	BT

R.FAST.18	Correct reporting of QLN	BT
R.FAST.19	Correct reporting of ALN	BT
R.FAST.20	Support of low power modes	CP
R.FAST.21	Correct inventory reporting	BT
R.FAST.22	Support of up to 14bits/tone in both upstream and downstream directions	CP
R.FAST.23	Correct reporting of performance data	BT
R.FAST.24	Support of RFI and ARI notching	BT
R.FAST.25	Support of upstream power back-off (UPBO)	BT
R.FAST.26	Correct reporting of vendor information	BT
R.ETH.1	Support of an Ethernet frame size of between 68 and 1534 bytes.	CP
R.WAN.1	Support of IEEE 802.1q VLAN encapsulation	CP
R.WAN.2	Support of encapsulation within an IEEE 802.1q VLAN (C-VLAN)	CP
R.WAN.3	Support of Multicast and Unicast over the same single-tagged VLAN.	CP
R.WAN.4	Ethertype (Tag Protocol Identifier) field of the Ethernet frame set to 0x8100	CP
R.WAN.5	CVLAN Canonical Format Indicator set to zero	CP
R.WAN.6	VLAN ID set to 101 for when GEA Data and Multicast are used	CP
R.WAN.7	IGMP reports encoded as IGMPv3 or IGMPv2 over CVLAN ID 101	BT
R.WAN.8	Multicast for GEA frames not encapsulated with PPP	BT
R.OAM.1	Support of “dying gasp”	BT
R.OAM.2	Support of EFM OAM as per IEEE 802.3 Clause 57	CP
R.OAM.3	EFM OAM statistics collection	BT
R.OAM.4	EFM OAM loopback	BT
R.OAM.5	RX and TX statistics collection point	CP
R.OAM.6	EFM OAM statistics collection response	BT
R.OAM.7	EFM OAM enabled on CPE G.fast ports	CP
R.FILTER.1 / R.FILTER.2	Compliance to ETSI TS 101 952 Part 1 (extended to 212MHz) or Part 3 (extended to 212MHz)	CP

<END>