LR-VDSL GEA-FTTC
Delivering faster broadband to more customers

Industry Consultation

Proposal Document Issue 1.0
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1 Document Contents

This document sets out Openreach’s industry consultation on Long Reach VDSL (LR-VDSL) including the service technical capabilities and proposed processes for industry operation.

2 Consultation Outline

This consultation seeks industry views on the potential deployment of Long Reach VDSL. LR-VDSL could be one of the solutions used by Openreach and Communications Providers to meet the Government’s universal broadband service objectives, as set out in the Digital Economy Act 2017.

Ofcom’s recent Wholesale Local Access (WLA) Market Review outlined a potential regulatory process to enable the introduction of services like LR-VDSL. Ofcom also set the expectation that industry and Openreach would work together to better understand and design any new or replacement services. This consultation picks up that cue and aims to provide industry with early visibility of LR-VDSL technical capabilities and an opportunity to provide input into replacement services.

We appreciate that this consultation is being carried out at a time when there is still some uncertainty around the Government’s proposals. However, we believe that LR-VDSL will be a part of any solution and whilst we do not have all the precise details at this stage we feel it is important to engage with industry as early as possible.

3 Consultation Objectives and Timescales

This consultation document has been issued to seek comments from Communications Providers on the proposed deployment of LR-VDSL. This marks the start of our formal customer engagement programme that will be conducted through the following Industry communications channels:

- Industry Forum - Copper & Fibre Products Commercial Group (CFPCG)
- Individual bi-lateral meetings as requested by CPs.
- Multi-lateral meetings with CPs.
- Meetings with representative industry groups e.g. Federation of Communication Services (FCS)

Openreach invites responses and any further comments or views on this initial proposal document by 14 July 2017 – see Section 6 “Guidance on Responding to this Document”.

If you require any further assistance interpreting any of the information given in this document please contact Alison Walpole at alison.walpole@openreach.co.uk.

4 LR-VDSL Overview

The majority of superfast broadband delivered today by Openreach relies on Generic Ethernet Access over Fibre To The Cabinet (GEA-FTTC). Using this technology speeds are dependent upon the distance that the copper cable runs between the Openreach cabinet and end customer premises. The GEA-FTTC technology currently deployed is called VDSL2. Premises situated within a few hundred metres of a street cabinet may be able to achieve download speeds close to the maximum possible, however, those situated further away may achieve lower speeds.
LR-VDSL is a modified version of the same VDSL2 technology that already exists in Openreach’s GEA-FTTC network. It is aimed at delivering download speeds >10 Mbps at the NTE for GEA-FTTC lines that are currently either receiving a download speed of <10 Mbps or for lines that Dialogue Services show would be unable to receive a download speed >10 Mbps.

In order to prevent exchange based ADSL, ADSL2, ADSL2+ or SDSL (all referred to as “xDSL”) customers served via a cabinet selected for LR-VDSL being adversely affected, these lines must be migrated to a non-exchange based service (either VDSL or LR-VDSL, depending on D-side insertion loss measured at 300kHz).

Openreach believes that the LR-VDSL technical enhancement to the VDSL2 product would have considerable benefits for end customers and industry in terms of download speed and increased superfast broadband footprint.

4.1 Results of trial to date
We have been running a Proof of Concept to test LR-VDSL in the live network since May 2016, and an LR-VDSL trial began in March 2017 with Communications Providers.

Downstream improvement rates at trial locations currently range from 0.1 Mbps – 22 Mbps. There is an expectation that average downstream speeds will increase by c16 Mbps at the point of strategic deployment. There is a potential reduction in upstream speed on certain trial lines due to the upstream bands used in the 8b frequency profile for LR-VDSL.

Three lines which had been put onto LR-VDSL appeared to have a better performance with standard VDSL, investigation is under way.

We are still awaiting two sites to be migrated so results are a very early indication. The migration window to move LLU SMPF lines to GEA-FTTC has been extended from 30 March 2017 to 11 May 2017 to give customers more time to place orders.

4.2 Proposed customer protection product specification
We are very keen to ensure that xDSL customers are suitably protected when a cabinet is migrated to LR-VDSL. To this end where customers are currently consuming copper broadband we are considering the introduction of one or more new protection products to support the deployment of LR-VDSL. These products would only be available for existing xDSL customers at the point at which they are migrated to VDSL services to ensure their product speed is not adversely affected post LR-VDSL deployment. The speed of the protection products would be designed to ensure that customers suffer
no degradation in service performance, whilst still leaving room for Communications Providers to offer superior products within the VDSL portfolio. New customers in a LR-VDSL cabinet area would be able to select from the VDSL portfolio, but since they do not use xDSL would not be offered the protection product.

Appropriate protection products would be provided at no additional rental costs when compared with the current xDSL service.

In support of the migration process we are also considering that we would fund self-install of the new VDSL service (managed install as required for vulnerable customers) as well as a contribution towards new CP provided Customer equipment if necessary.

Response Prompt 01. CPs are asked to consider the implications and opportunities that arise from a new customer protection product.

4.3 LR-VDSL specification

LR-VDSL is a set of changes to the way VDSL is operated in the network to extend the rate vs reach of GEA-FTTC. Each of the changes can be applied independently but work best when applied together. The components are as follows:

- Changes to the VDSL protocol to enable it to synchronise on long loops and to ensure VDSL always outperforms ADSL2+ from the exchange. Long Reach VDSL will be based on ITU-T G.993.5 Annex B “Vectored Long Reach VDSL2”, targeted at G.993.5 Amendment 2 and an equivalent annex in G.993.2. Approval of these amendments is expected late 17/18. Before this new annex is available, Openreach will use the existing “8b” profile which allows a higher transmit power to boost performance of existing lines, but cannot synchronise on very long loops.
- The removal of PSD shaping below 2.2MHz and boosting the PSD to the ITU-T mask. This causes significantly higher crosstalk into exchange based systems
- Enabling vectoring to prevent rate reduction due to crosstalk. Vectoring is already used in the platform and CPE functionality verified as part of MCT. We will need to work with all CPs to confirm modem compatibility.

This will enable GEA-FTTC VDSL2 lines with a D-side length in excess of 1.25km (0.5mm diameter copper) to be uplifted to give a higher downstream rate. This uplift involves the following steps:

- Changing the CAL value of the GEA-FTTC cabinet from EdB to 99 (where E is the CAL assigned to that cabinet) for lines still operating under standard VDSL. Removing the CAL shaping for all lines so that no PSD shaping is applied to the downstream VDSL2 signals, other than the G.993.2 limits. This boosts the performance of all lines connected to the cabinet.
  
  Note: As this is contrary to Part B of the current Access Network Frequency Plan (ANFP), negotiations will be required with the Network Interoperability Consultative Committee (NICC) to amend the ANFP to comply with LR-VDSL.
- Enabling vectoring (i.e. dynamic crosstalk cancellation) to all lines on the cabinet. Vectoring is currently applied in the downstream direction only and will cancel crosstalk from 138 kHz (i.e. the lowest downstream frequency used). Rogue line control will be used to remove any non-vector compatible modems from the vector group. Upstream vectoring support may be implemented in future.
- Deactivating and reactivating the lines to apply the changes.
- Once LR-VDSL is enabled on a DSLAM, if a CP modem supports the new annex LR-VDSL will be activated on lines long enough to see a benefit. Lines beyond c40dB will require the LR-VDSL annex in order to achieve sync. LR-VDSL can be applied on a line by line basis. CPs will order the GEA-FTTC product and Openreach will decide whether the order should be fulfilled by VDSL2 or LR-VDSL (if the PCP is enabled for LR-VDSL) in order to optimise outcomes for end customers. The final operation of the line is determined by the DSLAM and the CPE based on
the frequencies in use, and it is possible that lines might switch between the modes after provisioning depending upon the performance of the line.

4.4 Proposed customer management processes
Following appropriate consultation on proposed locations, an uplift programme of work will be published to CPs confirming the PCPs that will be upgraded to LR-VDSL technology. When a PCP is identified as having benefit to customers if LR-VDSL is enabled, CPs will be contacted by Openreach and asked to place orders for all lines using xDSL technology on the target PCP during a pre-agreed window of time.

A CRD will be specified for each order so that Openreach can fulfil the orders with minimum disruption to customer’s service by smoothing out the work on the cabinet whilst allowing for any business as usual work ordered.

Lines that have a d-side insertion loss of less than c30dB can be fulfilled by Openreach in advance of the LR-VDSL switch on date, lines beyond c30dB may need to be fulfilled on the switch on date and require a modem supporting the LR-VDSL annex.

If lines using xDSL technology are not ceased or migrated to another broadband product before LR-VDSL is enabled then the performance of the xDSL technology will be severely degraded or the xDSL will cease to function. If the line has LLU MPF it can still be used to provide a voice service after LR-VDSL is enabled on the cabinet.

Once a PCP has been scheduled for uplift to LR-VDSL, Openreach will need to close the cabinet to both new and existing LLU SMPF lines before the upgrade occurs. It is recommended that the cabinet is closed to new LLU SMPF orders for a short period before it is closed to existing LLU SMPF lines in order to minimise the risk of having in-flight LLU SMPF orders open at the point that LR-VDSL is enabled; this approach means that, during the intervening period, some customers with a d-side insertion loss of greater than c30dB may not be able to have a broadband service either via xDSL technology or via GEA-FTTC.

Currently, GEA-FTTC cannot be ordered on lines with a d-side insertion loss of greater than c30dB and this is controlled by the FTTC availability flag within Openreach Dialogue Services. In order to allow orders for LR-VDSL on these lines, Dialogue Services will need to be updated to show the predicted speeds achievable with LR-VDSL. The LR-VDSL speeds will apply not just to lines with a d-side insertion loss of greater than c30dB but also to lines with a d-side insertion loss of less than 30dB which would nevertheless benefit from LR-VDSL. If LR-VDSL speeds are reflected in Dialogue Services before the cabinet is upgraded to LR-VDSL then predictions could be given to end customers of speeds which might not actually be available at the point of ordering; however if Dialogue Services are not updated until LR-VDSL is enabled then customers with a d-side insertion loss of greater than c30dB will not be able to order GEA-FTTC until LR-VDSL is enabled and hence will not be able to place orders to migrate from LLU SMPF to GEA-FTTC.

Response Prompt 02. CPs are asked to consider the impact on their customers of replacing xDSL with a protection product and whether any restriction on xDSL service availability would be considered to be material.

Response Prompt 03. CPs are asked to consider the notification period for closure of a cabinet to new LLU SMPF orders

Response Prompt 04. CPs are asked to consider the notification period for closure of a cabinet to existing LLU SMPF lines

Response Prompt 05. CPs are asked to consider the length of migration window for CPs to move existing LLU SMPF lines to GEA-FTTC

Response Prompt 06. CPs are asked to consider when Dialogue Services should be updated to reflect speeds achievable with LR-VDSL and how this might impact upon point of sale speed predictions and CP compliance with Ofcom speed codes of practice and other relevant obligations.
Response Prompt 07. CPs are asked to consider how in-flight LLU SMPF orders should be handled when a cabinet switches over to LR-VDSL

Response Prompt 08. CPs are asked to consider what products they would wish to have available once xDSL technologies are withdrawn from target cabinet areas, for example WLR+GEA-FTTC, LLU MPF+GEA-FTTC, SOGEA.

Response Prompt 09. CPs are asked to consider whether any aspects of voice or voice-only services need to be considered.

Response Prompt 10. CPs are asked to consider what action should be taken if existing LLU SMPF lines have not been ceased or migrated to GEA-FTTC when a cabinet switches over to LR-VDSL.

Response Prompt 11. CPs are asked to consider the possibility that the LLU SMPF CP who has the relationship with the end customer may not consume GEA-FTTC and that this might require the end customer to change service providers.

Response Prompt 12. CPs are asked to consider the length of time that a cabinet is closed to new LLU SMPF orders before it is closed to existing LLU SMPF lines.

4.5 Alternatives for non-served LR VDSL customers

There will be a small number of customers on some LR-VDSL cabinets that won’t achieve an acceptable broadband speed even once the new strategic LR-VDSL annex is available and Openreach are currently investigating potential alternative solutions for these lines including:

- FTTP
- Copper Rearrangement

4.6 Fault management process

No change to the existing fault management process is proposed.

Response Prompt 13. CPs are asked to consider whether they need to have visibility of which lines have had LR-VDSL applied in order to support their fault management processes.

4.7 Transmission performance characteristics

Current GEA VDSL2 transmission systems use VDSL2 band plan 998ADE17 (B8-11) as defined in G.993.2 Annex B [2]. The band plan defines the various frequency bands that are used for upstream and downstream transmission and defines a maximum frequency of 17.664MHz.

Until the strategic LR-VDSL annex is available, Openreach will use VDSL2 band plan 998 (B8-4) as defined in G.993.2 Annex B [2] which is spectrally compatible with the 998ADE17 band plan but defines a maximum frequency of 12MHz.

Once the new LR-VDSL annex has been implemented by silicon and CPE vendors, Openreach will revert to a 17MHz plan with the LR-VDSL extensions enabled. This will allow lines which would benefit from LR-VDSL to automatically use the features as part of the training sequence.

Openreach expect the vast majority of vector ready CPE used by CPs to be firmware upgradable to support LR-VDSL. The full set of changes are expected to be “consented” by the ITU-T in June/July 2017.

Response Prompt 14. CPs are asked to consider their CPE development plans and whether they foresee any issues upgrading existing CPE or providing new CPE supporting the new LR-VDSL annex.

4.8 Timescales and deployment options

For the purposes of this consultation it is anticipated that LR-VDSL would need to be deployed as soon as practicable in support of the government’s public policy objectives. In order to achieve this, Openreach system changes would need to be made including changes to Dialogue Services, which would need to be consumed by CPs. Migration to LR-VDSL would be expected to commence late in 2018.

11 May 17
Response Prompt 15. CPs are asked to consider the timescale required for them to consume any changes to Dialogue Services.

Response Prompt 16. CPs are asked to consider what rate of rollout they could support

Response Prompt 17. CPs are asked to consider how long before LR-VDSL is enabled on a cabinet Openreach should engage CPs with existing lines on that cabinet

Response Prompt 18. CPs are asked to consider the impact of a requirement from Openreach to obtain information from them in order to inform analysis at both a national and a local level

4.9 Supplementary services
When LR-VDSL is deployed on a cabinet some CPs might have a significant number of existing xDSL lines which need to be migrated to GEA-FTTC.

Response Prompt 19. CPs are asked to consider whether there are any supplemental services which they might require from Openreach either during or after the deployment of LR-VDSL

4.10 Other considerations
xdB is expected to operate on LR-VDSL lines in the same way that it does for existing GEA-FTTC lines, as will other features such as physical layer retransmission.

Use of the new LR-VDSL Annex will require modems to be retested under the normal MCT process.

SLU is implicitly prevented in specific cabinet areas following the deployment of LR-VDSL in that area assuming the current technical limitations and rules of engagement on vectoring continue.

Response Prompt 20. CPs are asked to consider the impact of LR-VDSL on their SLU plans.

5 Specific Questions of CPs

Response Prompt 21. CPs are asked to confirm their support for the introduction and deployment of LR-VDSL in order to support universal broadband provision at 10 Mbps.

6 Guidance on Responding to this Document

Openreach invites responses and any further comments or views on this initial Proposal document. Responses should be submitted to Alison Walpole at alison.walpole@openreach.co.uk by 14 July 2017.

A summary of comments and questions from CPs illustrating the range of views that Openreach received by this date will be published in a consultation summary report and will be taken into account by Openreach as part of further detailed definition/specification.

This consultation will be discussed further at the main Openreach industry meetings (see Section 3).

As an open invitation to ongoing dialogue on this product, if you wish to hold bi-lateral discussions with Openreach prior to submission of your response to the consultation, then please contact Alison Walpole at alison.walpole@openreach.co.uk.
# 7 Glossary of Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Description</th>
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<tbody>
<tr>
<td>ADSL</td>
<td>Asymmetric Digital Subscriber Line</td>
</tr>
<tr>
<td>ADSL2</td>
<td>Asymmetric Digital Subscriber Line version 2</td>
</tr>
<tr>
<td>ADSL2+</td>
<td>Asymmetric Digital Subscriber Line version 2+</td>
</tr>
<tr>
<td>ANFP</td>
<td>Access Network Frequency Plan</td>
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<tr>
<td>CAL</td>
<td>Cabinet Assigned Loss</td>
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<tr>
<td>CFPCG</td>
<td>Copper and Fibre Products Commercial Group</td>
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<tr>
<td>CRD</td>
<td>Customer Required Date</td>
</tr>
<tr>
<td>End Customer</td>
<td>Direct customer of a Communications Provider (CP)</td>
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<tr>
<td>FCS</td>
<td>Federation of Communication Services</td>
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<tr>
<td>FTTC</td>
<td>Fibre To The Cabinet</td>
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<tr>
<td>GEA</td>
<td>Generic Ethernet Access</td>
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<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
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<tr>
<td>LLU</td>
<td>Local Loop Unbundling</td>
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<tr>
<td>LR-VDSL</td>
<td>Long Reach Very-high-bit-rate Digital Subscriber Line</td>
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<tr>
<td>MCT</td>
<td>Modem Conformance Testing</td>
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<tr>
<td>MPF</td>
<td>Metallic Path Facility</td>
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<tr>
<td>NTE</td>
<td>Network Termination Equipment</td>
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<tr>
<td>PSD</td>
<td>Power Spectral Density</td>
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<tr>
<td>PCP</td>
<td>Primary Connection Point</td>
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<tr>
<td>SDSL</td>
<td>Symmetric Digital Subscriber Line</td>
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<tr>
<td>SLU</td>
<td>Sub-loop Unbundling</td>
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<tr>
<td>SMPF</td>
<td>Shared Metallic Path Facility</td>
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<tr>
<td>SOGEA</td>
<td>Single Order Generic Ethernet Access</td>
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<tr>
<td>VDSL</td>
<td>Very-high-bit-rate Digital Subscriber Line</td>
</tr>
<tr>
<td>VDSL2</td>
<td>Very-high-bit-rate Digital Subscriber Line (standard) version 2</td>
</tr>
<tr>
<td>WLR</td>
<td>Wholesale Line Rental</td>
</tr>
<tr>
<td>xDSL</td>
<td>Generic term for ADSL, ADSL2, ADSL2+ or SDSL</td>
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Annex A - Legal & Regulatory Considerations

Background

In order to enable Openreach to begin consulting with its customers on possible technical options to support the Government’s objectives this consultation will assume that a broadband USO (or alternative scheme) will be formalised shortly and give a commitment to end customers to be able to request a minimum 10 Mbps broadband downstream service.

In Ofcom’s recent Wholesale Local Access (WLA) market review, Ofcom set out its views on how regulation and technology may be able to support such options:

“New technologies, such as LR-VDSL, could be used to deliver standard broadband to more difficult to reach areas through commercial deployment by BT alongside any universal service obligation. We can see there will be benefits from such commercial deployments and propose to ensure that regulation in the WLA market is not a barrier to deployment”\(^1\)

This document describes the outline of a new proposal from Openreach to support such a universal service and invites industry feedback.

Legal Note
The contents of this document are subject to further change by Openreach, including as a consequence of ongoing dialogue with stakeholders, further Openreach considerations or changes to Government or Ofcom plans.

Certain statements and assumptions in this document are forward-looking. Although Openreach considers that the expectations reflected in these forward-looking statements are reasonable based on current information, it cannot give an assurance that those expectations will prove to be correct. Openreach may also update those forward-looking statement to take into account, for example any market developments. These statements involve risks and uncertainties and actual outcomes may differ materially from those expressed or implied by these forward-looking statements.

Factors that could cause differences between actual outcomes and those implied by the forward-looking statements include, but are not limited to: material adverse changes in economic and financial markets conditions in the markets served by Openreach; supplier arrangements; future regulatory actions and conditions in Openreach’s operating areas; technological innovations; developments in the convergence of technologies and the anticipated benefits and advantages of new technologies, products and services, including broadband, not being realised.

The proposal for LR-VDSL represents Openreach’s view at the time of publication. It does not represent a finalised definition or plan for the implementation of LR-VDSL or any commitment to implement, which is dependent on further consultation with stakeholders and assessment of relevant commercial, legal and regulatory considerations, and the ability of Openreach to make a reasonable return on its investment. Any developments carried out by a CP based on the contents of this document are entirely at the CP’s own risk.

\(^1\) Wholesale Local Access Market Review – Volume 1: paragraph 1.29