A technical critique of the NGA regulated services proposed in the Ofcom Wholesale Local Access market review.

Executive Summary

The objective of this paper is to establish a clear technical framework for the evolution of NGA wholesale access services. A commentary on Ofcom's analysis of proposed regulated access to NGA networks is provided and a vision of how service provider and customer aspirations can best be met is offered.

Ofcom proposes two regulated access service, Virtual Unbundled Local Access ("VULA") and Passive Infrastructure Access ("PIA") and provides five characteristics of a VULA product.

VULA and Openreach's GEA product are reviewed against three of the five key characteristics: control of CPE, control of access, and contention. Suggested improvements include the following:

- *Ofcom should require Openreach to provide a defined and committed road-map evolution to deliver a "Wires only" product as soon as standards support this.*
- *Openreach should follow the standards for ALA that are being produced by the NICC Ethernet Access Working Group and all other relevant NICC standards for VULA.*
- *The Openreach embedded ATA should only support a single CP unless it can be demonstrated that multiple embedded ATA instances (each under the control of a single CP) can be incorporated into the NTE without cost penalty.*
- *Multicast and other add-ons must be available to all downstream players on an equivalent basis.*
- *The evolution of the existing GEA FTTC/FTTP experience towards 'wires only' requires more product development than just the broadband technology specifications, including enhancements to EMP.*
- *Ofcom needs to have Openreach confirm that its GEA product is un-contended.*

A roadmap for evolution of GEA to VULA is provided to draw together the analysis, give specific timing to the suggested improvements and to provide a practical way forward.

Additional analysis is undertaken of WDM and wavelength unbundling, PIA and SLU.

Four appendices are provided with detailed reference material in support of the analysis in the paper.

1. Introduction

This technical paper was prepared for a group of major Communications Providers consisting of BSkyB, Cable and Wireless Worldwide, Orange, O2 and TalkTalk. These Communications Providers, together with the vertically integrated access network owners BT and VirginMedia, provide well over 90% of consumer broadband connections in the UK. Much of their commercial success in the market is attributable to their ability to innovate and differentiate their service propositions to better meet emerging customer needs and expectations. In the Current Generation Access ("CGA") world, their ability to do so has been enabled by the availability of basic upstream access network services that have allowed them to develop their own service portfolio with no constraints on what can be delivered other than those dictated by the underlying technology options and cost base.

Catalyst Communication Consulting Limited was asked to analyse the regulatory remedies proposed in the Ofcom Wholesale Local Access (WLA) market review consultation document[1] against both their own aspirations in terms of regulated service inputs and the current BT Openreach NGA related portfolio. This work has been undertaken in collaboration with representatives of the paper's sponsors, drawing on their individual and corporate knowledge and understanding of NGA product, service and network technology issues. The resulting document's aim is to establish a clear technical framework for the evolution of NGA wholesale access services and regulatory remedies that will enable the continuation of the current, highly competitive retail communications services market in the new world of fibre rich networks. It provides a commentary on Ofcom's analysis and conclusions on regulated access to NGA networks in the WLA consultation document and offers a vision of how service provider and customer aspirations can best be met, given the current and near term status of the relevant technologies and standards.

2. VULA

The proposed imposition of the VULA remedy is generally welcomed as it provides an appropriate basis for enabling effective competition in the FTTC and FTTP NGA broadband market. The principle attributes of VULA are in line with the fundamental product requirements that are needed to support effective and differentiated service based competition in an NGA environment. However, it is disappointing that Ofcom's excellent vision shown in defining the key criteria of what constitutes the appropriate balance of functionality and economically viable disaggregated access, is let down by their assessment of how the current Openreach GEA product satisfies these criteria.

[1] Ofcom, Review of the wholesale local access market, 23 March 2010, http://www.ofcom.org.uk/consult/condocs/wba/wbacondoc.pdf

We note that "*The intention is that VULA would provide access to the NGA network in a way that is similar to how LLU provides access on the CGA network*"[2]. This is clearly the right starting point, but a number of specific conclusions serve to undermine the achievement of this vision. In particular:

2.1 Control of CPE: FTTC wires only

Summary: Ofcom should require Openreach to provide a defined and committed road-map evolution to deliver a "Wires only" product as soon as standards support this. The NICC contribution from Gavin Young et al has firmly established that there is something like a 6 to 9 month timetable for fully stable and proven interoperability for VDSL2[3]. .

Ofcom claim[4] that the lack of mature standards does not offer the immediate prospect of Openreach supporting CPs providing their own CPE, in what is referred to as "wires-only".

In the light of the evidence available, Ofcom should be able to say **now** that there are significant consumer benefits and require that when "wires-only" is technically feasible it should be provided. The service available to the end-user is highly dependent on the CPE. At the moment Openreach has control over the terminating CPE and this will inhibit innovation. CPs would have more control over the service if they could select their own CPE (subject to standards constraints).

A "wires-only" option will allow use of CPE that includes other service functionality, such as a wireless router, integrated into the consumer package. There is a global market for this CPE and no reason for it to be controlled by Openreach. In an FTTC wires-only variant, for example, BT is no longer responsible for the modem, and the NTE becomes the NTE5 faceplate on the wall (plus the service specific faceplate (SSFP). Such an approach uses fewer resources (i.e. requires one 'box' rather than two) so represents a cheaper and more environmentally friendly approach.

In our view, there are a number of key business and customer benefits that accrue from a "wires only" option:

- A single device is greener. It requires fewer materials and power consumption than a 2-box solution.
- A single device is more cost effective, due to consolidation of casing, power, electronics and peripherals. To illustrate the point, 40% penetration of Openreach's commitment to reach over 60% of UK homes passed could quite conceivably result in CPE expenditure of >£375m across Openreach and

[2] Ibid Para 1.19
[3] See Appendix 1
[4] Ofcom, op cit, Para 7.279

Industry. Reducing this total cost base is to the benefit of both industry and consumers.

- CP branding. We all invest a considerable amount in the positioning of our brands to consumers. This is diluted by the presence of Openreach branded and/or unbranded broadband hardware; given that CPs provide the service, CPs should be able to position a clear undiluted brand within the home. BT itself features its current broadband "BT Home Hub" prominently in all its advertising and seeks to differentiate its broadband offering through its own branded CPE.
- Operational costs. Introducing additional single points of failure is inevitably going to increase the operational cost to both Openreach and CPs. Allied to this, a single device managed by the CP will result in simpler support processes, quicker diagnostics and improved CP performance monitoring. The net effect will be fewer faults passed through to Openreach. We recognise the concern of Openreach to provide a stable service, however standards-based technology solutions are available that would facilitate Openreach being provided with the relevant device information by CPs to enable it to manage its copper lines effectively.
- Service innovation. It is within the realm of the CP to provide services to customers. A 2-device solution will continually beg the question of who is providing services to end users. We believe this is not in industry's interests. A notable example is the specific innovation opportunity relating to 3G around dynamic and seamless fixed-mobile convergence. In a 2-box solution, the CP Ethernet router has to control this switchover one step divorced from the last mile status.
- The corollary to this is that a 2-box solution leaves a wide open door for BT to continue to stack functionality into their electronics, stymieing innovation by other CPs. For example, whilst CPCA is welcome given the current operating model, the development obstacles would fall away were wires-only to be present, enabling CPs to innovate on voice and messaging (video calling, wideband codecs etc…)
- Unambiguous 'Demarcation' points can be agreed to smooth out fault diagnosis responsibility. Currently, within exchange-based broadband the NTE5 is the demarcation; this is 'blurred' with the GEA modem and also with the data extension kit.
- An early transition to the 'wires-only' model will enable an eased migration from the existing trial/pilot launch base. Delay will require a higher impact, managed transition for an increased/established user base.
- Mobile provider wishing to use VULA for cell site backhaul note that cell site CPEs require special functionality not found in residential devices. Being dependent on Openreach to develop and deliver CPEs with this capability constrains a mobile provider's options and slows deployment, and experience has shown that the number of changes to the service supplying a typical cell site is such that the simpler the service the better.

In addition to the consumer benefits noted above, there are a number of other enhancements to the experience that customers will have:

- Enhanced provision process (e.g. to allow migration from existing offering to VULA/GEA to be better managed from the end user perspective) due to avoidance of dual-installer scenarios and 2-box test, signoff and interaction management.
- A single box solution is the current operating model for DSL-based broadband across the UK. Consumers expect a single box in their home. Deviation from this core principle is likely to lead to considerable confusion through the entire customer journey, from provisioning through support.

Generic roadmap: Access technology development

Overall, a number of trends have previously been seen in the access technology and services market, from which a generic "road map" of deployment, standardisation based interoperability and development of different modes of competition can be derived:

Phase 1:

- Access Infrastructure Provider (AIP) supplies, installs and maintains CPE.
- Usually CPE vendor is the network equipment vendor.

Phase 2:

- AIP may introduce a limited range of CPE options (all thoroughly pre-tested).
- Over time this approved range grows.
- ISP/Content Providers may have the option to have their CPE approved
- Self-install options may be developed.

Phase 3:

- As interoperability, standards and self-install practices ma**ture:**
- The AIP can move to a full retail model.
- CPE is then additionally 'off-the-shelf'.

As the NICC contribution from Gavin Young et al[5] summarized in Appendix 1 shows, FTTC is clearly in Phase 2/3. The contribution established a set of criteria against which to judge the status of current mainstream next generation access network technologies as candidates for "wires only" status, derived from Ofcom's own approach in the ALA requirements document[6]. These are:

[5] NICC ETHERNET WG CONTRIBUTION: READINESS FOR WIRES-ONLY UNI, GAVIN YOUNG, C&W, MIKE PEMBERTON, BSKYB, LEE TURNER, TALK-TALK TECHNOLOGY, ARUL ARULKKUMARAN, VODAFONE, 12/2/10

[6] *"Further consideration is required to define the criteria that will signal that the market should move to a physical termination interface. These criteria could include stable standards, interoperability test plans, and industry plug-fest events that have been supported by many vendors. … The [wires only] option shall not be implemented until after relevant standards (e.g. WT-114, WT-115, and FSAN/ITU OMCI) and equipment test-plans have been defined to ensure multi-vendor interoperability."*

Stable Standards:

- Published by a recognised standards body/Forum.

Interoperability Test Plans:
Test plan documented by a recognised standards body/Forum and available for use by vendors.

Industry Plugfest Event Support

- A series of interoperability plugfests have been organised with the support of a recognised standards body/Forum.
- Multiple vendors representing equipment for both ends of the transmission link have been involved.
- The interoperability plugfest events have encompassed both chip-level and system level vendors.

It is clear from this analysis that FTTC based on VDSL2 is now ready for the development and deployment of "wires-only" access products. We would note that the last imperfections in interoperability are best "ironed-out" by actual use of mixed vendor networks in the field.

The state of the technology today is sufficient to allow this to go ahead immediately, with a potential "fall back" option for CPs/consumers experiencing interoperability difficulties of using CPE incorporating chip set/firmware configurations known to be compatible with Openreach vendor deployments[7]. In this context, it is worth noting that Telecom New Zealand have recently announced their intention of providing "wires only" facilities in the next stage of their FTTC trials[8]. The requirements for this are clearly defined and directly comparable with what is being requested of Openreach:

"*A VDSL2 compatible splitter must be installed at the end-user's premises and a VDSL2 PPPoE capable modem must be used with the service. Telecom Wholesale provides a reference modem for the WVS pilot – Cellpipe 7130.*"

We note Openreach's comments in their rejection of a previous SoR for FTTC "wires-only"[9] that they are unwilling to review their rejection of the SOR for a period of 3 years. In the light of the evidence provided on VDSL2, this is clearly completely unreasonable. As Openreach admit, interoperability tests have already been undertaken successfully in their own facilities at Adastral Park, and "wires-only" services are already available in a number of international markets, including Germany. The need for VDSL modems to interwork effectively is fully recognised but BT could now publish the details of VDSL2 chipset and firmware it is using for its cabinet electronics so CPs can ensure that their own CPE options have a benchmark interoperability fall-back.

[7] This would require that OR publish or communicate active chipset/firmware configurations to CPs consuming VULA.
[8] http://www.telecomwholesale.co.nz/f696,344962/344962_25751_Wholesale_VDSL2_3-0LC.pdf
[9] Wires-only Statement of Requirements Response (SOR 6956) – December 2009

They note that due to "interoperability immaturity" they would anticipate that "we will experience reduced service levels similar to the faults we see on today's broadband, e.g. early life failures and those that cannot be identified without an engineer visit." Given the generally positive customer experience that current generation broadband delivers, this is hardly a sound basis for a fundamental rejection of FTTC "wires-only".

We would accept that Openreach do raise some important issues in the SoR rejection, but we are confident that they are capable of pragmatic resolution. Openreach state that one advantage of a bundled modem would be the effective insulation of the downstream CP from future technology evolution compatibility risks. We understand that the relevant technology will continue to evolve but strongly feel that a combination of an Openreach commitment to adhere to transparent standardization processes and the publication of a firm and detailed service evolution roadmap will enable CPs and vendors to plan accordingly (both issues are discussed further below).

Openreach also touch on the question of how assurance levels can be maintained in the light of "wires-only" access, particularly with regard to the ease of demarcation in multi-CP environments. Our view is that this argument is only likely to be valid in a very small proportion of instances and Openreach should not seek to architect solutions that would severely constrain 99% of the market. In a VULA service environment, the CP taking the "virtually unbundled" line would have subsequent responsibility for dealing with any third party SP issues in any event. We would accept that the serving CP should also have a responsibility to ensure that diagnostic routines and processes are facilitated and must be committed to working with Openreach to ensure that appropriate and effective access is provided.

2.2 Control of CPE: FTTP Wires only

Summary: Ofcom should require Openreach to provide a defined and committed road-map evolution to deliver a GPON "Wires only" product as soon as standards support this. Standards and test plans for GPON at the PMD, TC and OMCI layers are mature and interoperability for these aspects of GPON has progressed well. The higher layer "Ethernet" functionality test plans are under development in the Broadband Forum. These together with associated plugfest events (for this layer) are around a year away. Hence a wires-only UNI approach in the UK for GPON is probably around eighteen months away.

Using the generic roadmap to access network technology and service evolution outlined in the previous section, it is probably the case that GPON is currently only at Phase 1. However, we would note that the work of FSAN is rapidly making it ready for Phase 2 status. We believe that GPON is firmly on track to the Phase 3 retail model with the work currently underway through the industries' standards bodies. In particular, we would note

the scope of the relevant Broadband Forum interop test plan work in progress[10]. NICC in the UK is already developing an ALA wires-only UNI specification for GPON (& VDSL2) which heavily references BBF & ITU GPON standards.

GPON interoperability will facilitate a "1-box" solution for ALA CPE (ONT, router, ATA etc. in same box). This GPON CPE (provided by the ISP) can then be connected via an essentially passive NTE interface, ideally on a self-install basis. GPON interoperability and a wires-only ALA UNI facilitate an open and competitive market for GPON CPE (ONTs) to reduce costs and are already included by Ofcom in its ALA requirements.

It is worth noting that "ADSL" at one time had very similar standardisation challenges, with essentially proprietary implementations of differing approaches to the underlying technology standards precluding any real interoperability, but now has a thriving retail CPE industry. Industrial and commercial logic dictated that vendors would, over time, recognize the advantages that standardisation and interoperability would bring; most obviously, lower costs driven by a bigger addressable market and scale economies in device manufacturing. We see no reason why GPON should be any different, with the commitment of vendor and CP resources that are already evident, given the overall strategic market benefits that will accrue. Trials to establish interoperability issues should be started as soon as possible in parallel with standards based activities to start to identify real world issues.

In just the same way as for DSL technologies, ISP or retail supplied GPON CPE with DIY install would lead to fewer boxes and inter-connecting cabling within the home and a consequently be more "user friendly" and neater to install. It will immediately result in reduced power consumption and should lead to overall reduced costs as it would enable ISPs and wholesale providers to use the same CPE across all 3rd-Party NGA (ALA) networks, and, hence benefit from enhanced economies of scale.

2.3 Control of access: Standardisation

Summary: BT must follow all the relevant NICC standards for VULA. It is imperative that there are no BT "specials" or proprietary "standards" since there are around 40 companies building NGA networks, and interoperability/interworking of services and CPE are vital. The aim should be that the same NNI and B2B specifications are applied to all of them via a set of NICC UK standards to reduce CP cost and effort of integration.

[10] See Appendix 2 and http://www.broadband-forum.org/technical/technicalwip.php

There are two NICC groups that are key:

2.3.1 Ethernet Access group covering ALA standards.

Summary: Openreach should follow the standards for ALA that are being produced by the NICC Ethernet Access Working Group. This group was specifically initiated at Ofcom's request to produce standards for ALA (UK profiles using the relevant international standards). At this point, we believe this work is still very relevant, even though ALA may seem to have been superseded by the VULA proposals. In our view, ALA describes a generic group of access standards of which VULA will be a specific regulatory driven implementation.

Specific NICC standard documents from this NICC WG include:

- ALA Requirements document ND1642
- ALA Architecture document ND1644
- ALA Service description ND1030
- ALA User Network Interface (UNI) specification ND1031

In particular, the key areas that CPs are specifically keen that Openreach follow the NICC standards are:

- NNI – to enable a standard approach for integration to CP networks
- UNI – to enable a standard approach to connecting CP/end-user equipment within the user's premises.
- QoS – to enable multiple services to be bundled in consumer offerings and also to facilitate business grade services.
- Multicast – there are a variety of ways this can be done so it is important that Openreach follow the NICC standard here so that multicast traffic can be delivered in a standard way across all ALA-Provider networks
- Ethernet OAM – To enable cost effective on-demand testing to assure residential lines but also with the option to undertake proactive OAM for managed business services and triggered failure indication for business customers who require resilience.

2.3.2 Voice group covering NGA Telephony – (Openreach implementation is termed CP-Controlled ATA (CPCA)

2.3.2.1 SIP Model.

Summary: We welcome Openreach's move to a "loosely coupled" call model that avoids lock-in to their preferred callserver solution.

There has been an ongoing debate about which functions reside in the ATA and callserver respectively, with the two camps being termed "tightly" and "loosely" coupled.

- Loosely coupled sees the ATA as being a reasonably standard SIP call agent having control over issues such as 3 way calling, whereas tightly coupled leaves the ATA being very much slaved off the callserver (in essence mimicking an H.248 device). The key advantage of loose coupling is that it means the call model in the embedded ATA is the same as any other SIP device, hence the call model on the callserver is also the same, and hence is more likely to be an "off the shelf" functionality option. This also removes the need to run two call-handling instances on the callserver if the CP is also managing non-CPCA customers.
- The key advantage of tight coupling is greater CP control.

BT had opted for "tight coupling" (in advance of any NICC involvement) and industry discussion has been aimed at persuading them that this is not in line with market needs. Openreach has recently confirmed that they will adopt the "loose coupling" approach. While this is welcomed, there is need for continued vigilance to ensure that the product offering complies as closely as possible with international standards.

2.3.2.2 Support of >1 CPs on ATA.

Summary: The Openreach embedded ATA should only support a single CP unless it can be demonstrated that multiple embedded ATA instances (each under the control of a single CP) can be incorporated into the NTE without cost penalty.

The original ALA requirements mandate support of multiple CPs for provision of voice services - in essence it mimics 2 x copper pairs into house for different CPs in LLU setup. In order to achieve this, at the very least it increases the degree of Openreach intervention in ATA management as everything needs mediation. At the extreme, one of the functional models tabled at NICC would have a Session Border Controller involved to steer traffic to the relevant CPs. This puts greater control in BT's hands and arguably makes local handover impossible, hence is not acceptable.

While the desire to have 2 independent CPs on ATA is laudable, it is of low priority because ultimately if one CP controls the embedded ATA, a second could deploy their own if they wanted to provide a voice service (alternatively a second fibre could be provided into the premises).

2.4 Control of access: Virtualisation/ Service functionality attributes

Summary: Multicast and other add-ons must be available to all downstream players on an equivalent basis. So far as possible control should be given to downstream providers rather than Openreach. The Service Provider should be able to control QoS and other service parameters to enable differentiation and meet changing end user demands.

2.4.1 Port control

To such an extent as the network equipment allows, any VDSL port (in the FTTC case), or any T-CONT (in the FTTP case), should be able to be monitored and controlled in the same manner as if it were a CP's own equipment. This prevents the network equipment owner (Openreach) from being able to define a set of homogeneous base products which limit differentiation in what is offered to consumers. More specifically, the CP should be able to monitor the following:

- Operational state
- Bit Error Rate
- SNR

And control the following characteristics:

- Max download/upload speeds
- Latency
- Noise protection

2.4.2 Quality of Service

A fully featured QoS implementation is essential to allow CPs to fully utilise the access bandwidth available, whilst still guaranteeing effective transport of services such as voice and video. Access network equipment may not support different QoS behaviours on a port-by-port basis, so a generic QoS design may be the norm – where this is the case, the generic QoS design should follow as closely as possible that specified by the NICC Ethernet Working Group.

2.4.3 Multicast

A multicasting capability is required to allow CPs and content providers to efficiently utilise the backhaul bandwidth available. Different makes and models of network equipment are likely to have differing multicast capabilities, so a generic design may be needed – where this is the case, the generic multicast design should follow as closely as possible that specified by the NICC Ethernet Working Group.

2.5 B2B/EMP Systems interfaces

Summary: The evolution of the existing GEA FTTC/FTTP experience towards 'wires only' requires more product development than just the broadband technology specifications. In particular, the inter business systems interfaces require enhancement to enable CPs to install, manage and operate the services. We consider that Ofcom/OTA should be giving the matter their attention, ensuring that market power in one area (access) is not leveraged into another (aggregation of smaller access networks)..

The 'Wires only' systems interfaces should be enhanced in a timely manner to enable:

- Dynamic Line Management including speeds/performance and profiles handling.
- Test, diagnostics and reporting including statistics (real time and historic), reports and management tracking including outages
- Product management including the ability to manage end user package speeds, and device identification, while also allowing transparency, for CP specific device management.
- Appointing services to enable timely and customer friendly experience with migrations to/from GEA products

A clear roadmap is required, detailing when the specific features at a system interface level would be available to enable the 'wires only' experience to be realized.

There is a potential gap in the specification of the ALA service as a whole in that, while the current draft NICC standards address interoperability at a network level, they do not encompass B2B systems for provide/L2C and assure/T2R of ALA. Since usage of the Openreach access network will dominate mass market CP consumption of "bitstream" services for some time, an "EMP like" interface may become a *de facto* standard. It is clear from the BSG COTS project that market forces are leading towards the establishment of "black box" intermediary services, provided by aggregators, that will sit between "AIPs" and downstream CPs providing "EMP emulation" to minimise both parties' incremental systems and process investment. If this becomes the norm for such smaller access networks, it might prove detrimental to the best interests of the market if Openreach could exert IPR in this field.

2.6 Un-contended: Removal of bandwidth constraints and contention

Summary: Ofcom needs to have Openreach confirm that its GEA product is un-contended. In order to meet the basic VULA attributes identified by Ofcom, the product must be un-contended and fundamentally controlled with regard to performance by the downstream CP. This is not the case at the moment.

The current Openreach products are restricted to 40Mb/s downstream and 10Mb/s upstream. This "capped speed" approach to is not necessary and is artificially restrictive. Network access operators should not offer speed-tiered products (particularly with GPON) as the cost of operation is no different whether an access link's throughput has been throttled or not. The bandwidth available could be defined by the Maximum Stable Rate (for VDSL)[11] or the aggregate bearer speed divided by the split ratio (for GPON)[12].

[11] Hence will vary between end users in a way analogous to current ADSL2+ based services being promoted as "up to 24 Mbps". CPs may choose to offer fixed rates to their end users, but this should be at their discretion.

[12] For current generation GPON with a 32 way split, this would provide a 75 Mbps down/37.5 Mbps up uncontended service, falling to 37.5 Mbps down/18.75 Mbps up with a 64 way split.

It is worth noting the approach being taken for the NBN project in Australia, whose Local Ethernet Bitstream access product shows many similarities with FTTP VULA:

"RSPs should have the flexibility to manage contention in their network to suit the requirements of their end users – NBN Co believes that RSPs should have certainty and control in the management of the bandwidth they purchase from NBN Co and the activities of other RSPs should not impinge on the end user experience the RSP has committed to deliver.
To this end, NBN Co wishes to ensure that contention will be RSP determined. To achieve this, NBN Co will likely offer bandwidth on a Committed Information Rate (CIR) basis, as opposed to a Peak Information Rate (PIR) basis, on the Access Link and independently on the Connectivity Link. If NBN Co was to offer bandwidth on a PIR basis, the performance one RSP can expect to get from its Access Link would be influenced by the actions of other RSPs ……"[13] -

However, it is acceptable for specific defined speed services to be provided as an option, where, for instance symmetric services are required. For FTTC, this would minimize crosstalk effects if done by the network provider rather than the downstream CP. For Connectivity Providers who sell broadband access products to enterprise customers, the ability to supply symmetric data services may be important. To cater for such scenarios, Openreach should offer some symmetric GEA base products. In addition, cell-site backhaul requirements in high density areas will be significantly higher than the speeds to which currently proposed services are constrained. Furthermore, cell-site backhaul traffic is already aggregated and relies on a stable throughput being available, so further aggregation and contention in Openreach's network should be avoided.

Openreach may argue that additional products are not necessary, as it would be possible to use traffic shaping at the Ethernet or IP layer to throttle the throughput of the faster direction of an asymmetric link, in order to offer an effectively symmetric service. There are reasons why this approach would not be the best way:

- For FTTC, lower speed generally means more stability. Therefore, for symmetric products, there's no point in running a higher speed in the downstream direction than the upstream. The higher than needed downstream bitrate would reduce stability, and increase crosstalk into adjacent copper pairs (albeit only to a minor degree).
- For FTTP, the logic is far more straight forward. Bandwidth in a GPON system not allocated to an ONT that doesn't need it can be allocated to a different ONT – i.e. by not giving one customer more downstream bandwidth than they need, the bandwidth they would have been allocated but not used in an asymmetric configuration can be used by someone else.

Links further back in the network, between the initial CP point of interconnect at the first stage Ethernet switch and the last access network element (FTTC street cab based

[13] http://www.nbnco.com.au/content/upload/files/Response_to_Industry_Submissions/NBN_Co_response_to_consultation_submissions.pdf

DSLAM or FTTP splitter) should be uncontended between both users and CPs. It is not clear from current published Openreach product and network documentation that this is the case. This may require enhancement of the current FTTC cabinet to handover site backhaul as penetration rates rise, but there appears to be no specific network technology reason why this is not achievable. We are aware that Ofcom has had detailed discussion with Openreach on this issue and received assurances that network planning and deployment rules should result in effectively "uncontended" services, but this is neither documented nor committed to in Openreach product descriptions and contracts.

2.7 Roadmap for evolution of GEA to VULA.

Appendix 3 provides an overview of how and where GEA falls short of the requirements of VULA. In order to see how it can evolve to meet the regulatory and industry requirement we propose a "VULA Roadmap" that will cover the "how and when" of VULA products evolving, taking into account industry technology refresh cycles, and explaining linkages between different requirements, with an approximate overall 3-5 years horizon. Based on the key issues and aspirations noted above an initial "strawman" is outlined below. This can form the basis of either a regulatory mandated evolution path, or, through industry consultation, perhaps facilitated by the OTA, the voluntary agreement by Openreach of key service development initiatives:

Standardisation – end 2010:

SIP Model – "loosely coupled"

ATA CP support

ALA Ethernet access functionality:

ALA Requirements document ND1642

ALA Architecture document ND1644

ALA Service description ND1030

ALA User Network Interface (UNI) specification ND1031

covering UNI, NNI, QoS, Multi-cast and Ethernet OAM issues in particular

FTTC "wires-only" – end 2010

Uncontended services – early 2011

Virtualisation/service functionality control – early 2011

VDSL2 enhancements: - during 2011 (for discussion and agreement with Openreach)

- **DLM -** The recent NICC report into the use of DLM in the UK showed that Tiered Rate Adaptation was optimum and certainly better than simple margin adaptation or Virtual Noise (VN).

- **PHY-R (Phy Layer Retransmission) -** This has been standardised by the ITU and could give significantly enhanced robustness against impulse noise (at the price of a slight increase in latency). This would be very useful for video streaming, especially for compressed HD or 3D encoded material. What are BT's plans/intentions for PHY-R?

- **Vectoring (cross-talk cancellation via DSM Level 3) -** This is an evolution of the DLM capabilities noted above. It can increase speed by up to 50% upstream and downstream on VDSL2, and is especially relevant in light of BT's shortcomings in dealing with crosstalk on their VDSL network. What are BT roadmap plans?

FTTP "wires only" – end 2011

3. WDM and wavelength unbundling

The Ofcom analysis and the associated consultant's reports in the WLA review represent a good overview of current and future PON family developments and reach appropriate conclusions. In particular, the conclusion that current GPON unbundling is unsatisfactory from both an economic and operational perspective is probably accurate. The potential use of a "fibre unbundling" remedy should not be rejected out of hand, however, as technology options and subsequent deployment choices will change overtime. Attention should continue to be focused on next generation GPON and WDM PON families and upgrade paths, and any potential use of "point to point" solutions.

4. Passive Infrastructure Access

Ofcom proposes a "mixed economy" of VULA and SLU/ PIA. The approach to PIA outlined looks reasonable. When giving consideration to the difficulties involved in PIA unbundling, it is right for the regulator to focus only on those challenges introduced by having a multi vendor environment. That is to say, issues around blocked duct, poor network records and suchlike exist regardless of how many CPs are using a section of network, furthermore, these challenges are not preventing BT from deploying their own NGA.

One notable omission from the WLA condoc is discussion of access for CPs to passive asset records (annex 10.40-10.42 makes a brief reference to BT's NEJ database). Access to full and accurate records of the passive assets (duct, chamber, etc) would be an essential element for successful PIA, as would survey services to validate designs.

Clearly there are a number of detailed implementation issues that will be need to be considered as part of the RO process. For instance, with regard to the discussion of New Build at 7.167-7.169, if a new duct is required (for a final drop for instance) who pays

the Excess Construction Charge? If CPs are required to pay the entire ECC, do they then have exclusive ownership of that duct? Alternatively, does BT bear the capital cost and then charge a rental charge for access to it?

Ofcom suggest BT and industry could start considering contents of a PIA RO before the formal RO process kicks in (any pre-work could shorten the formal regulatory process). We note the work done at BSG – the PISWG service requirement outline[14] in many ways mirrors the PIA remedy described in the Ofcom WLA con doc and could act as the as the basis of an SOR definition for discussion with Openreach as the basis for the RO, and would allow more time to develop common engineering standards for network build and interconnect, and also to industrialise the B2B processes.. This should also accelerate the timetable to completion of the RO. The work done by PISWG would indicate that some of the information and operational challenges identified by Ofcom should not be as onerous as implied. Consequently, the timetable for RO preparation seems excessive, particularly if industry can engage effectively with Openreach in the near term on a collaborative basis to maintain momentum.

In the Analysys Mason report[15] on PIA precedents established in other markets and their lessons for the UK, the following recommendation is made "*Overall, we believe that an operational model that includes all the features specified in our recommendations should result from an iterative process, involving the feedback of all UK stakeholders. However, we recognise that it may not be feasible to implement all functionalities in the initial development of the operational model, because doing so may delay the introduction of the duct and pole offer, and would involve a significant upfront capex investment by the industry. Instead, an incremental approach should be adopted, each developmental stage drawing on the experience of both Openreach and communication providers (CPs) of earlier stages. In order to facilitate the incremental development of the operational model, we recommend monthly meetings between the Openreach, the CPs and the regulator to provide feedback on operational issues and provide input into how the model could be improved.*" We would wholeheartedly concur with that approach and welcome Openreach's recent announcement of a series of workshops to start this process prior to the conclusion of the Consultation.

We would envisage that, in practice, PIA would be used in combination with other Openreach inputs (eg SLU) and CP self provided infrastructure to produce hybrid civil network models. In this scenario a CP may wish to interconnect with BT civil network where CP owned duct exists in close proximity to a BT enclosure. For example, a CP might wish to interconnect with the BT duct network at some intermediate point in order to only use the final drop infrastructure, rather than at the local exchange. Consequently, the PIA remedy product set must be available as a "menu" of optional network elements, rather than a monolithic connection from, say, the MDF to the customer premises.

We would also suggest that it is vital that PIA is complemented by some form of "dark fibre" obligation where available duct or pole space is limited. As PISWG suggest, where

[14] See Appendix 4
[15] Final Report for Ofcom: Operational Models for Shared Duct Access, 1 April 2010

there is limited capacity in a duct, it should not be given out on a simple "first come first served" basis. Rather than limit overall operator access to the duct for PIA, there should be a requirement in such circumstances that Openreach install fibre in the remaining capacity and lease the fibre strands to operators irrespective of operators' own business models (e.g. collective investment models or onward sub-lease/ resale models).. Alternatively the first operator who takes PIA must lease fibre in that duct to other operators.

Sections 7.39 to 7.68 of the WLA condoc deal with dark fibre unbundling. While we made note of some good suggestions (such as provision for building parallel PONs), some of the observations made regarding build costs did not seem to recognize the potential savings from PIA – we see dark fibre and passive asset unbundling as being complementary in the longer term. The opportunity for such options must not be foreclosed for lack of "fit for purpose" remedies at this stage.

5. SLU

The con doc notes the views of some CPs that the current SLU product is deficient. This covers a range of product, process and pricing issues around the current portfolio. Most obviously, the current regime does not offer a defined "active cabinet sharing" which is required to minimize deployment costs, complementing the cost efficiency offered by PIA mandated duct and pole access.

It is worth noting that there is a "close similarity to EoI" requirement imposed on SLU as a result of the consultation on Variations to the Undertakings undertaken in the first half of 2009[16]. In practice, there are huge cost and operational differences between the SLU RO product offered to CPs and the "internal SLU" that is effectively used to create GEA e.g. connection charge of £128, ordering/fault reporting via Excel spreadsheet, no SLA/SLG etc.

Given the growing importance of SLU, Ofcom should be taking similar steps to facilitate industry-BT engagement over SLU as it is doing for PIA. In our view, the two remedies are complementary: PIA will most likely be used in conjunction with SLU to deploy FTTC, and the success of PIA will therefore be bound up with the success of SLU). There are three main strands to such negotiations:

a) Fixes to the existing SLU product set – commercial, technical and process – addressing the non-exhaustive list of issues mentioned above;

b) New elements needed to extend the SLU product set: for example different permutations of active cabinet sharing;

[16] See para 3.51 http://www.ofcom.org.uk/consult/condocs/fttc/statement/statement.pdf

c) An appropriate suite of options for backhaul: these might include variants of BES/Gig E, PIA basaed service elements, or access to dark fibre.

We would therefore support BT-industry negotiations over the SLU product definition, with the aim of establishing within a fixed timescale a clear view of the product set that would best meet industry requirements. The OTA has previously played an invaluable role in resolving process issues associated with LLU, and we believe their involvement in any industry engagement with BT over the SLU product could be equally beneficial.

In summary, we believe that Ofcom should:

a) Set a timetable for Openreach to negotiate with industry the characteristics of a fit for purpose SLU product set (in the same way as it is proposing to mandate for PIA);

b) Allocate OTA resource to facilitate industry engagement with BT over SLU product and process issues.

Appendix 1: FTTC "wires-only" status

STANDARDS

The standards for VDSL2 have been published by the ITU and ETSI and of these the key physical layer transmission standards upon which interoperable silicon depends have been available for three to four years.

The UK ANFP was updated to incorporate VDSL2 three years ago.

In addition, Ethernet OAM standards from the ITU and IEEE have been published for three or four years and VDSL2 modems including proven and working Ethernet OAM functionality are already being deployed in the UK.

REFERENCES

[1] ITU G.993.2, Very high speed subscriber line transceivers 2 (VDSL2), 2006
[2] ITU G.993.2 Amendment 1, Very high speed digital subscriber line transceivers 2 (VDSL2) Amendment 1, April 2007.
[3] ITU G.997.1, Physical Layer Management for Digital Subscriber Line (DSL) Transceivers, 2009
[4] ETSI TS101271 v1.1.1, Access Terminals Transmission and Multiplexing (TM); Access transmission system on metallic pairs; Very High Speed digital subscriber line system (VDSL2), January 2009.
[5] NICC ANFP issue 4, ND1602, March 2007.
[6] IEEE 802.1ag, Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management.
[7] ITU Y.1731, OAM Functions and Mechanisms for Ethernet-based Networks, 2006

INTEROPERABILITY TEST PLANS

The Broadband Forum Functional and Performance test plans for VDSL2 have been thoroughly worked through by all key VDSL2 silicon and equipment vendors over the last three years. The Functionality test plan was published in 2009 and the Performance test plan is expected to be published in March 2010.

REFERENCES

[1] Broadband Forum (BBF) Technical Report, VDSL2 Performance Test Plan, TR-114, Expected March 2010
[2] Broadband Forum (BBF) Technical Report, VDSL2 Functionality Test Plan, TR-115, November 2009

INDUSTRY PLUGFEST EVENT SUPPORT

The Broadband Forum has organised seventeen VDSL2 interoperability plugfests over the last four years focussing on both chipset vendors (eleven events) and system vendors (six events). These plugfests have been used to enhance a specific interoperability test plan which has then be used to guide the development of the formal test plans for VDSL2.

REFERENCES

[1] Broadband Forum (BBF) PD-139: Interoperability Test Plan for VDSL2 Plugfests

Appendix 2: FTTP “wires-only” status

WT-247 - Part1 (ONT) GPON Conformance Test Plan – Part 1 (ONT)
This test plan describes a series of tests that may be used to verify whether particular GPON ONT implementation conforms to TR-156 functional requirements and adopts the configuration recommendations described in the ITU-T “OMCI Implementer's Guide”.

WT-247 – Part 2 (OLT) GPON Conformance Test Plan – Part 2 (OLT)
This test plan describes a series of tests that may be used to verify whether particular GPON OLT implementation conforms to TR-156 functional requirements and adopts the configuration recommendations described in the ITU-T “OMCI Implementer's Guide”.

WT-255 GPON Interoperability Test Plan
This test plan describes a series of tests that may be used to verify whether particular, identified combinations of GPON OLT and GPON ONU implementation are interoperable when configured for the particular service deployment models described within TR-156. The prerequisite to go through WT-255 is to be compliant with WT-247 (part 1 and part 2)

Timetable for standards completion:
– WT-247 Part 1 ONT Conformance by end of 2010
– WT-247 Part 2 OLT/ONT Conf by mid 2011
– WT-255 GPON Interop in 2011

– NOTE - Some testing for WT-247 will begin in 2010

Appendix 3

VULA/GEA comparison

1. *Local:* interconnection should occur locally

Interconnection, by the access seeker, should occur locally; that is at the first technically feasible aggregation point. In practice this is likely to be in the local serving exchange where the first Ethernet switch is located.

Ofcom position:
It is our understanding that BT's GEA product, as provided by Openreach, extends between the end user premise and the local serving exchange. In the case of FTTC the local serving exchange is the site where FTTC deployments are aggregated. In the case of FTTP the local serving exchange is the site where the FTTP 'head end' equipment is accommodated. Further, FTTC and FTTP will share the same local serving exchanges. BT's current plan is to have about 800 to 1000 of these local serving exchanges. These proposed GEA arrangements would seem to be compatible with our VULA requirements.

Verdict – GEA is broadly compliant with the VULA attributes

2. *Service agnostic:* should be able to support a multitude of services

VULA should be a generic access product. That is, it should provide service agnostic connectivity. VULA should therefore only be limited by the inherent capabilities of the access technologies deployed.

Ofcom position:
In the case of BT's FTTC-based GEA products the basic connectivity does appear to be service agnostic. However, there is potentially an issue in the way that BT is tying the availability of this product to other products/services, such as MPF or WLR. In order to meet the VULA requirements BT would need to make a stand-alone version of this product available.

In the case of BT's FTTP-based GEA products, again the basic connectivity does appear to be service agnostic. However, there is a complication in that BT has chosen to embed an ATA into the NTE, which currently is a necessary part of the GEA product. Although, this voice ATA does not belong in this market, we are aware that there are good economic and commercial reasons for embedding it in this way. Therefore, to the extent that a voice ATA is inherently embedded into the GEA product we consider that access to this should be made available in accordance with the VULA requirements. In practice, this would mean that the voice ATA functionality should not extend beyond the local serving exchange and control over the voice ATA functions should be provided to the interconnecting CP.

Our analysis - FTTC – in some senses, the "full MPF" equivalent "standalone VULA" is needed to replicate the full range of inputs in the "LLU world", but it forces the CP into a "derived voice" rather than fully PATS compliant "baseband voice" telephony offering. However, there doesn't seem to be an alternative approach, other than to revert to WLR.

FTTP – "open ATA" and "wires only" offer contrasting means of making the access product more service agnostic.

Verdict - GEA will be broadly compliant when "standalone" and "open ATA" are available.

3. *Un-contended:* dedicated capacity should be available to the end user

The connection, or capacity, between the consumers' premises and the local serving exchange where interconnection takes place should be dedicated to the end user, i.e., the connection should be un-contended.

Ofcom position: It is our understanding that BT's GEA products, based on both FTTC and FTTP technology, are ostensibly un-contended. That is, there is sufficient capacity in the access network to ensure that the peak demands on end users can always be supported.

Our analysis: The Ofcom position appears to be wrong – GEA is based on some degree of contention according to the published service descriptions:

For FTTC, the GEA product documentation states:

"Within the overall Peak Information Rate for the product, a 20Mbit/s 'Prioritisation Rate' (PR) will also be applied. When a CP sends traffic at an instantaneous rate above the Prioritisation Rate, this traffic may be discarded if there is Openreach **network congestion.** We would expect that under congestion, each GEA Data Port will receive the lower of the Prioritisation Rate, or their current line rate.
The CP can mark traffic as either "Can drop" or "Should not drop" using 802.1p markings as described in the SIN. This marking is optional. Where the CP has marked frames as "Should not drop" in the CVLAN, "can drop" and unmarked frames are always dropped from that CVLAN first. The use of frame marking by a CP for one end user has no impact at all on traffic for any other end user."

For FTTP, similarly:

"Within the overall Peak Information Rate (PIR) for the product, a downstream 20Mbit/s 'Prioritisation Rate' (PR) will be applied. When a CP sends traffic at an instantaneous rate above the Prioritisation Rate, this traffic may be discarded if there is **network congestion**. We would expect that under congestion, each GEA Data Port will receive the Prioritisation Rate.
The CP can mark traffic as either 'Can drop' or 'Should not drop' using 802.1p markings. This marking is optional. Where the CP has marked frames as 'Should not drop' in the CVLAN, 'can drop' and unmarked frames are always dropped from that CVLAN first. The use of frame marking by a CP for one end user has no impact at all on traffic for any other end user."

VULA symmetry and contention obligations should, in the first instance, only be constrained by the technical capacity of the network architecture. It is important to differentiate between innate technology constraints and those that are the result of specific OR design decisions which may be driven by short term cost minimisation concerns, but could also be the result of more strategic design choices to limit the capability of the downstream CP to use VULA as an input for some types of service deployments. A more appropriate approach would be for Openreach to provide the service unrestricted to downstream suppliers. Each end user connection should be uncontended and offered as a single access product to the Service Provider, subject to a proper evaluation of network economics and feasibility.

For FTTC, it may only be a question of uprating the backhaul capacity from the street cabinet. For FTTP, constraints on splitter ratios and individual end user bandwidth limits will need to be agreed.

Verdict – GEA fails to meet the VULA attributes

4. Control of access: sufficient control of the access connection should be made available

CPs would need freedom of control in order to provide different types of service and, potentially, also vary the QoS parameters in delivering those services to enable them to effectively compete with other providers.

Ofcom position:
In the case of BT's FTTC-based GEA products, we understand that BT is currently offering three generic profiles, each with a different trade-off between line speed and line stability. In addition BT is applying dynamic line management to the connection. This would appear to offer the interconnecting CP with a reasonable level of control. However, should additional profiles or greater control be required by CPs we would expect BT to met reasonable requests. BT's FTTP-based GEA products are not as advanced as its FTTC-based GEA products and consequently there is less information available about control options associated with BT's FTTP-based GEA products.

Our analysis:
The current committed Openreach product plans fall well short of what is technically and operationally feasible. Whilst discussion continues on how profiles can be managed and real-time performance monitored and managed, there is no current product road map that demonstrates convergence with reasonable CP expectations.

Verdict – GEA fails to meet the VULA attributes

5. Control of Customer Premises Equipment ("CPE"): **sufficient control of CPE should be available**.

Allowing CPs the freedom to choose CPE provides the flexibility needed to ensure CPs are able to differentiate how they deliver services to their customers. Restricting the type of CPE (other than in accordance with generally recognised and accepted standards) would limit CPs ability to offer differentiated and innovative products.

Ofcom position:
BTs current presentation of its GEA products is an Ethernet port on the NTE. Ethernet is a common and well understood standard and so it should be relatively straight forward to connect GEA to consumer premises equipment (CPE), such as computers, routers, TV decoders, etc. It is our current understanding that the standards are not sufficiently mature, for either FTTC (VDSL) or for FTTP (GPON), to enable a wires-only presentation to be readily implemented. This suggests that it would not be straight forward to adopt a wires-only interface for GEA today, whether it is based on FTTC or FTTP. In light of this, BT's proposed Ethernet presentation would seem to be a sensible option at present.

Our analysis:
The NICC contribution from Gavin Young et al, established a 6 to 9 month timetable for fully stable and proven interoperability for VDSL2. That should mean that Ofcom mandate Openreach to make the FTTC "wires only" product available within that period as part of a defined road-map evolution. FTTP will take longer but Ofcom should still seek a clear and unequivocal commitment from Openreach to implement. Additionally, delivery of an "Open ATA" capability via the CPCA work should not be used as a rationale for not providing "wires-only".

Verdict - FTTC fails to meet the VULA attributes, given the current status of standards. FTTP is currently compliant on the same basis, but Ofcom should impose an obligation to provide "wires only" when standards allow, perhaps with an appropriate "trigger".

Appendix 4

BSG PISWG - Outline requirements for a network element "passive access" product set

Introduction

The BSG PISWG is examining the opportunity for the reduction of NGA deployment costs by exploiting relevant existing "network" infrastructure through some form of commercially agreed or regulatory intervention mandated sharing.
This document outlines an initial draft requirements specification of a suitable "passive access" product set. In practice, this involves a number of products that could be required and used in a variety of combinations, depending on the route and the operator's requirements. The product set below also includes elements that would address the information needs of an operator for them to be able to make an informed decision regarding the economic/commercial viability of their proposed use of shared infrastructure. This specification is at a top level, and a number of issues would need to be resolved and further work undertaken to develop this. It is expected that all products here would be underpinned by SLAs and SLGs, including appropriate timescales for provision of each product.
This is intended to be generic to any passive infrastructure, but has focused initially on Openreach's network as a starting point, given the likely central role that Openreach would play in this market, the network's ubiquity and the availability of information regarding its infrastructure and existing products and services.
Where new infrastructure is required due to a lack of available space, there are a number of issues that need to be resolved by industry. These will be considered in a further paper looking specifically at the provision of new passive infrastructure.
In order to derive the product set out described, the following assumptions were made.

- A passive infrastructure-sharing product set should be based on a requirement for 'efficient use' of existing infrastructure.
- Any product set should seek to minimise disruption caused by civil works, and disruption to end-users. Minimising the amount of civil works would also reduce the carbon footprint of infrastructure sharing.
- Operator cooperation will be required, and will be an important enabler of effective passive infrastructure sharing arrangements. Opportunities for cost-sharing should be built in to the product set to aid cooperation, efficient use and to minimise disruption.
- No estimations concerning cost have been made for these requirements; they represent a wishlist from CPs. A number of these requirements may need to be revised in light of an examination of the costs involved in meeting them and the practicalities of providing services to address them. Further work would need to be undertaken to explore the various options and requirements set out here.
- Where possible, the product set should build on existing products offered by Openreach and BT Wholesale as part of their regulated wholesale portfolios, and existing standard industry practices.
- Operators will want flexible access points along a route.

- A number of corollary issues, such as permitting new overhead distribution and providing greater certainty regarding wayleaves, would need to be resolved in order to maximise the usefulness of passive access products. These are highlighted below; responsibility for resolving these issues lies with government and the regulator, with input from the industry.

Product set

Initially, operators would be concerned with establishing the feasibility of infrastructure sharing in any given location, and analysing the impact on their business case of doing so. In order to do this most efficiently, it is envisaged that a three stage process be developed, each step providing a greater level of detail and certainty than the previous one.

Stage 1 – Initial information gathering/planning

- The first stage would be an initial review by the operator of the area in which they intend to explore either utilising duct access or through pole attachment. This would be based on information made available by the infrastructure operator at a high level. This stage would enable operators to identify whether there are routes in the area that could potentially meet their needs.

- Existing products and services such as Openreach's Maps by Email,[17] or Linesearch.org,[18] provide a useful basis for this stage, providing information regarding underground or overground routes (duct lengths, approximate locations of joint boxes, PCPs, pole locations, and other plant information).

- These would need to be developed in to a fit-for-purpose tool; this would include agreements regarding the maintenance and upkeep of these records, including recording information regarding work undertaken in an area, when, and by whom, and the easy online availability of information to match the proposed network footprint being considered.

- However, all information would be provided with appropriate disclaimers regarding the accuracy of existing records.

- It may also be pertinent to record areas that have been previously surveyed by an operator, along with a process for contacting that operator – this is developed below in the discussion of a survey product.

- Security considerations mean that access to this information may be limited. A useful condition may be to restrict access to those with Code Powers or equivalent street works authorisation, although this will need to be considered in light of the needs of new entrants and community broadband operators.

- Similarly, it may be necessary for operators to edit the information that is made available, to ensure security and privacy requirements are met. Openreach's security category

[17] http://www.openreach.co.uk/orpg/networkinfo/locatenetwork/mapbyemail.do
[18] http://www.linesearch.org

classifications for 21CN may provide a useful example on which to basis any requirements.

- There remains an issue of how data regarding infrastructure owned by non-traditional infrastructure providers, such as community groups, is recorded.

- The level of information available should allow an initial network deployment plan to be developed, based on assumptions on the potential for network re-use in the footprint, providing an estimate of overall network economics for a first pass business case.

- A period of time should be permitted for operators to provide an indication of intent to progress to stage two for a given area to other operators. Such a process would enable operators to share costs at stage two, and potentially stage three, should an area have interest from multiple operators. Some form of clearing house for registering interest in an area may assist with such a process.

Stage 2 – Desk research and analysis

- Depending on the results of the first stage planning process and business case analysis, the second stage would be for the operator to ask the infrastructure provider to undertake desk research on the route(s) identified by the operator.

- Taking Openreach's network as an example, this would mean providing data drawn from the duct records for comparison with the data available on the maps and the cable records to provide information regarding the underground and overground infrastructure along the route(s), and an indication of the likelihood that there would be available space on that route.

- Information regarding any planned works along the route, or in the nearby area, would also be useful to an operator. These would include any planned alterations to the network.

- Such information would be provided with appropriate disclaimers concerning accuracy and completeness, but would provide a greater degree of certainty, based on the infrastructure provider's knowledge of the network and general planning rules in use.

- This stage could be optional for those operators who wish to proceed directly to stage 3; this may involve a combination of stages 2 and 3 being provisioned together. However, it is important that this is offered as a separate stage, in order to provide operators an opportunity to consider whether to proceed following receiving this information.

Stage 3 – Survey

- The third stage would be for the operator to ask the infrastructure provider to conduct a physical survey of the required routes.

- The survey product would need to provide a standard means of requesting information along any part of a route or routes (between A and G as described below in the network

diagram), as well as a standard way of recording the results, capturing the information required by operators.

- The survey would need to capture where there appears to be usable space, where chambers and other relevant network points are located (and what types), the type of duct or pole, and where space and/or access is not available, or where further stabilization work is required before further cables can be attached to an overhead pole.
- The survey should ideally be scalable depending on the requirements of the operator. Therefore, route distance might be the most appropriate unit to define the survey's requirements, and the survey product should permit surveying of the smallest distance that an operator would find useful.
- Operators may also require a survey to consider infrastructure operated by a third party along the selected route(s). Thought needs to be given as to how surveys along a route where multiple infrastructure providers are present could be most efficiently undertaken.
- A further consideration could be the interest of multiple operators in surveying the same or neighbouring areas. The process set up to provide the survey product may need to consider how best to efficiently survey an area in these cases, perhaps by providing opportunities for cost sharing.
- If a survey takes place, a record should be made that a survey had been carried out, by whom and when; this information should be indicated to operators conducting initial information gathering, perhaps through recording this on the network maps.
- Where a blocked route is subsequently cleared or the stabilisation of a particular pole strengthened by the infrastructure provider, this should be notified to those operators that had previously shown an interest in that route, but following the survey results had decided not to proceed with a deployment.
- Survey information is likely to be a valuable resource, and a means by which survey results can be shared between operators would need to be established. This would support both a cost-effective approach, and limit the disruption caused by multiple surveys. There are a number of options available:
    - All survey results immediately form part of a national database that all operators have access to. While this would lead to a more open approach, the free-rider issue may act as a disincentive to surveys being undertaken.
    - A process for cost-sharing between operators once the survey has been undertaken could be developed, by enabling operators to identify other operators that have conducted surveys in a particular area.
    - A period of exclusivity could be granted to the operator undertaking the survey, during which time they would be able to decide whether to proceed on the basis of these results. Once a decision has been made, the survey results are then released to other operators. This would not preclude commercial cost-sharing arrangements between operators during this period of exclusivity.

- Within the results of the survey the infrastructure provider should provide alternative deployment options and approximate costs for these, where the survey has indicated that a route, or part of a route, is not able to be shared.

Stage 4: Ordering and fulfillment

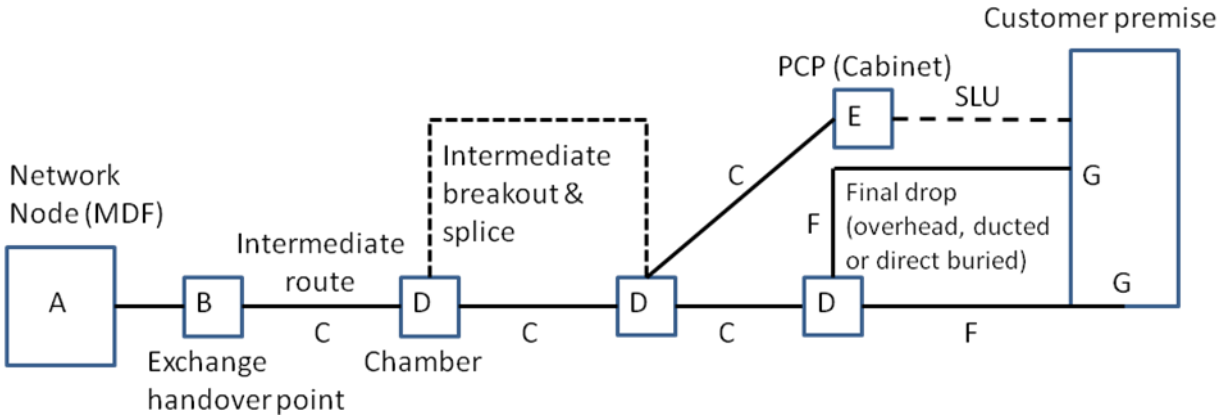
Once the pre-deployment stages are completed, an operator will make a decision whether to proceed with an infrastructure-sharing arrangement. Should they choose to proceed, there will need to be appropriate processes devised to permit the ordering of the required products, and the tracking of progress and issue identification and resolution. Many of these requirements will be based on existing industry practices and processes.

- However, passive infrastructure sharing contains an inherent uncertainty regarding the likelihood of a product being able to be provisioned, even following the pre-deployment stages. Therefore, processes to address issues arising from blocked ducts or pole instability and unavailable routes that weren't identified would need to be considered.

- One possibility is that the probability of a blocked route or pole instability is factored in to the pricing of a product-set, and that the infrastructure provider will resolve these issues in the most appropriate way as part of its agreement with the operator.

- Alternatively, the infrastructure provider could provide options and costs to the operator, with the operator having the option to cancel its deployment should an issue with the proposed route(s) arise and no suitable alternative can be agreed.

The products that would comprise the passive infrastructure sharing product-set are set out below. The requirements refer to the points marked A through G on the network diagram below. In practice, this involves a number of products that could be required and used in a variety of combinations, depending on the route and the operator's requirements.



A – Network Node (MDF)

- As with LLU, operator requirements would involve space, power and Cablelink services (similar to Access Locate).

- It may be that existing products to support LLU and interconnection are appropriate for this purpose.

B – Exchange Handover point

- Again, requirements are similar to LLU/interconnect: there needs to be space for multiple operators, in order to enable cable access to the exchange (In-Span Interconnect-type services).

- It may be that existing products to support LLU and interconnection are appropriate for this purpose.

C – Intermediate routes

- For duct access:
    - Space is the key variable, with the standard minimum requirement 25mm of space for a sub-duct.
    - Exactly how the sub-duct is provisioned needs to be resolved – working assumption is that Openreach would provision the basic sub-duct.
    - Equally, how the space within a sub-duct is allocated and utilised needs further consideration.
        - Concerns over a 'land grab' could lead to efficient use requirements.
        - Alternatively, open access requirements on any operator using a duct access product to deploy fibre may be required, ie they would be obliged in turn to provide access to their infrastructure based on the "passive access inputs" to other CPs. Typically this would involve provision of blown fibre tubes or dark fibre to third party CPs.
        - Initial provision of blown fibre tubes and/or fibre for open access by the original infrastructure provider or the appointed contractor during sub-duct deployment should be considered as an option.

- For pole attachment:
    - This applies to sections of a route where an overhead infrastructure is available.
    - The requirements for sharing overhead routes could involve wayleave issues, as well as sharing space on existing and new telegraph poles.
    - A revision to the Communications Code to allow new overhead distribution is currently being considered by government; revising this and the associated planning regulations would need to be factored in to the to the consideration of overhead sharing.
    - Where an overhead infrastructure is available, pole attachment products can be used:
        - To carry cables from pole to pole as part of a distribution network.
        - To carry cables from a pole to premise as the final drop.
        - To mount passive splitters that are used, for example, in the distribution network of a passive optical network.

    - To carry a cable from a nearby chamber (see D below) to the top of a pole.

- The condition of the asset at the time of the deployment may require additional work to be undertaken to strengthen or repair it. The arrangements for covering the cost of these works could be met in a similar way to that discussed above for addressing an unusable route.
- Further work on the economics of the available options would need to be undertaken in order to inform decisions on these issues.

D – Intermediate chambers or overhead cable runs

- Operators would require flexible physical interconnection; this translates to access to multiple intermediate chambers or overhead cable runs along a route in order to break in and out to connect to their own network.

- This would include access for splicing and maintenance in the case of a duct route; whether this would require a dedicated chamber or whether this could be achieved through access to a BT chamber needs to be addressed. It should be noted that SLU already has a chamber 'break-in' product that may form a satisfactory basis for all or part of this requirement. In the case of overhead deployment, the question of who physically undertakes the work would need to be addressed.

- This would be applicable to all chambers where duct access is capable of being provided or where access to a distribution network based on pole attachment has been requested.

E – SLU

- This will be covered by SLU-enabling products, such as PCPLink, but it is likely that additional options will be required and it is unlikely that all the current products are fit for purpose.

F – Final drop

- Up to the lead-in to the premise, this would be served either by duct or pole attachment as per 'C'.
- From the lead in to the home, the minimum requirement is likely to be smaller than a standard sub-duct as described in 'C', as the minimum an operator would be required to provide to the home is a single fibre.

- Where fibres are available to the customer premise that operators are able to access, it needs to be clear that this is permissible under existing wayleaves.

- However, there may also be instances where new wayleaves are required to deploy new duct and cable to the customer premise. Where the final drop cannot be shared and new infrastructure is required, this would be dealt with as per the new infrastructure requirements paper.

G – Customer access

- Access to the home causes disruption to the end user; it may be necessary to consider a requirement for there to only be one operator to enter the home. This may place open access obligations on that operator to provide access to other operators as discussed above in 'C'. This could be similar to the 'mutualisation' policy in France.

Cost sharing

- Where multiple operators have expressed an interest in an area and wish to deploy in the same location, thought needs to be given as to how access is provided, particularly in the event of limited available space (i.e. insufficient space for the number of interested operators). This scenario could be particularly relevant where operators have shared costs in previous stages, such as the survey.
- One possible solution is for operators to determine between them who should have priority, as part of their cost-sharing arrangements.
- Alternatively, operators may wish to cost-share on the provision of new infrastructure.
- It may be necessary to consider whether, once an operator has decided to proceed with a deployment, a period of time should be permitted for other operators to declare an interest in that area and enable them to be part of the deployment. This would raise similar issues to the above, such as priority of access and the arrangements for cost-sharing in the event of new infrastructure being required.

Stage 5: Lifecycle maintenance

- Processes for the ongoing maintenance and repair of the infrastructure, such as fault diagnosis and reporting, during the lifecycle of the infrastructure sharing arrangement would need to be developed. Again, these could be based on existing industry practices.
- Provisions in the event of exchange closures and other network alterations would need to be in place. These currently exist for existing product sets such as LLU and Ethernet; it is likely that these provisions would be similar to these existing products.

Stage 6: Cessation and redeployment

- Provisions for asset recovery and/or reuse would need to be established. A range of issues would need to be addressed to develop this, including responsibility for the condition of the infrastructure asset, and processes for transferring the fibre asset should this be a desire on the part of the operator.
- This would need to include provisions in the event of operator insolvency, building on the existing Funds For Liabilities provision. This may need to be revised in order to ensure that it is fit for purpose, both for passive infrastructure sharing specifically and for the emerging NGA market more generally.
- Conditions exist on current Openreach products that could provide a template for the required conditions in this case.