ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.
RESPONSE TO OFCOM CONSULTATION

FIXED ACCESS MARKET REVIEW
Approach to setting LLU and WLR charge controls
20 August 2013

1 Introduction and summary

Adaptive Spectrum and Signal Alignment, Inc. ("ASSIA"), a leading international supplier of Digital Subscriber Line (DSL) management technology, submits the following observations on certain issues raised in this charge control consultation to assist Ofcom in its objectives in substantially improving the affordability and performance of fixed broadband access in the coming years.

In summary:

- Current and near-term technology innovations in DSL management can significantly reduce the costs to operators of providing fixed broadband access using DSL;
- A range of DSL management technologies exists, with widely varying effects on the operating costs and performance of DSL networks;
- BT Openreach has historically used proprietary solutions for DSL management, the performance of which may be substantially below industry norms;
- A trend is developing across Europe wherein the most advanced DSL technologies, "VDSL" and "Vectored VDSL," are deployed by former incumbent operators, reducing facilities-based competition in the broadband access market and heightening the need for affordable Wholesale Line Rental to enable robust competition in services-based competition (or "bitstream unbundling");
- Cost controls on BT Openreach are important in incenting it to adopt technologies that reduce the costs of network operations;

- ASSIA believes that changes in cost controls and in the way in which BT Openreach accounts for and offers some services will give greater transparency and incentives to BT Openreach to adopt and offer "best available" DSL management technologies;
- Ofcom's current approach to charge control may not be consistent with emerging EU law in this area;
- Ofcom's forthcoming review of quality of service and fault rates will need to address technological change that substantially improves customer experience in fixed broadband access; and
- BT Openreach is at risk of breaching competition rules if it uses its dominance in local broadband access to create a single, BT owned-and-managed, with proprietary management practices, DSL service that is the only one available in the UK.

2 About ASSIA

ASSIA was founded in 2003 by Dr. John Cioffi, a noted expert and pioneer of DSL technology and professor emeritus of electrical engineering at Stanford University. The company was created to help service providers realize breakthrough improvements in the performance and profitability of their DSL networks by use of Dynamic Spectrum Management (DSM). DSM[1] is a standardized set of DSL management capabilities, practicable on any DSL equipment compliant with the ITU-T DSL standards used in the UK. In particular, ADSL1, ADSL2, ADSL2+, VDSL2 and, soon, Vectored VDSL2[2], are the ITU-T DSL standards deployed in the UK. Support for DSM is mandated in each.

ASSIA's products manage approximately 65 million DSLs worldwide, or nearly 20% of all DSLs worldwide (and a much greater fraction of all DSLs managed with DSM). Roughly 90% of all DSLs in the United States are managed by ASSIA's products, as are approximately 60% of all DSLs in Latin America. In Europe and the UK, the company counts BSkyB, SFR and Bouygues (two of the three French CPs), and operating companies of Group Orange, Deutsche Telekom and Telefónica amongst its customers. Major Asian operators including China Telecom are also customers. Further, ASSIA is actively engaged with regulators in many of these jurisdictions, and in DSL standards bodies.

ASSIA thus serves a broad set of telecommunications companies representing the full range of service providers and markets — from incumbents to competitive carriers and in markets ranging from more regulated to increasingly open and competitive. ASSIA thus has a unique and broad perspective on DSL technology, economics and regulation, which it offers to Ofcom in this response.

[1] DSM encompasses three different levels of DSL management. BT often refers to the first level of DSM as "Dynamic Line Management (DLM)."
[2] "VDSL" as used herein refers specifically to VDSL2.

In deployments of ASSIA's DSM products, ASSIA's customers have observed the following benefits:[3]

- Up to a 60 percent reduction in calls, dispatches, and churn related to physical layer issues, improving network economics and broadband end-user satisfaction (handling customer complaints, site visits from engineers to repair lines and lost revenues from churn all significantly affect the economics of broadband provision);
- Up to a 40 percent increase in speed and service reach, reducing the capital costs of deploying and operating DSL technology, and increasing the speeds that can be delivered to end-users located away from the exchange or street cabinet housing the DSLAM;
- Up to €370,000 (~£315,000) annual savings in energy costs using the power management module in a one million line European network without compromising speed and reliability;
- Automatic performance optimization of all network lines;
- Robust and accurate DSL diagnostics, reducing the costs of physical interventions by the network operator.

Over the past several years, technologically advanced countries have seen a resurgence of interest in copper-based broadband solutions such as VDSL2 and Vectored VDSL2. These copper-based solutions can achieve speeds in excess of 100 Mbps and represent a very low-cost alternative to FTTH for providing superfast broadband to residential customers. VDSL2 and Vectored VDSL2 are typically served from a street cabinet (so-called "FTTC" or "FTTCab") to reduce the length of the copper loop between the DSLAM and the customer premises. A increasing fraction of ASSIA's customer engagements focus on planning and continuous optimization of FTTC DSL deployments, for the purposes of minimizing capital and recurring costs, while achieving operator-defined tradeoffs of speed and stability (QoS).

Finally, ASSIA has been active in Europe, the UK (including in the UK NICC Standards organization) and in the US to ensure that broadband access competition is preserved in deployments of Vectored VDSL. Vectored VDSL increases speeds in dense VDSL deployments by cancelling crosstalk among VDSLs.[4] While it is demonstrably feasible for multiple operators' DSL systems to coexist in a shared copper plant, it is technically expedient to for all VDSLs to be operated by a single entity when Vectoring is in use. Recent regulatory decisions in Belgium, Austria and Germany have effectively turned control of Vectored VDSL (nearly equivalent to control of FTTC) in any geography to a single operator. While this approach simplifies certain technical aspects of Vectored VDSL deployments,[5] it reverses

[3] Each broadband service provider's network and operating objectives are different. The benefits of DSM, while generally substantial in all cases, thus vary from one network to the next.

[4] As in wireless systems, the capacity of DSL is limited in dense deployments by interference among DSLs or "crosstalk."

[5] Note that consolidating control of the Vectored VDSL infrastructure is not a technical panacea. Legacy ADSL technology, which accounts for the majority of DSL today in the UK, will interfere with

several decades of improvement in broadband access competition by largely eliminating the requirement for unbundling. Competition in such environments is then on the basis of so-called "VULA" or "bitstream unbundled" services, in which a wholesaler offers a limited number of bitstream services to resellers, who then compete based on price or value-added services (input cost being largely fixed). In contrast to this "one size fits all" approach, DSM can be used to provide resellers with a degree of control of the Vectored VDSLs connecting to their customers, enabling differentiation at the physical layer (and therefore for end-users according to their needs) while preserving determinacy in network performance for the wholesale operator that deploys and manages the Vectored VDSL infrastructure. Such differentiation is consistent with Ofcom's goals for VULA that operators can exercise "a degree of control that is similar to that achieved when taking over the physical line to the customer."[6]

3 Why ASSIA is responding to this consultation

ASSIA comments on Ofcom's current charge control review because of the likely impact of DSL management technology in fixed broadband VDSL networks, and specifically on the issues of quality of service and of fault diagnosis, reporting and repair.

The costs that BT Openreach is allowed to recover under the charge control for the use of its network and, in an FTTC environment, specifically its MPFs and (at least where there is no alternative operator having a build to the cabinet – as is likely in the large majority of areas of the UK) its DSLAMs, should be structured to give BT Openreach an incentive to adopt or allow the use of "best in class" technology, especially with respect to DSL management. If not appropriately implemented, cost control in this area can impede take up of new technologies and thus deprive both BT and other operators (and their customers) of higher service levels and lower costs.

ASSIA addresses three cost control issues in this response:

- The best means to adjust the cost control model so that adoption of state of the art DSLAM management can be encouraged, in the FTTC environment in particular;
- How DSL management technologies can reduce the costs of building new networks and meeting quality of service requirements; and
- Using appropriate management technologies to minimize incidence –and therefore cost – of faults (particularly in an NGA network).

This means that ASSIA's observations in this response will address the following consultation questions:

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vectored systems, for example. DSM techniques are well-suited to addressing coexistence issues of this sort.

[6] "Review of the wholesale local access market - Statement", Ofcom statement published 07/10/10. See http://stakeholders.ofcom.org.uk/consultations/wla/statement

Question 3.5: *Do respondents agree with our proposal to apply the anchor pricing principle by means of a model of [a] hypothetical all-copper network? Please provide reasons to support your views.*

Question 3.11: *Do respondents agree with our proposal to use glide paths to align charges with costs for these charge controls? Please provide reasons to support your views.*

Question 5.1: *We would welcome the views of stakeholders on our proposed approach to estimating the cost of changes to service levels.*

Question 5.2: *We would welcome the views of stakeholders on our proposed approach to analysing fault rates. In particular do stakeholders believe that fault rates should differ between MPF, WLR and SMPF? Please provide reasons to support your views.*

In addition, ASSIA has significant concerns about the effect on potential competition of a regulatory regime that fails to give BT the incentive to employ best-in-class management practices and to create appropriate open management interfaces. In short, other operators will be forced to use BT Openreach's own DSL management technology for the NGA network (in the same way as has already happened for current ADSL services). This 'vanilla-only' approach to DSL management will discourage operators from developing innovative services for their customers (and indeed may prevent some services from being offered at all) and will weaken the competitive spur to BT itself to offer these services.

4 European Commission Draft Recommendation: Ofcom's approach

We note that the EC Draft Recommendation[7] will make a number of adjustments to the way in which national regulatory authorities such as Ofcom calculate the cost controls for operators having SMP in certain network services. In particular, the Draft Recommendation provides the following.

> *34. NRAs should adopt a bottom up long run incremental costs plus (BU LRIC+) costing methodology; i.e. the use of a bottom up modelling approach using LRIC as the cost model and with the addition of a mark-up for the recovery of the common costs.*
>
> *35. NRAs should adopt a BU LRIC+ costing methodology that estimates the current cost that a hypothetically efficient operator would incur to build a*

[7] European Commission [draft] recommendation of XXX on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment, draft of 7 December 2012, www.ec.europa.eu/digital-agenda/en/news/draft-commission-recommendation-consistent-non-discrimination-obligations-and-costing. - cited at the consultation document para 2.24 ff

modern efficient network, which is in principle an NGA network. This is without prejudice to the question whether any NGA network present in the relevant geographic market is subject to cost-oriented access pricing, which is addressed in Recommend 36 of the NGA recommendation and Recommends 49 and 50 below.

36. When modelling the NGA network, NRAs should define a hypothetical efficient NGA network, capable of delivering the Digital Agenda for Europe (DAE) targets, which consists wholly or partly of optical elements.

42. When estimating the cost of wholesale access services that are based entirely on copper, NRAs should adjust the cost calculated for the NGA network to reflect the less performant [sic] features of a copper network. For this purpose, the NRAs should consider an FttC network to be the modern efficient NGA network and should estimate the cost difference between an access product based on FttC and an access product based entirely on copper by making the relevant adjustments in the FttC engineering model, e.g. replacing the optical elements with efficiently priced copper elements, where appropriate.

Ofcom has chosen not to follow this methodology in this charge control review (for the reasons given in para 3.196 of the consultation document).

Ofcom nevertheless has confirmed that it prefers, in general, to set charges using costs and asset values derived from the most efficient available (MEA) technology that performs the same function as current technology (consultation document 3.34). This is in line with the principles set out in the draft Recommendation. However, for the period covered by this charge control review, Ofcom has indicated that it will not use the MEA approach – because of the expected pace of technical change which could increase regulated costs to 'current generation' consumers – but rather the 'anchor approach' described in paras 3.36 - 3.40 of the consultation document.

The Draft Recommendation will not require NRAs (e.g. Ofcom) to apply the recommended methodology until 31 December 2016. Ofcom has said that, rather than impose 'one-off' changes to the controlled charges in local access markets where BT Openreach has SMP as a result of this review, it will normally provide a 'glide path' whereby the changes are introduced gradually over the period of the review. This is to better simulate changes that would occur in a competitive rather than a regulated market, and also to provide a charge control background of sufficient certainty that BT and other communications operators can plan investments.

We note, however, that the period for this charge control runs from April 2014 to April 2017 – that is, after the time when the principles in the Recommendation should be complied with. Any glide path will therefore need to have a trajectory

which will enable compliance with the Recommendation by the end of the control period at the latest.

This charge control review needs, therefore, to ensure that by the end of the period, the costs recovered by BT Openreach are those of an MEA-costed, NGA FTTC network consisting at least partly of optical elements. Only where access services are based ***entirely*** on copper (for example, narrowband voice telephony and exchange-based ADSL), will Ofcom be able to adjust this method to take account of the cost difference in using copper over fibre.

5 Incenting best management technology in NGA networks

The costs and performance of DSL can be dramatically affected by the choice of network management strategy, with implications for wholesalers, resellers, consumers and, in general, competition. Ofcom should give BT Openreach the incentive to allow all operators (including its own wholesale and retail arms) to adopt the best available DSL management technology, and to evolve that technology over time in response to technical advances and commercial priorities.

We think this means:

- BT Openreach should be required to account separately and on a per unit basis for the development and running costs of DSL management in its regulatory accounts so that, by 2016, compliance with the MEA test can be checked[8];
- BT should be required to establish a set of open DSM interfaces, corresponding to those specified in the DSL standards, for its FTTC deployments that provide resellers the ability to meaningfully control the physical layer properties of wholesale services (related work items are currently underway in NICC);
- BT's own DSL management service costs (assuming it continues to provide these services for NGA networks) must be efficiently incurred: that is, it should not be cross subsidized by other parts of BT's NGA development programme.
- BT Openreach must unbundle the cost of DSL management services in its FTTC offer. At present, BT Openreach does not offer a set price even for sub-loop line testing, etc. (the nearest service we could find in its price list to DSL management services), but charges on a time basis,[9] reducing price transparency for operators.

[8] In its year to 31 March 2013 Regulatory accounts (Section 7.10.2 at p 80), BT has booked £32 million for LLU systems development and £195 million for DSLAM capital/maintenance, noting in both cases that it has not provided a per unit cost.

[9] "Sub loop standard line test – RWT From 30/06/08 this will be charged for via Time Related charges – See below" and "Time Related Additional changes may be raised where non-standard work is required that is not included in standard price." BT Openreach Price List – retrieved 21/09/2013.

Allowing resellers to select among management systems that leverage the open interfaces referenced above (including any system that might be offered by BT) will mean that operators will be able to select and use the DSL management service that best suits their requirements, including cost efficiency. This alone is likely to ensure that the best available technology is used to manage the UK's NGA fixed broadband network and that any costs incurred in providing these services meet the 'best available technology'/MEA test.

We do not, therefore, fully agree with Ofcom's proposal to use anchor pricing based on a fully copper network for this charge control (Q3.5): there is a risk of new 'best available' technologies not being used in the UK fixed broadband network (configured as FTTC) unless the glide path is adjusted to allow for full implementation of the draft Recommendation by 2016 (Q3.11).

6 Dynamic Spectrum Management (DSM)

DSM is a standardized collection of management interfaces for optimization and diagnosis of DSL network performance. ITU-T Recommendation G.997.1 specifies the management data and control parameters for DSL modems used in DSM. The IETF and the Broadband Forum publish specifications for the manner in which those parameters are exposed to DSM management entities (e.g., IETC RFC 2662 and Broadband Forum TR-027). Finally, ATIS and the Broadband Forum define DSM algorithms and architectures (e.g., ATIS 0600007 and Broadband Forum TR-198). All standards-compliant DSLAMs support DSM, and there is a variety of commercial and proprietary DSM management solutions. DSM is thus a readily available technology, although there are wide variations in performance among implementations.

Figure 1 depicts a monolithic DSM implementation. An Equipment Interface module makes use of the standardized interfaces and quantities mentioned previously to retrieve and set parameters on network elements. These actions are taken under the control of a Diagnostics and Optimization module. In particular, the optimization process (e.g., with respect to speed and stability) is informed by the data collected from the network and by the equipment operator's wholesale service objectives.[10] When the equipment operator is a wholesale bitstream provider, these objectives include the fixed, limited number of speed, and possibly stability, offerings that can be resold to end-users by resellers.

[10] Regulatory restrictions on DSL operation, such as the Access Network Frequency Plan (ANFP), also inform the optimization process with respect to permitted powers and spectrum utilization. DSM can work entirely within the constraints of the ANFP, and can leverage the latest developments such as dynamic UPBO in the AFPF V5.1.1

In contrast,

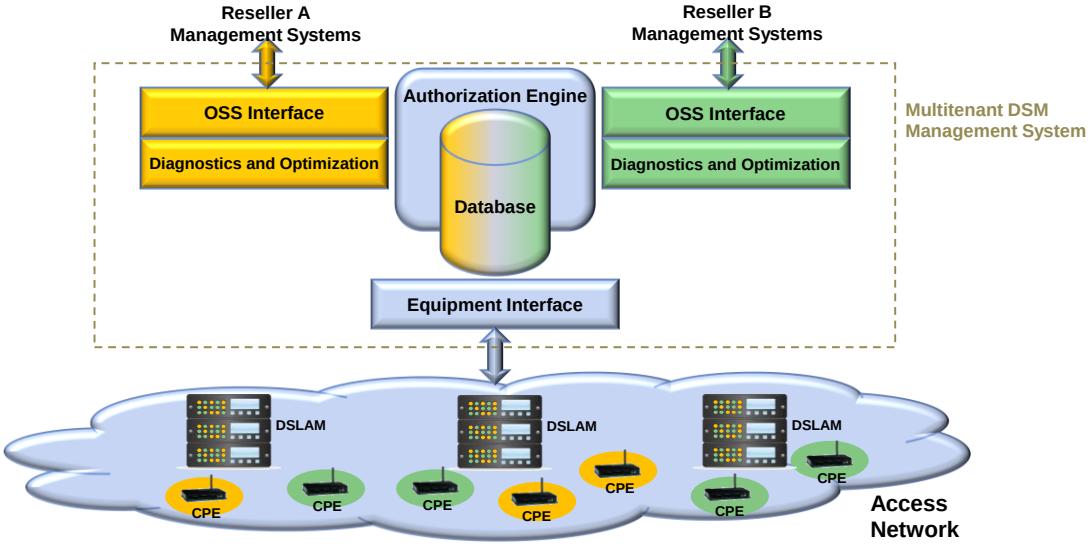

Figure 2 depicts a multitenant DSM implementation. The standardized equipment interfaces are still used as in Figure 1, however data is generally segregated among resellers. Each reseller has significantly enhanced latitude (a) to control the DSL services offered to its customers and (b) to directly receive diagnostic information regarding service quality. The optimization process in this case is informed jointly by the resellers' service objectives, by the wholesaler's objectives of performance determinacy and by regulatory compliance. While each reseller's freedom in defining their DSL services is necessarily less than when resellers operate their own DSLAMs, it is substantially more than in a "one size fits all" pure bitstream scenario.[11]

[11] The OSS interfaces in

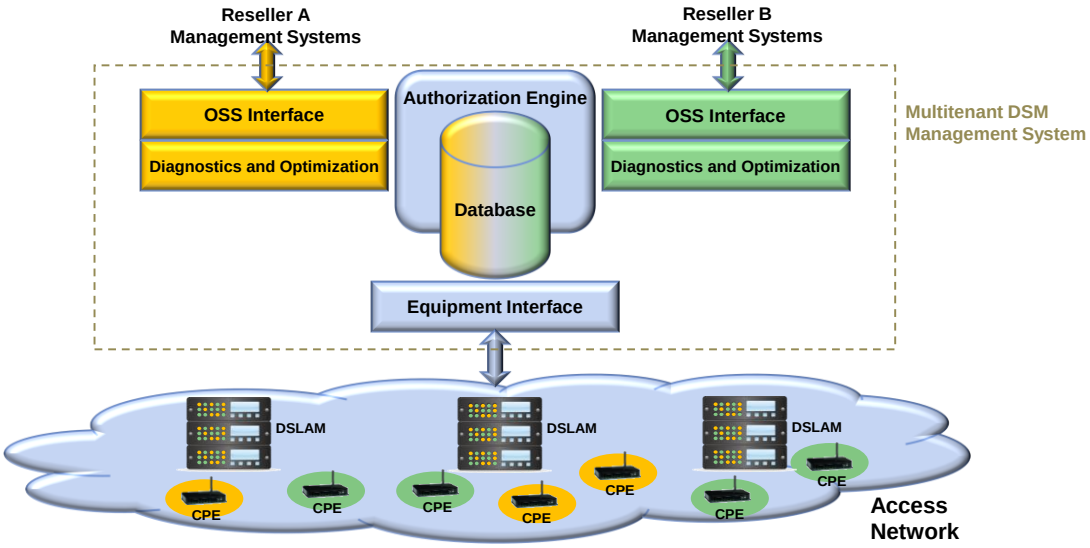

Figure 2 can be identical to those used today by competitive providers to provision and manage their existing networks, reducing resellers' burden in adopting new wholesale services.

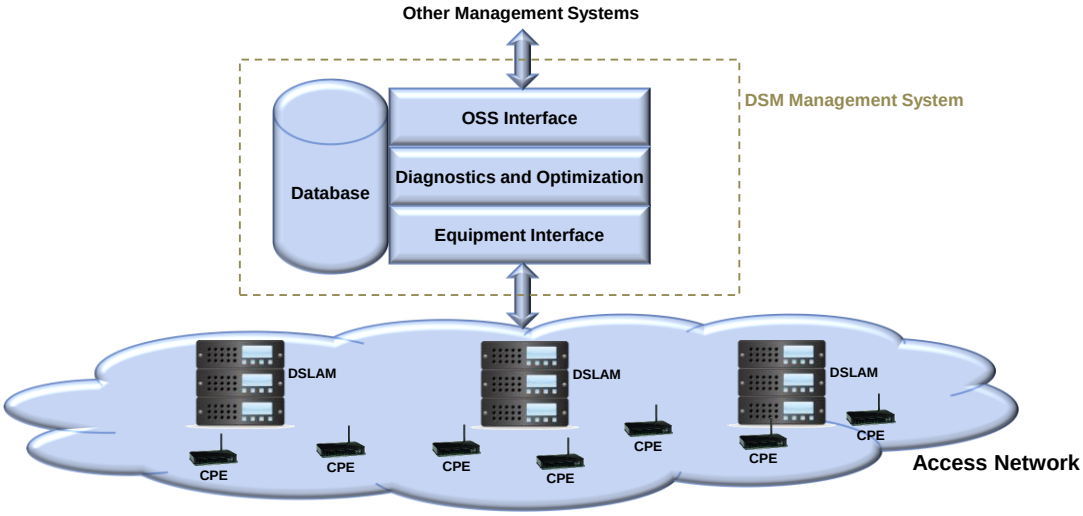

Figure 1: Monolithic DSM Implementation

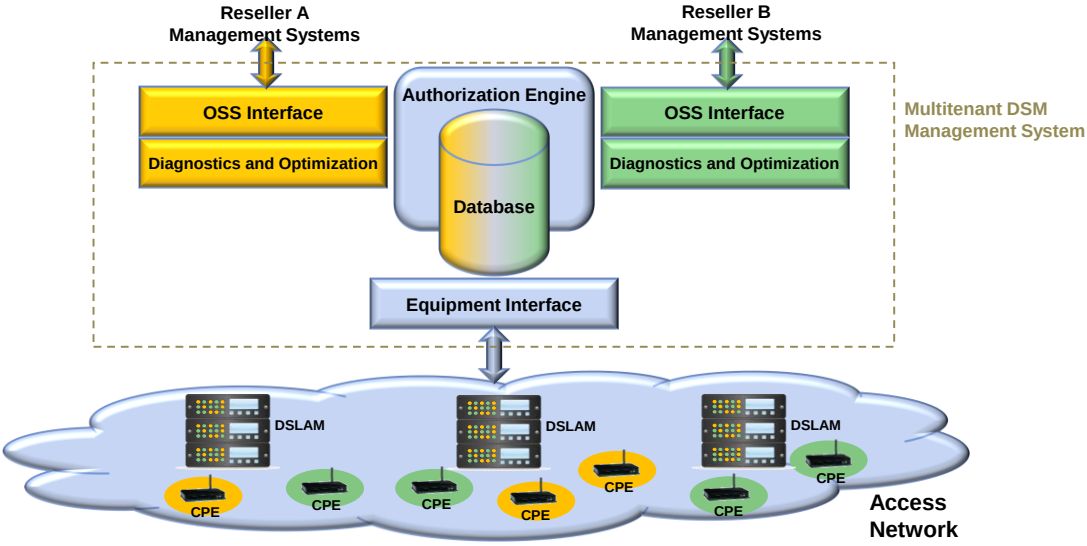

Figure 2: Multitenant DSM Implementation

7 Effect of new technology on network costs

a) Quality of service

We note that Ofcom continues to be concerned about quality of service in regulated wholesale fixed access services generally (consultation document, para. 5.5) and is continuing to examine the issue. As a consequence, Ofcom is not presently in a position to make firm proposals about the level of minimum quality standards nor, therefore, on the appropriate level of charge for the cost of meeting them.

Since

- the proposals in this consultation do not include any specific allowance for quality of service standard (but assume a constant 2011/12 service quality baseline); and
- exclude the costs associated with NGA provision for the 'basket' of costs on which this charge control is based,

our comments will necessarily be general. We also note that Ofcom will be consulting again on quality of service issues, including price control aspects, “this autumn” (consultation document, para 5.4) and we expect to provide a further response then.

As illustrated above, established technology for managing DSL services can greatly improve the quality of service experience for customers of fixed broadband services.

We

- firmly believe that technology advances in delivering VDSL services over copper loops can substantially reduce customer issues with quality of broadband service;
- caution Ofcom against assuming, without cogent evidence, that BT Openreach’s proprietary DSL management services (which we understand are developed in–house) are “best available”/MEA; and
- believe that, even if BT Openreach can show that its proprietary DSL management systems are MEAs, not all of the development costs may have been efficiently incurred.

In particular, it is not clear that the costs associated with developing BT’s proprietary DSL management systems to date should be fully included in any cost allowed in the charge control relating to QoS obligations as they may not have been efficiently incurred. At least, BT should be required to provide a transparent account of those costs in its regulatory accounts (see above).

b) Fault rates

As with general QoS concerns, Ofcom continues to consider evidence on the apparent rise in fault rates in recent years – especially early life faults - and proposes to consult again shortly on action to reduce the incidence of faults.

The charge control for faults is an important part of the cost of LLU (fault diagnosis and repair are 27% of the cost of an MPF), and those costs will be materially affected by the outcome of the current Ofcom review. Again, ASSIA notes that best DSM practices (a) substantially reduce faults occurring in both LLU and NGA environments and (b) reduce costs in remediating faults through accurate identification of the nature and location of faults. Especially for WLR and bitstream services, in which one party (the wholesaler) is responsible for outside plant issues and another (the retailer) can be responsible for premises issues, it is critical to know the location of the fault to ensure that the correct party is dispatched and that the end-user’s service is rapidly restored. Further, many faults can be resolved remotely through DSM, substantially reducing the cost of this line item and hence, the appropriate level of charge recoverable by BT Openreach.

Our answers to Q5.1 and Q5.2 are that we agree that further work is needed to assess the appropriate QoS levels and regulatory requirements to achieve them.

Ofcom should not assume that baseline 2011/12 is necessarily the appropriate baseline for this charge control and should be prepared to adjust the glide path towards a new service level and associated charge regime on the basis of the evidence from its forthcoming reviews. In particular, the QoS levels and fault rates for BT Openreach ADSL services may not reflect the rates which could be achieved in NGA networks if "best technology" is appropriately used. Further, the appropriate access QoS is intimately related to the applications used by the consumer. Those applications may be substantially different for superfast broadband than currently for ADSL.

8 Competition in the NGA world

As noted previously, competition in NGA networks and services is increasingly likely to be provided over BT Openreach's FTTC infrastructure --at least for the foreseeable future and for most customers and operators. BT is the provider of essentially all VDSL services in the UK today, and may be the sole provider of Vectored VDSL in the future. Openreach uses only proprietary BT-developed DSL management services as part of its ADSL bitstream offering, and ASSIA believes BT has similar management intentions for the NGA environment. As bitstream (VULA) access to the NGA network is likely to be the predominant method of reaching customers used by competing operators[12], only BT's DSL management system will be available in the UK NGA network unless BT Openreach changes its commercial stance or is required or given the incentive to create a best-practices open management interface by appropriate regulation.

Most importantly, ASSIA understands that BT's DSL management systems do not currently allow resellers of BT's VDSL service any meaningful control of the physical characteristics of those services other than speed.

ASSIA is advised that BT Openreach may be abusing its dominant position – contrary to Art 102 Treaty of the Functioning of the European Union and/or s 18 Competition Act 1998 - in the Wholesale Local Access market (WLA)[13] (in which it has an over 80% market share) if it refuses any access to its VDSL infrastructure to alternative suppliers of DSL management products. DSL management products for NGA services can, by definition, only be supplied to DSLAM and MSAN operators: in relation to VDSL services, Openreach is likely to have a (near) monopoly of such operation in the UK for the foreseeable future.[14]

BT Openreach's commercial behaviour risks slowing or stalling technical progress and affordable broadband access, in particular by entirely preventing the testing and roll out of alternative premium DSL management products in the UK. This commercial policy has the potential to deprive UK fixed broadband consumers of a higher quality of service due to lower interruptions to service and higher speeds and

[12] Ofcom review of Wholesale Local Access Markets, October 2010, para. 1.25-1.26
[13] At 1.18-1.22
[14] As above, (with the exception of the Hull area).

to prevent consumers from benefitting from lower prices; savings that could be made by operators in DSL maintenance costs using alternative technologies to BT's systems will not arise and cannot be passed through to consumers.

9 Conclusion

Ofcom's forthcoming work on service standards (and fault reporting), as well as its ongoing work to bring its charge control regime into line with the Draft Recommendation, will be important in ensuring that BT Openreach has the correct regulatory incentives to use and allow the use of best available DSL management technologies.

We urge Ofcom to ensure that:

- costs incurred by BT and/or BT Openreach in developing DSL management systems are transparently reported and efficiently incurred;
- a set of open DSM interfaces is established, corresponding to those specified in the DSL standards, for its FTTC deployments that provide resellers the ability to meaningfully control the physical layer properties of wholesale services;
- in working towards compliance with the (proposed) EU Commission Recommendation on NGA charge controls, Ofcom ensures that the FTTC network model it creates applies MEA principles to DSL management;
- BT is not allowed to take advantage of its position in local access infrastructure to carve itself a dominant position in the UK market for DSL management systems.

We are of course happy to assist Ofcom further with any questions that may arise from these observations – none of which are confidential - and look forward to participating in the quality of service consultation shortly.

25 September 2013.