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Keep nothing confidential

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Yes

**I confirm that I have read the declaration:**

Yes

**Ofcom should only publish this response after the consultation has ended:**

You may publish my response on receipt

**Additional comments:**

References:

1) [http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white\\_paper\\_c11-520862.html](http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html)

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**Question 1: How enduring do you think congestion problems are likely to be on different networks and for different players?:**

Congestion problems look set to endure almost indefinitely, and will continue to provoke much discussion about the capacity of various networks, and the underlying investment it will take to ensure that they scale effectively. Added to this of course is the changing nature of what consumers are using the networks for. The underlying trend is the fact that both mobile and fixed networks are rapidly becoming entertainment platforms, with a significant slant towards online video, be it streaming or download. One of a great many forecasts indicates a large growth in mobile traffic, for example, with a corresponding rise in video content consumption along with other high bandwidth forms of traffic: according to Cisco, globally, mobile data traffic will double every year through 2014, increasing 39 times between 2009 and 2014 (1).

Within this mobile traffic, almost 66 percent of the world's traffic will be video by 2014 (1).

The net result of course is a familiar pattern, with a growing gap between data usage and revenues, which has been highlighted by many organizations, not least Ofcom itself (2).

The problem of congestion, however, manifests itself in different ways depending on

whether the network is wireline or wireless.

With the fixed network infrastructure the major theoretical constraint to capacity is the willingness of service providers and / or governments to invest heavily in capacity uplift. After all, a fixed infrastructure exists to the vast majority of properties in the UK, and a fixed-line infrastructure is (with few exceptions) a dedicated provision to a property, be it a business or a consumer residence. To an extent, the investment has already gone in, and what remains is to upgrade it to provide, for example, fibre-optic infrastructure and the resultant increased levels of data transfer. We have seen, for example, the commitment in the UK Digital Britain report to a universal provision of a minimum level of 2 Mbps broadband access to the UK population by 2012 and now recently pushed back by the new government to 2015 (3). We have also seen a commitment to broadband as a human right in Finland where, under Finnish law, every Finn now has the right to access to a 1Mbps broadband connection and the Finnish government has vowed to connect everyone to a 100Mbps connection by 2015 (4). British Telecom in the UK has committed funding to a fibre rollout.

Another constraint, however, is local planning: in many cases a fibre infrastructure requires a new network topology consisting of additional street furniture, not all of which is welcome to local neighbourhoods, but which, conversely, is a lot less controversial than installation of mobile telephone masts.

For fixed-line infrastructure therefore, enduring capacity constraint is likely to relate to the ability or otherwise of service providers and governments to commit funding to infrastructure, it is possible that funding in the future will offer analogies to road building: if capacity is provided it is immediately used, leading to an endless cycle of funding debates.

This leads to the crux of the debate, which is that from a consumer perspective, the fixed-line infrastructure is increasingly used as a means of consuming high bandwidth video content, particularly with the rise of online and catch-up TV via services such as BBC's iPlayer, the ITV Player, and Channel 4's 4oD. This has of course led to situations where a small number of subscribers' online behaviour has impacted the larger majority of consumers who are relatively light users. There is a major disparity between the cost to support the bandwidth consumed by the few, and the fees that such users actually pay to service providers for their connection.

With mobile infrastructure, capacity constraints will endure but for different reasons. Investment, like for fixed-line infrastructure, will be a constraint, but for different reasons than for the fixed-line infrastructure, primarily because service providers themselves have largely funded network rollouts rather than relying on government intervention. However, other factors also come into play, most notably wireless frequencies which are of course regulated and which operators have paid substantial license fees to obtain. There is a physical limitation on the amount of frequency that can be allocated, as we have seen from the LTE debate on utilization of the so-called 'digital dividend' of spectrum to be made available once digital switchover occurs.

As with consumer behaviour in a fixed-line context, the debate really pivots on consumer use of mobile networks, which has of course expanded to high bandwidth

services driven by online video, music and rich application-driven content. With their networks seeing an equivalent shift towards becoming entertainment platforms, carriers have had to battle instances of network availability becoming problematic in certain geographic areas. As with fixed networks, a small number of users have consumed so much data that it has become an issue to provide the majority of users with the coverage they are entitled to.

This is dramatically illustrated in Nielsen research in the US showing that an extremely small minority of users are consuming vast quantities of data. According to this analysis, the top 6 percent of smartphone users are consuming half of all data and that the average smartphone user is consuming around 298MB of data a month (5).

## **Question 2: What do you think are possible incentives for potentially unfair discrimination?:**

Potentially unfair discrimination of traffic could occur for a variety of reasons:

- Certain types of vertically integrated providers (e.g. Sky or BT Vision, where a content proposition is offered alongside access) may be considered to have a vested interest in prioritizing their own content over that of a rival 'over-the-top' provider.
- In a similar way, service providers are under pressure to find new revenue sources in a consumer ecosystem increasingly driven by video and content over more traditional voice and access fees. It is not hard to imagine certain traffic being privileged if it carries more commercial potential than other sources.
- The ability to shape and manage traffic is complex for many service providers, and without a comprehensive, real-time ability to manage volumes, types and consumer behaviours at scale, it is possible to imagine potentially unfair discrimination occurring through purely technical limitations of systems to manage such complexity
- Service providers invest heavily in network technology, and must be able to intervene in the network to safeguard the infrastructure itself
- Service providers increasingly need to be able to guarantee certain kinds of application or 3rd parties' access to the network, particularly if these are, for example, healthcare or utilities parties which require constant and reliable connectivity
- Finally, there is a need to offer fair access to a wide range of paying consumers. Service providers are increasingly challenged by the fact, mentioned earlier, that a few users excessively utilize the network, to the detriment of the wider majority, who are in effect forced to shoulder the cost. Managing bandwidth to provide fair use may also lead to unfair discrimination

Beyond these potential, and theoretical, cases, it is crucial to note that in a UK context, potentially unfair discrimination will incur equal and opposite market reaction, both in a wireless and wireline context. Since the opening up of the fixed local loop and the creation of Openreach to provide equivalent access for any internet

service provider, the UK enjoys a buoyant wholesale market where, in the majority of the UK, there is always a potential competitor for consumers to switch to. Furthermore it is now relatively simple to switch. This potential will act as a natural brake to any discriminatory behavior. In a consumer environment also characterized by social networking and customer advocacy (positive and negative), it is not in service providers' interests to stir up any waves of unrest through any actions that could be perceived as unfair in the marketplace or which appear to contradict what consumers believe they have paid for.

### **Question 3: Can you provide any evidence of economic and or consumer value generated by traffic management? :**

Although not direct examples of traffic shaping or management, recent examples of pricing changes in the US and UK marketplace show that consumer value can be generated by service providers' responses to the excessive use of bandwidth by a few customers.

In the United States, AT&T have recently changed their pricing plans from \$30 a month for unlimited access to \$15 per month for up to 200 megabytes of data, and \$25 per month for up to 2 gigabytes of data. According to AT&T, 65% of today's smartphone data users consume less than 200 MB of data per month, and 98% of them use less than 2 GB of data per month. These data plans then represent an opportunity for virtually all of AT&T's data customers to reduce their monthly data charges.

According to a recent press release announcing O2's change in pricing plans in the UK, only 3% of customers will have to pay for additional data allowances, as the lowest bundle (500MB) provides at least 2.5 times the average O2 customer's current use (6).

A more direct example of consumer value created by actual traffic management has been the ability for new Plusnet customers in the UK to declare what types of traffic they intend to use over their fixed-line connection, e.g. video, gaming, email etc. This enables Plusnet to inform their DPI shaping technology to prioritise certain traffic for particular consumers, the advantage being that the consumers themselves have informed their provider, rather than the other way around.

It is likely that traffic management could indeed offer a greater variety of consumer propositions, thus increasing direct consumer value, as well as offer a variety of new business models to be set up to provide such services to consumers. Research by Nielsen indicates that consumers are willing to pay for a wide variety of services and content-related offers (7).

However, traffic management is not presently widespread in the UK marketplace in a consumer-facing way and as such plentiful evidence is not yet forthcoming. Given the competitive nature of this marketplace, as pointed out above, there is ample scope for experimentation, and we believe that positive examples will soon be much in evidence.

One challenge to seeing examples in practice though is that quality of the service for

end consumers depends on the level of control the service provider has over the consumer edge device and the network itself. It should be possible for the provider therefore to determine whether or not to be able to run software and hardware to be able to monitor such usage.

Various types of traffic management, including temporary or permanent rate-limiting, re-directing or blocking of particular protocols or addresses are also essential to manage threats to networks and their users from, among others, worms, viruses and other malware, malicious websites and denial of service attacks. Content inspection and filtering is also necessary to protect users from unwanted communications such as spam (both incoming and outgoing) and other inappropriate content. Indeed current government policies actively promote the use of traffic management tools to address problems of copyright infringement and illegal material

This in turn points to the challenges service providers will face in being able to deliver different levels of quality to end consumers. If level of service is to become a differentiator in the marketplace, it implies that providers will need to invest in innovative new ways to guarantee these. Given that wireless and wireline networks are increasingly becoming entertainment platforms, it will become hugely important to be able to guarantee service levels, in much the same way as satellite and Freeview networks are. Traffic management is arguably the most powerful and appropriate way for service providers to do this, pointing to the potential future consumer and economic value to be gained from forms of traffic management.

**Question 4: Conversely, do you think that unconstrained traffic management has the potential for (or is already causing) consumer/citizen harm? Please include any relevant evidence. :**

It is important in this debate to understand the UK context and how it differs to that of the US, where the net neutrality debate has taken on a highly emotive flavour. In an open market such as the UK where consumers have real choice and where switching providers has been made possible through market regulation, the rather dystopian vision of unconstrained traffic management as it is described in the United States is not likely to come to pass.

To an extent, wireless networks in the UK have already been able to manage traffic in an unconstrained manner, as a paradigm of prioritizing voice traffic already exists. After all, most customer complaints about mobile networks relate to dropped calls, which in turn service providers seek to prioritize over their networks.

It is highly likely that in the UK, unconstrained traffic management would become largely self regulating. Consumers would likely gravitate towards service providers who offer the best packages for their individual needs, and given the amount of competition between players, this is likely to mean that service providers pay close attention to how they offer different kinds of access or usage bundles.

It could be argued that recent privacy breaches of individual consumer usage patterns, such as service providers' trials of deep packet inspection software, illustrate that traffic management has indeed already caused consumer harm; however, this incident was quickly followed by a consumer backlash and a much more open

approach to traffic management, accompanied by an informed media debate. The marketplace itself has largely been self-regulating.

The debate about the Digital Britain report in 2009 in fact foregrounds the need for traffic management, if its pledges to provide a universal service commitment are to be realized. After all, service providers are going to have to be able to ensure that all UK citizens have a certain level of internet access, which they will have to balance against the data consumption of the few.

What this points to is the need for service providers to have a consistent method of managing data consumption, which is also transparent to end consumers. This is a major challenge, but is necessary in order to provide the benefits to consumers illustrated earlier. It also represents an intelligent middle way between, on the one hand, the openness of the public internet with small potential for return on network investment, and on the other, the closed model of content delivery predicated on network access payment. Such a middle way, however, is only possible through much better understanding of a number of factors driving data usage:

-Volumes: the ability to track types of internet traffic (e.g. voice, streaming video, text, video-conferencing, gaming, music downloads, P2P etc) and at various times of day in an accurate and real-time manner

-Quality: the ability to deliver the smooth passage of certain types of traffic depending on its nature and the commercial model (how a consumer has paid for the traffic). Service providers have the ability to carry this out for their large corporate customers who utilize dedicated IP networks, but it is not currently a feature of most consumer retail providers for cost and technical reasons. Further to this is the entitlement management needed to ensure that types of consumers have access to certain data types based on their commercial relationship to the service provider

-Consumption: the ability to make real-time judgment calls on traffic based on the value of the data type and the usage by particular end consumers of the data

### **Question 5: Can you provide any evidence that allowing traffic management has a negative impact on innovation? :**

We have already alluded to the fact that managing traffic in general represents a technological and business challenge to the service provider marketplace, which in turn implies that there is broad scope for market innovation and technological advances.

We have also alluded to the potential new business models that can be opened up by allowing consumers to choose what types of services they would like to use and by allowing service providers to guarantee service levels for these uses.

Both illustrate that allowing traffic management will encourage innovation. In an important sense, the level of traffic management shifts the locus of innovation between the core of the network and the edge of the network. The competitive nature of the UK marketplace will largely allow a balance to be struck:

-Allowing traffic management shifts the onus on innovators and entrepreneurs to come up with innovative solutions to effectively manage bandwidth in better ways,

ultimately providing consumer-facing and industry-facing products and services that provide value in different ways. A potential downside is that traffic management potentially limits the attractiveness and inventiveness of wider consumer-facing innovation as applications and services that leverage the open internet are to an extent &ldquo;left out in the cold&rsquo;; and unable to develop services that can operate in a traffic management paradigm

-Prohibiting traffic management arguably maintains the current status quo, which is a huge amount of innovation at the edges, and highly consumer focused, around applications and services for an increasing proliferation of over-the-top players and devices, to the detriment of service providers who actually provide the network that underpins this. It is necessary to support innovation within the network itself &ndash; without the prospect of commercial deployment, innovation will be hindered

To summarise then, traffic management itself would encourage innovation in many areas.

To end with an analogy, let us suppose that, hypothetically, electricity had no cost to end users. Many would innovate and find new and exciting applications for &ldquo;power&rsquo;. At some point in time, let us suppose that electricity became more scarce and required some form of rationing. The type of innovation that was possible in an environment of abundance would be difficult to recreate, and it would not be possible for the providers of electricity to provide totally equal access to a scarce resource if it needed to fund the ability to provide it.

**Question 6: Ofcom's preliminary view is that there is currently insufficient evidence to justify ex ante regulation to prohibit certain forms of traffic management. Are you aware of evidence that supports or contradicts this view? :**

Broadly we agree with Ofcom's stance that there is insufficient evidence to justify ex ante regulation to prohibit certain forms of traffic management. As we have described above, the UK marketplace, due to its structure and competitive nature in both fixed and wireless networks, has the potential to be largely self regulating in this regard. There are three examples from a specifically UK context that illustrate this:

Firstly, service providers's trials of deep packet inspection technology mentioned earlier. The real crux of the issue this posed in the marketplace was one of consumer consent rather than the technology itself. It served to foreground the reasoning behind traffic management and the need for an informed debate, rather than causing a backlash against traffic shaping per se.

Secondly, Plusnet's innovative approach to allowing customers to inform them which traffic they particularly seek to use their service for highlights that there is a strong argument in favour of traffic management as a way of better managing end consumers and improving the overall customer experience of broadband in the UK, which is not currently characterized by high levels of loyalty, advocacy or even satisfaction

Thirdly, it is too early to truly pinpoint whether or not traffic management is or is not

having a deleterious effect on either the wireline or wireless industries. We strongly believe, as we have highlighted, that it is unlikely to do so in a competitive environment where consumers have real choice and can exercise it, and indeed we believe it has the potential to vastly improve the way in which service providers both market and operate their services, opening up the potential for new and more innovative business models within the broader industry.

A parallel can be drawn with the recent debates on the Digital Economy Act. The Act as it currently stands mandates service providers to warn consumers of excessive illegal downloading (characterized by P2P traffic) via letter prior to cutting off their service. Management consulting firm Detica, in their response to the debate (8), provided an interesting and valuable angle. Their response questioned the need for such directly prescribed mechanisms for combating illegal downloading, pointing out that "service providers should have the freedom to implement traffic management remedial actions taking into consideration the aggregate effect on their licensed services, business models and market events. To support this objective, insights into the trends of infringement and the impacts of corrective actions should be closely monitored. This would enable all stakeholders to understand and better appreciate the incentives to offer or deterrents to enforce to achieve the desired goals". The key to this argument was, effectively, that early regulation was too prescriptive and heavy handed, and that ultimately the service provider marketplace should have more freedom to address the issue, but based on an informed and ongoing real-time analysis of the evidence as provided through network data.

A further case against regulation of traffic management is that privacy rules and other regulation that may be imposed on service providers are not necessarily imposed on other companies providing services on top of the service provider's access network, which puts the service provider at a competitive disadvantage when it comes to alternative or more innovative business models. To give an example, companies such as Google and Yahoo can use the content of email items and search behaviour to promote specific advertising to end users. However, service providers may ipso facto be prevented from providing similar or alternative services based on content users are consuming through any traffic management regulation. Given the scale and reach of so-called "over-the-top" companies and the amount of network traffic they consume, this appears particularly unfair to service providers, and supports Ofcom's position that there is insufficient evidence to justify ex ante regulation to prohibit certain forms of traffic management.

**Question 7: Ofcom's preliminary view is that more should be done to increase consumer transparency around traffic management. Do you think doing so would sufficiently address any potential concerns and why?:**

We agree wholeheartedly with Ofcom's judgement that more should be done to increase consumer transparency around traffic management. In the UK, consumer education has been extremely successful in generating the kind of open marketplace we have seen develop, where consumers have real choice in service providers. Further transparency around traffic management will close a key gap in this current marketplace and will serve to enhance this competitive landscape.

While there is a general sense among consumers of the disproportionate data consumption of the few versus the many in both a wireless and wireline context, there is little real understanding of what service providers are doing to address this, over and above throttling certain kinds of content, particularly peer-to-peer, which has of course been a controversial aspect of the debate over the Digital Economy Act.

Further transparency, through an easy to compare set of guidelines around usage, would significantly improve this situation. Currently, any kind of access restriction based on traffic or volume, tends to be provided in detailed terms and conditions which may be available to consumers but which are not universally easy to understand or to compare between providers.

Indeed we feel that the general marketplace is in need of increased education about bandwidth usage in general, as in many cases it is clearly suboptimal. We can see this in the issues around advertised broadband speeds in the UK. A recent survey of UK broadband consumers states that 85% of the consumers felt it unfair for ISPs to advertise packages as "unlimited" when a fair usage policy (FUP) or traffic management/shaping measures are attached (9). Also BT's long-running "Adam and Jane" campaign was banned for misleading customers over the speed of the company's broadband (10).

This also points to the issue we have highlighted elsewhere of the technical challenges to service providers of being able to actually measure the volume, quality and nature of customer data consumption, even more to be able to do this in a real-time manner that is available to consumers in the form of warnings, counters or indicators of consumption.

While it is important to provide further transparency to consumers, it is also important not to be excessively prescriptive about the mechanisms available to service providers to do this. Broad guidelines are more effective in this kind of consumer environment than detailed sets of measures. As we have pointed out in other areas of our response, service providers need to have the flexibility to measure, monitor and improve their networks, as well as to innovate around the business models they are able to develop with other players in other industries to ensure that valuable consumer propositions are developed.

With a clearer view of what traffic management means, e.g. information around what kinds of traffic exist and how these are prioritized, this will not only help general public understanding, but also allow service providers to innovate more with consumer propositions. For example, instead of offering connectivity, service providers could offer specialist packages such as video calling with extra internet, or TV viewing with free downloads, and also offer levels of quality of service. The advantage of such traffic management is both the ability to offer more relevant consumer-facing propositions.

**Question 8: Are you aware of any evidence that sheds light on peoples' ability to understand and act upon information they are given regarding traffic management?:**

The most telling example in the UK marketplace of peoples' ability to understand information regarding traffic management is perhaps the growing disparity between advertised broadband speeds and consumers' actual experience of the bandwidth they receive, as we alluded to above in Ofcom's own survey of consumer attitudes. A recent development in September 2010 is the Communications Consumer Panel's letter to Minister of Culture Ed Vaizey asking him to compel internet service providers to advertise average or typical broadband speeds rather than 'up to' speeds (11).

Building on this, there is an increasing disparity between the advertised 'unlimited' access advertised by a great many fixed-line service providers and the 'fair use' policies that such providers also have implemented. There are very few service providers that do not carry such fair use policies; however such information is not universally easy to find or indeed compare.

Neither is it simple for consumers to understand what their exact allocation of bandwidth is and how much they are consuming on an ongoing basis.

Therefore it is difficult to say with any certainty in the UK marketplace that there is a widespread ability to understand and act on information regarding traffic management, beyond basic growing awareness of it.

However, we believe it is only a matter of time in such a buoyant marketplace as the UK for comparison websites and indeed service providers' own material to start to make consumers vastly more aware of the need and consequences of traffic management. Indeed, the messages about contention ratios to the consumer's premises, peak usage times and the kinds of traffic that generate excessive bandwidth use are now understood widely in the marketplace.

There are interesting and germane examples from the developing world about end consumers' ability to act upon information regarding traffic management, particularly in Africa, where the MTN Group was the first operator to introduce dynamic pricing. In this example, consumers are offered vastly cheaper voice calls at non-peak hours, which helps service providers manage capacity. It has led to a corresponding increase in consumers making voice calls either very late at night or very early in the morning, thus benefiting from cheaper rates (12).

**Question 9: How can information on traffic management be presented so that it is accessible and meaningful to consumers, both in understanding any restrictions on their existing offering, and in choosing between rival offerings? Can you give examples of useful approaches to informing consumers about complex issues, including from other sectors?:**

Some recent examples from public initiatives highlight some best practices around informing consumers about relatively complex issues.

-The Oyster payment method for the London Underground offers consumers the ability to travel without tickets on the Underground network, provided their Oyster

swipe card is either topped up or pre-paid with credit. Behind the scenes, the act of ‘touching in and touching out’ determines the fees that are deducted from the card

-The Congestion Charging scheme in Central London involved a very simple principle of having to pay a fee for driving within a restricted area in the city

-The recent launch of the bicycle scheme within London, where consumers purchase a subscription then pay per use for a bicycle, picking one up from one location and returning it to another, with protocols to highlight faulty machines

The common theme to these three launches is a very simple and consistent branding and message, and a consumer proposition that is distilled to a very simple process. Behind the scenes, the charging mechanisms and infrastructures are highly complex, but this is largely masked from the end consumer.

The lessons from these are that any traffic management in a telecommunications/broadband context needs to be highly simplified, distilled and made extremely consistent.

Our suggestion for how this could be done would be for a number of consistent identifiers to be agreed between all UK service providers to highlight:

-What kind of traffic is which, and how these are treated in the network (i.e. time-sensitive flows are prioritized)

-What shaping applies to which consumer packages, to enable meaningful consumer comparison

-Any time of day restrictions

-Provide more hard information up-front to consumers while making the purchase or switching decision or when changes are made to the policies (privacy) or packages.

### **Question 10: How can compliance with transparency obligations best be verified?:**

In earlier sections of our response, we highlighted that broad guidelines should be favoured over detailed, prescriptive policies to be adopted by all. Given that service providers’ networks are not all the same and often use different technologies or indeed offer very different consumer propositions, there will be no single way to ensure transparency obligations.

However, if consumer transparency can be distilled into a clear set of universal and high-level guidelines, then it will be relatively simple to measure compliance. Largely, the market itself provides a measure of this in the UK, through the various comparison websites that aggregate different offers and offer like-for-like comparisons. This will likely provide a way for the market to introduce a modicum of self-regulation, as providers who are not forthcoming with information or who make it difficult to understand will not be treated favourably by comparison sites.

It is important that service providers have the flexibility to vary their fair use policies or traffic management approach in order to continue to provide innovative and differentiated services; for this reason, compliance should be verified through a very high level and light touch code of practice, that ideally would build on the two most significant elements of broadband advertising that we have seen in recent months: the disparity between advertised and actual speeds, and the gap between &lsquo;unlimited&rsquo; and &lsquo;fair use&rsquo; policies.

Such a code of practice would be voluntary and largely self-regulating, with adjudication in the last instance to be provided through the standard Ofcom ombudsman route.

**Question 11: Under what circumstances do you think the imposition of a minimum quality of service would be appropriate and why? :**

It is important to allow all wireless and wireline subscribers access to basic services. If a minority is using an excessive amount of capacity, as we currently can observe, this prevents other paying subscribers from receiving adequate service without the service provider investing more in capacity. It should be possible for providers to regulate usage such that the network is more fair, and can actually guarantee a minimum quality of service. The ability of users, be they consumers or businesses, to unbalance this fairness through excessive data use, by individuals or by automated software, should be controlled.

There are various instances where a minimum quality of service is required, particularly at the level of service provided to third parties who wish to have access to the network and to end consumers. It may be desirable to guarantee higher quality of service for time and mission-critical services such as healthcare applications, security monitoring and secure e-government services. This quality of service would have to be guaranteed across the entire path of connectivity, from end device to consumer premise.

Echoing an important theme of our response once more, imposition of a minimum quality of service should be introduced with caution. If such an imposition is performed too prescriptively, then service providers lose the flexibility to innovate with consumer propositions and alternative business models. We suggest therefore that a minimum quality of service be considered in broad terms such as a minimum bandwidth to be available to all, much as the Digital Britain report has suggested, and the Finnish government have enshrined in legislation. A minimum bandwidth effectively guarantees that a number of mission-critical applications will be able to function and various business models to exist. Importantly, a minimum bandwidth for mobile networks will offer a lesser speed than for fixed networks, in line with the extra restrictions on such networks as highlighted in the response to question 1) above. Added to this, it may also be desirable to guarantee:

- Latency below 500 milliseconds to major domestic internet sites
- Dropped packets below 1%
- Average monthly usage of up to 1Gb (with a lesser usage limit for mobile networks as outlined in the response to question 1) above

Over and above this minimum standard, other types of access and quality of service should remain within the domain of the service providers to innovate, collaborate with other third parties, and ultimately have the flexibility to offer the consumer more choice and variety.