

BT PLC

BT Response to the DCMS consultation on Digital Communications Infrastructure Strategy.



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1. Executive Summary

BT welcomes the Department for Communications Media and Sport's (DCMS) consultation to support the development of a long-term (2025 – 2030) digital communications infrastructure strategy for the UK with the aim of “ensuring that the UK builds on its strong digital foundations to continue to benefit from world class communication networks, supporting further economic growth and wider social benefits” and in so doing, make sure the UK has the right infrastructure to meet the needs of users and ensure that the UK is competitive on a global scale. We hope that BT's response informs sound policy decisions in this space supporting the following outcomes:

- growth in the communications sector and broader UK economy, boosting innovation and creativity, maintaining global competitiveness and ensuring the UK realises the benefits of a world class infrastructure;
- facilitation and encouragement of efficient private sector investment in infrastructure;
- evolution of a fair, consistent and equitable converged regulatory framework;
- clarity in the role of Government, including coordination of policies, programmes and investment.

This paper offers an overview of BT's vision of a desirable potential future UK infrastructure scenario, the necessary policy and regulatory steps to help achieve this, as well as the potential risks of alternative approaches.

1.1 2025 – 2030 Scenario: BT Vision for a Truly Digital Britain

BT envisages a promising future scenario for UK ICT infrastructure that is both world-leading and realistically achievable, where the UK extends its current strong position (see Annex 1 for current overview) compared to key economies, realising a scenario in 2025-2030 with outcomes described in detail in section 2, but summarised below.

- Across the UK there will be a pervasive need for connectivity driven by an explosion of personal smart devices, wearables, connected (and increasingly driverless) cars, smart homes, sensors, mobile payments, remote/mobile working, etc.
- Underpinned by the Internet of Things (IoT) and Machine to Machine (M2M), individuals, businesses and society will have automated and intelligent access, insight and control of their environment providing significantly enhanced outcomes, time-saving, resource utilisation and cost reduction across key sectors (e.g., energy, health, environment, transportation and waste management.)
- Residential bandwidth demand and time online will have increased, particularly driven by increased video and TV viewing on-line and the migration to ultra-high-definition services. The range of demand will reflect the different compositions of households as well as different individual interests. It is difficult to predict accurately 2025 demand, particularly because a meaningful prediction must reflect a willingness of consumers to pay. That said we feel it is reasonable to expect that even low demand (perhaps single occupant) households will require a 10Mb/s speed in 2025. For most family and larger households, although these represent a minority of the total UK households we expect their concurrent

TV/video to drive higher bandwidth demand to be above any “median” figure. We note that the Broadband Stakeholder Group (BSG)¹ recently estimated that for the median household download demand for 2023 would be roughly 19Mb/s, but believe that a figure of 35Mb/s (representative of the 99th percentile of BSG’s analysis) is a more cautiously appropriate estimate for what could potentially be desired by most families. Upload demand is also expected to increase for some users owing to the increased adoption of home-based working/video conferencing, cloud type services, etc. Overall, demand will remain highly asymmetric for most, dominated by download of video consumption. While any prediction may ultimately prove spurious, we are confident that should actual user demand increase further than this prediction it will be effectively met by fibre investments being made now and over the next decade. For example recent trials of G.fast technology in the live network highlight the still unrealised potential of copper access with speeds of 700Mb/s².

- The needs of business users, including SMEs, are expected to continue to increase, driven by a new generation of digital-aware entrants into the workforce, as well as remote working, online collaboration, cloud technology and ecommerce. However, increasing business demand will be more clearly linked to business benefit and willingness to pay; demand will in turn be met by commercial investment in ever deeper fibre deployment.
- Specifically on SME use, although there is little public domain research on their future bandwidth demands, they share many of the characteristics of consumer demand, particularly at the mini and micro/SOHO end of the sector. In particular, their demand will be driven by the need to “stack” simultaneous use of various applications that demand access bandwidth. However, as shown in the recent communications consumer panel report³ they are increasingly calling for tailored communications packages that deliver more robust services with business grade support levels to reflect the fundamental importance of these services to their business. This need for resilient and robust services will therefore result in a continued separation between business grade (and higher cost) services and normal consumer grade services. (See Annex 2 for an overview of current BT business NGA and business connectivity products)
- Significantly increased user expectation for ubiquitous, perpetual and resilient connectivity will be satisfied by effectively universal coverage, with appropriate funding where necessary, where speed of connection will no longer be an issue across 99% of UK premises and geography, delivered by a mix of fixed, Wi-Fi and 4G/5G wireless technologies. Investment will continue to be driven primarily by commercial investors across both fixed and mobile with strong and effective competition at the service layer ensuring value for the end user.
- Converged and complementary network access layers in fixed, Wi-Fi and mobile, providing users with a seamless experience with devices automatically selecting the network, providing optimal cost/service combinations for voice and data, including resilient options for key services. All of the integrated network should be accessible to service providers on equivalent terms to enable truly competitive offers to consumers in nationally consistent services.

¹ <http://www.broadbanduk.org/2013/11/05/bsg-publishes-new-model-for-analysing-domestic-demand-for-bandwidth/>

² <http://www.btplc.com/Innovation/Innovationnews/gfast/index.htm>

³ <http://www.communicationsconsumerpanel.org.uk/downloads/panel-micro-business-report-final.pdf>

- In fixed networks, the current “mixed economy” approach, driven primarily by fibre to the cabinet (FTTC) will extend superfast coverage to 99% of UK, offering speeds that continue to exceed the needs of the vast majority. Where needed, users with extremely high demand will be served by commercial solutions (e.g., fibre to the premises (FTTP), fibre on demand (FoD) or business connectivity/Ethernet services).
- However, delivering FTTC coverage to 99% of the UK will by no means herald the end of investment in fibre deployment and innovation in the UK. Indeed, continuous ongoing investment will be made in “NGA 2.0”, to meet growing commercial demand from consumers and business, to drive fibre deployment deeper into the network to support faster services and greater capabilities driven by commercial need. This investment will support the continued development and investment in new technologies such as vectoring, G. Fast, fixed-mobile and increasing volumes of FTTP.
- Through efficient sharing of, and access to, mobile infrastructure underpinned by regulated wholesale access, national roaming and economically rational consolidation, mobile network coverage will cost-effectively blanket the whole geography of the UK. This will be supported by innovative architectures enabling greater spectrum efficiency combining Wi-Fi and 4G core and small cell technology.⁴
- Large parts of the UK will continue to have a choice of fixed and mobile infrastructure providers. Where there is a single provider of infrastructure, service level competition through effective wholesale access at both fixed and mobile level irrespective of the provider will ensure that all consumers enjoy the benefits of service level competition.
- The potential for an ‘all-IP’ world where voice and video are delivered over IP networks in place of DTT⁵ (complementary to satellite and cable distribution), providing a step-change in user experience through more personalised and immersive experience, greater choice, access to ultra-high resolution programming and enhanced services. As a result public service broadcasters (PSBs) are better able to reach and serve their audiences while better monetising them, thus ensuring a greater investment in world-class UK content. Mobile operators benefit through greater coverage at lower cost, and the release of spectrum.
- The UK will continue to stay at the forefront of major OECD nations in take-up, utilisation and economic exploitation of superfast services owing to universal coverage, robust market-based competition, ‘all-IP’ services and applications, enhanced QoS, and fundamental trust in online applications. Consumers will continue to benefit from world-leading competition, pricing and innovation and UK businesses will be better able to compete and win in increasingly global markets.

This compelling scenario, a vision for a truly digital Britain is achievable if Government and regulators implement the right policy and regulatory actions. These should build on the positive

⁴ BT 4th Quarter results presentation on mobility strategy :-

<https://www.btplc.com/Sharesandperformance/Quarterlyresults/PDFdownloads/q414-slides.pdf>

⁵Emergence of next TV distribution platform in Europe Analysys Mason article:

[http://www.analysysmason.com/About-Us/News/Newsletter/IPTV-platform-Europe-Oct2014/?utm_medium=email&utm_source=Act-](http://www.analysysmason.com/About-Us/News/Newsletter/IPTV-platform-Europe-Oct2014/?utm_medium=email&utm_source=Act-On+Software&utm_content=email&utm_campaign=Analysys%20Mason%20Quarterly%207C%20Latest%20news%20and%20opinion&utm_term=The%20emergence%20of%20the%20next%20TV%20distribution%20platform%20in%20Europe)

[On+Software&utm_content=email&utm_campaign=Analysys%20Mason%20Quarterly%207C%20Latest%20news%20and%20opinion&utm_term=The%20emergence%20of%20the%20next%20TV%20distribution%20platform%20in%20Europe](http://www.analysysmason.com/About-Us/News/Newsletter/IPTV-platform-Europe-Oct2014/?utm_medium=email&utm_source=Act-On+Software&utm_content=email&utm_campaign=Analysys%20Mason%20Quarterly%207C%20Latest%20news%20and%20opinion&utm_term=The%20emergence%20of%20the%20next%20TV%20distribution%20platform%20in%20Europe)

[On+Software&utm_content=email&utm_campaign=Analysys%20Mason%20Quarterly%207C%20Latest%20news%20and%20opinion&utm_term=The%20emergence%20of%20the%20next%20TV%20distribution%20platform%20in%20Europe](http://www.analysysmason.com/About-Us/News/Newsletter/IPTV-platform-Europe-Oct2014/?utm_medium=email&utm_source=Act-On+Software&utm_content=email&utm_campaign=Analysys%20Mason%20Quarterly%207C%20Latest%20news%20and%20opinion&utm_term=The%20emergence%20of%20the%20next%20TV%20distribution%20platform%20in%20Europe)

current UK position, as a leading digital economy, enhancing existing approaches with sensible extensions of successful policy in fixed infrastructure to other sectors of the converging ICT landscape. Equally, it is critical that we avoid radical swings in the approach that has enabled the UK to be a leading digital economy today; misguided policy will deny the potential of further development and risk undermining the UK's current strong performance in fixed coverage, innovation, competition, take-up and pricing.

We consider that the following key policy features need to be recognised and addressed if the UK is to build on its current position. We have also identified not only long-term strategic issues but also short-term actions and recommendations that will enable the UK to achieve the scenario described.

1.2 Achieving the Scenario - key recommendations:

- **Promote effective, consistent access regulation across all converging ICT sectors**

To drive continued investment and innovation in fixed and mobile access infrastructure, policy should be aimed at:

- Aligning regulatory approaches including the competition and investment benefits of functional separation across the converged fixed, mobile and content service markets at UK and EU level.
- Focusing regulation on bottlenecks at the access level, and across all networks where the bottleneck occurs, irrespective of the owner of the bottleneck resource, be it content or connectivity.
- Ensure effective wholesale access is possible and consistent for many competing service suppliers (driving healthy market competition).
- Provide long-term regulatory certainty in these markets by, for example ensuring market review periods more closely match infrastructure investment return periods.
- Avoid depriving the sector of economic value (e.g., through punitive charge controls and spectrum auctions) that is essential to make sufficient investments in infrastructure and deliver enhanced performance and services levels.
- Promote and expand the benefits of open access networks currently available on the openreach fixed network to other bottleneck areas. Such open access increases retail level competition bringing benefits of lower prices, greater take-up and more innovation. It is important that such open access principles should be embedded in new regulatory frameworks as they are developed and apply across all platforms and geographies.

- **Support universal network coverage across UK**

Ensure that returns to infrastructure are sufficient to support the necessary investment in fixed and mobile coverage commensurate with quality of service expectations. The solution will need to enable the most cost effective means of delivering universal superfast premise coverage to circa 99% of the UK.

- Ensure BDUK phase II and III are implemented with adequate funding and a technology neutral approach.
- Engagement by UK Government with the EU Commission to address inconsistencies in State aid which deny superfast infrastructure deployment in urban white spaces that suffer from the same issues as BDUK intervention areas.
- Ensure near universal geographic coverage at lower, "base level" speeds to support out of home and IoT/M2M demands delivered by a mix of fixed, Wi-Fi and 4G/5G wireless technologies.

- **Achieve “full potential” efficiency of scarce spectrum assets**

Pursue Government spectrum policies that aim to achieve “full potential” efficiency of scarce spectrum assets; promote much greater sharing of spectrum; open access to mobile networks to create and sustain competition; and encourage the innovation and efficient investment that are required for the development of the digital economy in the UK.

- Support a regulatory framework that enables economically rational consolidation towards fewer, stronger national network providers with greater resources as well as more sizeable and more efficient spectrum allocations, but with inclusion of the necessary safeguards to promote downstream competition.
- Work with Ofcom to support competition and innovation of mobile services in the context of the consolidating national mobile network infrastructure, by promoting wholesale access to mobile network infrastructure on fair, reasonable and non-discriminatory terms and require provision for national roaming across mobile networks.
- Evolve spectrum allocation process (which tends to promote status-quo industry composition and allocation of spectrum to the highest bidder - not the most spectrally efficient) towards approaches that focus on maximising efficient spectrum allocation and consumer benefits. Future awards should also enable large spectrum blocks to be awarded suitable for neutral (and fewer) host wholesale networks.
- Promote responsible spectrum sharing with additional spectrum (possibly on a dynamic allocation basis) yielding additional economic value while controlling introduction of new licence-exempt technology standards to avoid a “tragedy of the commons”.
- Support identification of new spectrum for mobile in millimetre wave bands for very high speed short-range applications within a future 5G system and to make this available on a shared basis.
- Coordinate longer-term spectrum release by delaying the current timetable to release 700MHz and other relevant spectrum planned during 2020-2022 or earlier, as release in multiple blocks is costly compared to the short-term benefits. A later release date for this spectrum (beyond 2025) could, with the right Government policies, enable much more spectrum to be freed up at potentially lower costs. This requires joined up policy around broadband, mobile and media.

- **Ensure Policy and Regulation allows for withdrawal of redundant/inefficient products if they are incapable of providing the required level of service at the level of cost that the market needs.**

A number of regulated products are reliant on elements of the traditional copper/PSTN access network from the exchange e.g. Local Loop Unbundling, Wholesale line rental 20CN/21CN broadband etc. We anticipate that in these timescales the majority of customers will migrate to application based services for voice and video/TV over an IP network. Although these services can clearly be delivered currently over an exchange based copper network it is not possible to know if they will continue to be capable of delivering the service, speed, and quality the vast majority of the market will require in the future. It is thus too early to say if services such as 21C copper broadband for example will be able to meet customer requirements over time and thus if

they will continue to have a long investment life. Although some market forecasts in the UK show copper/ADSL broadband set to drop below 2 million lines by 2020⁶ out of a total market of over 28 Million lines such demand is difficult to be certain of. It is therefore important that legacy regulations do not prevent the market from migrating to more efficient infrastructures if the market requires it.

BT believes that the future of copper networks from the exchange will be dependent on the speed at which the market moves to requiring high speed services for the vast majority that require FTTC type speeds. At some point in the future, demand for copper/ADSL broadband and other services delivered over copper from the exchange may be insufficient to provide the level of service required by consumers at the level of cost that the market needs. Currently however it is difficult to be clear on when this point will occur but it may be within these timescales. If/when this point is reached it will be necessary to ensure that regulation and policy does not prevent the effective retirement of these inefficient assets.

We would stress however that copper from the fibre point out to the customer (so called “d side copper” - FTTC etc.) will have an effective economic life well beyond that for exchange based copper discussed above. Thus copper on the customer side will remain until market demand for speed cannot be met by FTTC and other copper/fibre hybrid solutions and we believe this will be well beyond the timescales covered by this consultation.

Therefore, we ask any infrastructure strategy to consider the following:

- Ensure that the UK Policy reviews the need for historic services required by regulation e.g. at EU level, and ensure that the flexibility to enable their withdrawal is available if the demand for higher speed services moves to a level that the historic services cannot be supported at a viable cost in the market.
- **Promote infrastructure utilisation by building trust in network resilience, online security, privacy and safety**
Building and operating a world class ICT network across the UK, and offering world class IP based services to end users will not deliver the expected economic benefits if UK customers and businesses do not trust the network and the data they make available through using the network to be secure and utilised to their benefit.
 - Take steps to ensure resilient network assets e.g. power supply systems are made available to support the QoS requirements in a cost effective manner.
 - Ask that governments develop initiatives for cyber-security, online crime-prevention, and online safety by working in partnership with ISPs from the outset and seek to find balance between natural tensions between privacy and security.
 - Ensure government policy promotes an online environment that enables children and vulnerable individuals to exploit the full potential of the internet with minimal risk.
 - Promote trust in the collection and use of customer data by government and service providers by ensuring that customers are able to control and manage their personal

⁶ Point Topic Market report March 2014

information for their benefit not the benefit of third parties, although this is not directly an infrastructure issue, trust (or lack of trust) in the infrastructure and services on it could significantly impact the usage and investment case. Thus reliability, resilience, security and trust in the network become ever more critical to end users.

- **Ensure use of international benchmarks and performance targets underpinning policy ambitions and investment are evidence based and contextually relevant.**

Targets, benchmarks and performance data sets that track and compare UK performance with key economic competitors are important as they can and do drive investment, policy and regulatory behaviour. It is therefore important that any such benchmarks are appropriate, relevant and fact based, focussed on relevant countries in an objectively comparable manner.

- Utilise comprehensive, broadly based economic and performance benchmarks to track UK performance based on the Ofcom EU scorecard.
- Ensure comparison against key relevant EU and global competitors not small/incomparable benchmarks.
- Any future policy or regulatory targets for coverage, performance and service should be based on evidence-based review of actual user needs which effectively differentiates between luxury, discretionary and truly vital use cases.

1.3 Policy Risks

In addition to the positive actions outlined above, that UK government can take to encourage the delivery of this truly effective and efficient ICT infrastructure across the UK, there are a number of areas where **action may need** to be taken to prevent obstacles to the realisation of this strategy for ICT being achieved. In particular we would highlight:

- **Avoid distraction from “Gigabits for all” lobby**

Resource and investment pursuing a “Gigabit access for all” approach, when there is no evidence to justify these speeds at the access layer and strong evidence that such speeds will be completely unnecessary for all but the most extreme usage case⁷ means that the very significant costs of appeasing such calls would be effectively wasted for the foreseeable future, such calls are thus distracting and wasteful when there are many uses for scarce funding sources. The “mixed economy” approach has been shown by research in the UK and elsewhere⁸ to offer significant economic and societal benefits, and deliver those benefits earlier than an FTTP only approach. Ensuring such a mixed economy delivery across UK premises and enabling further commercial investment in driving fibre ever deeper into the access network as commercial demand materialises will ensure maximum benefits without wasted government investment. Government should therefore ensure that the mixed economy approach is fully enabled and not distracted.

⁷ <http://www.broadbanduk.org/wp-content/uploads/2013/11/BSG-Domestic-demand-for-bandwidth.pdf>

⁸ http://www.communications.gov.au/broadband/national_broadband_network/cost-benefit_analysis_and_review_of_regulation/independent_cba_of_broadband

- **Avoid discouraging infrastructure investment with “dark fibre” access**

Some responses to this consultation will no doubt call for BT to be mandated to provide “dark fibre” access. Ofcom looked at such calls in their last market review and concluded that such a move was not only unnecessary but risked undermining the competition and benefits currently offered on the basis of the current regulatory framework. We believe such conclusions remain the case today and will be the case in the future. At best dark fibre is likely to lead to “cherry picking” i.e. operators will be use such access not to build NGA networks (as that is already allowed via the PIA products from openreach) but to duplicate non-broadband networks in particular leased line networks. Typically in UK cities and key business areas BT and multiple other operators such as Virgin Media have invested in leased line networks across the entirety of the city and wider business areas. Provision of Dark fibre access from one provider therefore effectively removes any incentive for existing NGA providers or others to invest in further networks of their own and in addition third party operators will seek to use any dark fibre assets to threaten their leased line revenues on the existing commercially funded networks.

- **Reject structural separation of access providers – continue to build upon benefits of functional separation in openreach model**

The current “functional separation” model approach that is a feature of the UK fixed access market through Openreach, has delivered arguably the most competitive broadband market in the world, with hundreds of service providers operating across the UK delivering high quality low cost services to UK consumers and businesses.

It provides the basis for very strong and vibrant downstream competition in the UK market. In contrast, where the openreach functional separation model does not operate or if it were to be discontinued we have or risk, the development of islands of vertically integrated monopolies with a lack of varied ISP support that may lock customers in to a limited range of service providers and lead to higher prices and reduced innovation. The “openreach” model avoids this.

The integration of openreach with BT Group, enabled by this approach has also led to massive investment in the wholesale fibre access network, currently in excess of £3Bn of BT Group commercial funds as well as a committed scale Service Provider from the start to ensure competitive challenge to operators who may have sought to continue to extract returns from legacy copper broadband investments. This combination of group scale investment and ISP leverage has brought the UK to the forefront of NGA coverage, take up, usage and engagement measures across Europe and the globe. Investments of this scale would have been more difficult to justify and higher cost for a separated entity, given its smaller scale. Additionally the inability to leverage the engagement of a committed national scale service provider would have further compromised a separated entity. The combination of a functionally separate openreach but linked structurally to the larger BT Group and its national scale Service Providers provides an optimum means of delivering these complex regulated services and investments. Thus calls for structural separation of the successful BT Group/openreach model will cause significant uncertainty for any future investment in fixed networks, risk compromising the highly competitive market structure that exists in the UK today and should be rejected.

- **Avoid diluting the standard of review for regulatory decision making - resist a move away from merits based appeals**

Given the economics of building, maintaining and improving broadband access networks across the UK some form of regulatory oversight is expected to continue over these timescales. It is therefore important that appropriate redress in the form of an effective merits based appeals process against regulatory decision is maintained. Any weakening of the appeals basis increases risk of investment in these vital assets running counter to the governments wish to encourage investment.

2. Introduction, future ICT infrastructure

Predicting the future, especially around technology and its impact on user needs, is always difficult, particularly if an attempt is made to predict changes in excessive detail and on specific dates. The best strategy is to look sufficiently far into the future to focus on the 'direction of travel' for key drivers and macro-trends in a way that is sufficient for informing policy, yet removes the potential for criticism based on short-term tactical issues and disagreements.

Even this approach is imperfect. Looking 10 years ago back to 2004 it could not have been predicted that the internet would be spoken of as the fourth utility. Or that it would be perceived as critical to UK households and businesses, and that the UK would be world leading in fibre coverage, 4G deployment, digital switchover, with huge volumes of transactions and retail sales taking place online (some 21% of all retail sales now on line in the UK according IMRG), with many segments of the population consuming entire TV series online viewed on devices like phones, tablets and 'phablets', rather than TVs.

3. Current UK position

It is important to recognise here that the UK is at the forefront of the digital economy and digital infrastructure developments today. It is a leader in the vast majority of indices of digital readiness in terms of infrastructure and its application. The UK has:

- very high levels of household internet connectivity, with virtually ubiquitous coverage of basic broadband;
- very high levels of superfast availability (over 78%) and growing rapidly;
- the highest level of superfast take up of major EU economies (25% of broadband lines are superfast);
- firm, funded and contracted plans to take superfast coverage out to over 90% of UK premises;
- the strongest contribution from the internet economy to GDP in the G20 and set to increase that lead by 2016⁹;
- very high annual consumer benefit (over \$3,300¹⁰) from the internet compared to cost.

The task of looking forward to future scenarios to guide optimal infrastructure policy and strategy is informed by examining what policy impacts have supported the UK's current leadership position and strong trajectory for the future. In that regard, the UK's position has benefited from a focus on

⁹ Boston Consulting Group:- "The Internet Economy in the G-20" – March 2012

¹⁰ Boston Consulting Group:- "The Internet Economy in the G-20" – March 2012

driving service level competition while ensuring sufficient, scale, investment and regulation of infrastructure competition through the following:

- functional but not structural separation;
- active intervention by government where market failure exists but in a technology neutral fashion;
- recognition that infrastructure competition was unrealistic at the coverage levels needed and that service competition over a common fixed access network has delivered significant benefits;
- A flexible approach to regulation of new investment and new markets that have enabled rapid growth and underpinned investment decisions.

Equally it is worth reflecting on some of the shortcomings of policy/regulatory strategy (admittedly with the benefit of hindsight), which seems to have not had the beneficial impact hoped for.

- A lack of consistency in the regulatory approach to converging markets, in particular the mobile access market and content access, which has resulted in different approaches to competition in these converging markets. The high levels of competition, low price and new investment delivered over the fixed network have resulted from an effective service competition model over an open access common infrastructure. Leveraging the benefits that have delivered the levels of investment, completion and service availability.
- A rigid adherence to infrastructure competition in mobile in spite of economic and service convergence, this has continued in spite of the effective consolidation down to two effective networks generally and only one in or even none in rural areas driven by simple economics of investment for coverage in increasingly sparsely populated areas and where additional customer acquisition is likely to be very low or non-existent.
- Spectrum allocation policy rules that appear to work against new entrants and new investment, for example by effectively requiring full national coverage and consequent customer base in order to compete for spectrum blocks at auction.
- Regulation focussed on promoting short term consumer benefit/low cost to the potential detriment of long term investment in infrastructure and new assets. When the industry was focussed on maximising benefit and returns from a largely established infrastructure e.g. copper access, a focus on short term consumer benefit such as low retail price may have been realistic. However, at a time of major investment in replacement infrastructure such as is happening with fibre/NGA a longer term focus from the regulator on measures to promote that enable investment in new and better infrastructure for the benefit of the consumer and UK business is appropriate.

4. What the future holds for ICT Infrastructure

In spite of the difficulties of future predictions even from a point of leadership BT accepts that DCMS has sought to base this consultation on different potential views of the future and we have thus sought to respond in kind with our view of the future market in the UK.

Scenario 3 in the DCMS document accords with many of BT's views on the likely future scenario to evolve in the UK market in these timescales. However, there are a number of key differences that we believe are supported by emerging trends and evidence in the market and are worthy of further

consideration. To that end BT has documented below a 'Scenario 4' that builds on the DCMS Scenario 3 but factors in BT's further views on evolution of the UK market and the key trends and developments we see as critical to maintaining and growing the UK leading position. We have also included with Scenario 4 a technology commentary as in the DCMS consultation, in which we highlight our key views on technologies that will impact future scenarios, and how they will evolve based on demand but also based on potential policy and regulatory action (or the absence thereof). This section includes technologies currently not identified in the consultation where we consider them important.

BT's view of the future market scenario therefore forms the basis for our response against the scenario questions (8-22) in the consultation, as well as forming the 'lens' through which we have chosen to answer the subsequent questions on infrastructure and regulation. In the latter sections of the consultation, i.e., our responses to Q27- 44 are on the basis of seeking to ensure that the policy environment is conducive to assisting with the evolution of a positive future scenario as we outline it.

This scenario of the future UK ICT market is one that BT believes has strong potential to be realised and will continue to drive the UK economy and ensure that its leading position in the internet economy is maintained and built upon, both in terms of the value of the internet economy and the investment in the required ICT infrastructure. However, such a scenario will not happen automatically. For it to be realised effectively, appropriate policy and regulatory decisions will need to be taken and implemented in order to strengthen and build upon the strong fundamentals and sound foundation already created. Some of these policy choices will need to be bold if they are to extend our leadership further and enable the opportunities whilst avoiding poor policy outcomes that could lead to the UK sacrificing its leading position.

5. BT's view of the future ICT infrastructure – realising the potential.

Key themes

Our future scenario is guided by a number of key themes that we consider important for Government and industry to recognise and to work towards.

- Customer expectations of coverage and access to IP networks and services will be effectively universal, not merely in terms of all premises, but indeed all public spaces, modes of transport, and wider geographic areas, e.g., for IoT sensors and general mobility, etc.
- All ICT services will largely be delivered as 'applications' over an integrated all IP data network rather than separate fixed and mobile voice, data and specialist service networks.
- 'Mobile' and 'Fixed' services and IP networks will be complementary and indistinct to the customer, i.e., they expect services and devices to work on fixed and mobile networks seamlessly using the most effective technologies such as Wi-Fi and 4G/3G, etc.
- Regulatory distinctions between networks delivering converged services will be increasingly anachronistic, and if not addressed will adversely impact investment and growth.
- Customers expect to be able to control and manage their personal information for their benefit not the benefit of third parties, although this is not directly an infrastructure issue, trust (or lack of trust) in the infrastructure and services on it could significantly impact the

usage and investment case. Thus reliability, resilience, security and trust in the network become ever more critical to end users.

Customer expectation and demand ‘touch points’

People’s expectations will be such that ubiquitous coverage and connectivity are taken for granted, and that fixed, mobile and Wi-Fi will seamlessly work with each other and act as resilient supports for each other for key services/connections.

Devices will be simple to use, whichever connectivity is available or best delivers the service required for moving seamlessly between networks. They will be increasingly independent of user interaction with wearable, auto-sensing technology, with IoT devices being completely independent of any individual.

This will drive convergence and bundling such that at the access layer at least, the communications network becomes, as far as the end user is concerned, a national utility network comprising fixed and mobile elements that complement and support each other to provide the best service. The ownership structure of the access network is increasingly irrelevant to the end user.

Demand will be user-context specific, driven by the personal needs of each user rather than location specific as it is today, effectively based on what the user is seeking to do at the time not where they are located. This does not though imply equivalent requirements or demands from fixed and mobile networks however. Demand from fixed connections, principally home based, will continue to exceed user demand from mobile connections ‘on the move’ which is driven by ‘human factor’ type issues¹¹ such as inability to view video, etc., whilst driving, less contiguous time blocks, limitations of screen resolution in mobile devices or other form factor issues, etc.

In parallel with this increasing personal device demand driver, there will also be increasing demand that is independent of users, initiated by machines that are tracking, sensing, measuring in the background, etc., to enable a more efficient and productive society. Much of this demand is expected to be relatively low bandwidth compared to video type applications, however, coverage and other parameters such as reliability, latency, etc., will be more critical.

The distinction between consumer and low-end small business network requirements will become blurred and with increased home and remote working, demand will drive better quality of service across all networks. The corporate market will continue as a distinct market. Improvement of performance in networks will drive an ongoing expectation for even better networks.

The majority of businesses will fully embrace working digitally as competitive forces make this essential. This will create additional demand across the economy and across the country. This demand does not imply the same capacity everywhere, however, as usage in ‘static’ home and business applications are expected to be different from ‘on the move’ or out of home/premise type applications such that premise level network performance will continue to significantly exceed the base level performance that will be required across geographic areas. Significant regional divides across the UK in the basic coverage, however, is unlikely to be acceptable. In short, the economic vs service capability trade-offs are, and will remain very different between dense, affluent urban centre and remote rural hillside resulting in an economically driven service variation. Generally these differences will be manageable and the service levels required will be met by commercial deployment, however, if increases in performance above the economically achievable level are needed e.g. to deliver wider societal benefits or other benefits that cannot be monetized by the

¹¹ As shown in the BSG “out of home” broadband demand study – as yet not formally published.

infrastructure investors then this may require assistance in some form if it is to be delivered effectively.

Service evolution “touch points”

Voice traffic will have fully shifted to IPvoice. This traffic whilst predominantly originated on mobile/personal devices will continue to utilise both fixed and mobile networks for access to the wider IP network/platform in accordance with the increasing convergence and complementarity of these networks at the access layer. Fixed lines will continue to be a key enabler of this coverage underpinning an IP based, effectively service independent, connectivity network that utilises fibre and fixed networks as far as possible, and then extended in home and out of home via a ‘wireless edge’. Copper will continue to be a key element of this fixed network into the premise but as all services become IP delivered copper will only remain where it is economically competitive compared to fibre deployment. Copper will therefore remain in conjunction with fibre as part of a “multi technology mix” at the ‘final drop’ end of the access layer since the “Mixed Economy” approach of hybrid fibre/copper access is far more future-proof in economic terms¹² offering the ability to deliver high-speed access for a large proportion of users at much lower cost. Services that are dependent on other parts of the copper network such as 21C broadband using ADSL etc. may increasingly struggle to be justifiable economically if they can’t meet the demands of the base market and could risk becoming a drag on further investment in the IP network.

The need for geographic ubiquity of connections from both personal use and IoT type applications will drive network expansion potentially complemented by a low power/low frequency overlay for IoT traffic depending on economics (particularly economics of the wireless network) but underpinned and supported by the fixed network in order to deliver this geographic (i.e. not merely premise,) coverage.

Satellite still will have a role in broadband, but effectively reserved for the most sparsely populated areas although it is expected to continue to be innovative on the delivery of television services.

There will be continued demand for television in a linear and non-linear form but non-linear formats will increase significantly such that non-linear TV could be the dominant form of viewing in these timescales. Consumers will be increasingly agnostic to the platform over which video content is delivered and the very high degree of personalisation that is already emerging in the consumption habits of young adults¹³ will favour IPTV and non-linear distribution models as the most economic. We anticipate therefore that sometime between 2025 and 2030 there could be an effective switchover to IPTV facilitating an opportunity to free up all of the spectrum currently used by DTTV, for mobile operators, resulting in overall greater economic benefit. TV will be increasingly immersive and bi-directional and more effective transmission methods will be sought to support and enhance the immersive user experience. There will be a move from HD to 4K standards, although the cost and “form factor” issues of 4KTV will impact the scale and pace of this move. Radio will be increasingly delivered by streaming to connected devices.

Cloud technology will be the norm, with greater upstream (less asymmetric) and high capacity broadband networks available for those that require them, although for the majority of consumer users the download requirements will continue to dominate. SMEs and business users will, however, drive demand for increased upload capability. Content will increasingly be stored on the

¹² http://www.communications.gov.au/broadband/national_broadband_network/cost-benefit_analysis_and_review_of_regulation/independent_cba_of_broadband

¹³ <http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/cmr14/>

internet/Content Delivery Networks closer to users to meet the need for instant access to such services and the drive by major content players to preserve the quality of their delivery by investing in local IP interconnect and storage/delivery¹⁴.

Each home will be a home network with equipment readily available, easy to use and affordable and equipment will automatically connect wirelessly or via home network cabling to each new electronic device.

Deployment of connected devices will exceed expectations, driven by smart homes, smart cities, smart energy, e-Health and the growth in the intelligence of machines. Driverless cars will lead to safer motoring requiring more ubiquitous road coverage. Such applications are expected to be relatively low bandwidth compared to video based applications and thus will not significantly drive peak access demand but will drive transaction volumes, latency, reliability and other QoS requirements on the network as well as increasing demand for geographic coverage beyond premise footprints.

There will be significant convergence of fixed and mobile networks as well as broadcasting networks such that it is realistic that by 2025-2030 they will be effectively part of a single converged communications platform to which the user is effectively agnostic. The devices used to access these networks will also increasingly converge, as both business and consumers will want to consume content whether on the move or not and the concept of “traditional TV usage” will change dramatically. Usage and capacity of these converged networks will therefore be driven by economics and affordability. Demand and prices for wireless broadband services, given the interdependence with Wi-Fi and mobile, will be driven by the lowest cost means of provision to support high data usage¹⁵.

Investment in these various networks will be supported by the ability of all levels in the value chain to make effective returns. If returns are focussed only on the IP service layers with returns on the infrastructure constrained or difficult to achieve then effective investment in the infrastructure will be compromised.

Access demand and network capacity growth are not directly linked

A significant increase in demand for total data volume (network capacity) will **not** be matched by an equivalent increase in the need for peak access speed for the vast majority of users. As a result demand for ultrafast speeds of over 1Gbps applying to both uplink and downlink are not realistic and certainly not driven by any realistic use case in these timescales. This has been analysed and modelled in some detail by studies such as the BSG demand study in the UK and a similar study in Australia. Limitations on peak access demand caused by the need to effectively “stack” concurrent applications together in ever more unlikely scenarios for a particular household mean that Ultrafast demand is likely to be restricted to business, some SME and specialist users meaning that a “Mixed Economy” approach utilising virtually ubiquitous low cost superfast deployments for the vast majority is appropriate. Thus the ability to overlay ultrafast capacity economically for those that require it on top of a ubiquitous low cost superfast capability will offer significant economic advantages¹⁶.

¹⁴ The future of the Internet – innovation and investment in IP interconnection : Arthur D Little May 2014

¹⁵

http://www.plumconsulting.co.uk/pdfs/Plum_Insight_June_2014_Do_you_need_a_mobile_data_forecast_to_estimate_spectrum_demand.pdf

¹⁶ http://www.communications.gov.au/broadband/national_broadband_network/cost-benefit_analysis_and_review_of_regulation/independent_cba_of_broadband

Reliability and security

The increasing reliance on these networks for “critical” services rather than broadband as a “best efforts” service will mean that resilience will be an increasingly essential feature for end users. Although this can be delivered by having fixed and mobile networks covering the country the availability, capacity, reliability, low latency, jitter and noise levels requirements for critical compared to best efforts service will have a cost and will need to be reflected in the prices for the services. These costs will need to be reflected in the regulatory and policy approach to these increasingly critical networks. Thus a wider group of Quality of Service metrics will replace the current emphasis on speeds and be regularly updated. Networks will be more scalable and able to respond more rapidly to demand through virtual network management. SMEs will require these service metrics, together with greater transparency around quality of service and enforceable Service Level Agreements.

The increasing linkage and interdependence of ICT networks and utility networks, particularly the electricity network, mean that resilient supplies of power to the ICT network will become more important.

Technology commentary for this future scenario

Delivering the underlying infrastructure to realize this scenario requires that the policy and regulatory approach to the many elements of the telecommunications environment must fully address the complete convergence and complementarity/substitutability of the different network elements.

In a world where the majority of devices will be wireless, providers will seek to deploy a heterogeneous infrastructure combining fixed, cellular and Wi-Fi technologies that deliver the lowest cost per bit and capable of delivering a user experience that will evolve rapidly over time. By 2025 5G technologies will have the potential to form an important element of this capability. Although potential capabilities of 5G are unclear today, it is apparent that in order to achieve ubiquitous and consistent connectivity, a more dense radio access network will be required regardless of radio type. All of these factors imply increasing physical convergence of the wireless networks into a single economic network covering the vast majority of the UK. In effect, there is an economically rational drive towards a single fixed network (with Wi-Fi/wireless at the edge) and a single cellular network with very dense cell capacity. The outdated reliance on infrastructure competition in the cellular market will therefore not be practical; rather effective wholesale access to these networks will offer the best chance of delivering the required coverage and capacity with the lowest cost per bit network.

Although fibre based access will be utilised on a far more ubiquitous level than is seen in the current infrastructure i.e. fixed access for all users will increasingly be dominated by fibre based systems such as FTTC, the fixed access network will remain a “mixed economy” model that combines copper/fibre hybrid technologies (FTTC, FTTRn, G. Fast, etc.) with full FTTP on the “D side”. Such a model offers huge economic advantages in responding to an unpredictable future of access demand and revenue streams whilst enabling great flexibility in response to demand when it does appear.

The dominance of video delivery based services in driving bandwidth needs over these timescales, especially to consumers will mean that symmetric services for the majority are unlikely. However, user expectations of upload speed will continue to grow and the network will need to deliver higher upload speeds as a result.

The fixed access network will also need to be more resilient and integrated with the wireless access networks through both Wi-Fi and cellular technologies. Building out to high levels of geographic coverage across both fixed and wireless networks will provide a number of benefits. In addition to allowing subscribers and business to support the relentless evolution of applications and devices, a

more ubiquitous access network will expedite and optimise the deployment of other applications and technologies such as 5G, M2M, public safety and smart cities.

As part of an integrated IP delivery platform, both fixed and mobile access networks will be capable of supporting consumer, business and public service applications; running in parallel with the ability to separate the services and providing security of information flow. Thus protecting against cross connection or malicious access by third parties (denial of service attacks, hacking etc.). They will also need to be offered on effective and equivalent wholesale terms to all players if the true economic benefits are to be realised from this national infrastructure

The IoT will be widely deployed leveraging the very lowest bit rate radio and fixed overlay technologies such as Power Line Technology through to high bandwidth traffic types such as video to support public safety requirements. This connectivity will be delivered over the fixed/fibre access infrastructure although in many cases reach will be sufficient to allow access at a lower volume of sites. Use of the fixed network will enhance security and resilience compared to current wireless options.

Whilst the internet will remain international the data centres providing the Internet exchange and peering environment will have devolved to a more regional model which will have evolved significantly to support the federation of CDNs bringing connectivity and content closer to the user. In addition to large managed CDNs which support the caching and processing of data from graphics to telemetry, large content providers will also have created a set of overlay CDNs that are optimised and scaled to ensure a high and measurable level of quality.

4K content will increasingly become the production mode of choice for video content. However, the need to actually deliver content in 4K formats will be tempered by the ability of users to display, consume/benefit from the higher quality (e.g. need for large screen size to overcome limits of visual sensory perception etc.) The existing broadcasting multiplexes will only be capable of carrying a limited number of 4K channels in comparison to the proliferation of IP technology which will allow fast delivery of new 4K channels, more interactive/immersive experiences, and greater viewer insight and innovation for content developers and advertisers alike. In this scenario it will be possible for “all IP” content delivery to be achieved allowing the release of spectrum to further enhance wireless coverage.

Overall the physical network will have been transformed from a copper based network designed around the requirements of fixed voice to a predominantly fibre based IP data delivery and connection network, with the capability to deliver varying quality of service levels in accordance with user and service needs providing fast and cost effective access to capability when needed. Traffic profiles will have shifted significantly in response to the proliferation of cloud techniques. Technologies such as Terabit Ethernet will be used to connect large infrastructure providers to the backbone networks. These connections will be virtualised by provider and are defined once again by agreed specification of both physical and logical interfaces.

The fabric of the UK infrastructure will be dynamic. Wireless access will have significant levels of dynamic programmability to cope with heterogeneous access. Capacity will not be dedicated to any one application, access, or geographic area or licenced user. Rather, dynamic capacity management and effective wholesale access will ensure the optimum use of infrastructure and provision of seamless resilience.

Security and resilience of the infrastructure will need to reflect the degree of importance of the infrastructure to its users and indeed the whole economy. The resilience requirements of a critical national infrastructure rather than best efforts internet will need to be embedded at all levels

including supply of power and backup power for the operation of the relevant components either directly from the grid or via standby systems.

6. Key features of the BT View for policy makers.

- **Promote effective, consistent access regulation across all sectors**

Promote consistent legal/regulatory regime to drive continued investment and innovation in fixed and mobile access infrastructure.

The solution does not involve removing regulation and encouraging a market free-for-all. Instead, it requires *alignment* of regulatory strategies across the converged fixed and mobile service markets at UK and EU level. Regulation also needs to *focus* on the bottlenecks at the access level and across all networks. These bottlenecks typically occur at the ‘final connection’ of the customer to the network. Ideally, this should be a single, simple point that supports a multiplicity of players and services. Under a positive regulatory regime, access to that point should be possible for many competing suppliers (driving healthy market competition).

Importantly, we need to avoid the following scenarios. Either, fragmenting competition leads to creation of multiple ‘last mile’ access points beyond the required fixed and wireless option (hugely inefficient and leading inevitably to rises in service costs) and simply unsustainable at the limits of coverage. Or, lack of competition means ‘monopoly access’ by just one service provider or a limited number of providers. As far as network access points are concerned, ‘built by one, shared by many’ needs to be the approach fostered by consistent and constructive regulation. The beneficial outcome will be equivalent access for all customers to the full range of networks and service options in the market and maximal coverage. This will create a consistent environment – the necessary foundation of an effective market. It will encourage a stronger UK, pan-European, and global communications sector yielding greater benefits for consumers, industry and the economy.

- **Support universal network coverage across UK**

Ensure that returns to infrastructure are sufficient to support the necessary investment in fixed and mobile coverage commensurate with quality of service expectations.

The solution will need to enable the most cost effective means of delivering effectively universal superfast premise coverage to circa 99% of the UK plus near universal geographic coverage at lower speeds to support out of home and IoT/M2M demands delivered by a mix of fixed, Wi-Fi and 4G/5G wireless technologies.

The government should therefore give serious consideration to how and if universal broadband coverage across the UK at both a premise and landmass basis should be achieved. Some form of USC maybe an effective way to achieve this however there are a number of key features of such a commitment that would need to be considered. In particular; the extent of the commitment and any limitations, how such a commitment is to be funded/paid for, and at what level of service should such a minimum be set.

- **Achieve “full potential” efficiency of spectrum**

Much greater sharing of spectrum, mobile networks and open access to those networks is needed to sustain competition, and encourage the innovation and investment that are required for the development of the digital economy in the UK.

Relying on national retailers and wholesalers is insufficient to achieve these benefits going forward. Instead of relying on the assumption that four national networks supported by two physical mobile networks can deliver competition at wholesale and retail level and deliver innovation, it becomes imperative to look at increasing competition by strengthening sub-national players in the mobile access market as well as ensuring the development of MVNOs and innovators.

As well as spectrum sharing options we believe that providing open access e.g. through a neutral host platform should be a key part of the solution. A neutral host is the most efficient way to make spectrum accessible to the widest number of players, will maximise the performance of the mobile broadband platform, and will require the least investment. A neutral host model will reduce the barriers to entry and expansion for facilities-based operators whose networks are not necessarily national in scope.

The regulation of fixed telecoms in the UK is a clear example of how such common access can optimise network efficiency and promote competition to maximise long-term customer benefit. As in Fixed, the solution is to make regulated access to the “raw materials” of the service, i.e. the network, at the lowest level that is practical.

- **Enable effective withdrawal of redundant/inefficient products and regulation to promote cost saving and investment**

We have highlighted that the ICT market and ICT infrastructure investment is progressing rapidly to a focus on IP only services. As a result we believe there are benefits to investment from a focus on IP only services, and how a resulting IP only network can be most cost effectively delivered.

In particular, as voice services, including formal PSTN and emergency call support moves to an IP voice delivered service for the vast majority, as it will in these timescales, the role of services dependent on the traditional copper interfaces at the MDF, such as local loop unbundling and Wholesale Line Rental will be dependent on their ability to continue to meet the needs of the base market. The point at which all customers are most economically served via fibre based IP delivery networks carrying voice and data as IP services is difficult to predict but could potentially occur within these timescale. If this were to occur the additional costs and complexity of supporting copper and exchange based interfaces for a very small part of the market alongside the fibre access network could become uneconomic, and become a drag on further investment.

Current take-up forecasts by independent analysts e.g. Point Topic¹⁷ show broadband connections in the UK growing to upwards of 25 million premises by 2020 with the vast majority of these (over 23 million) being fibre based e.g. FTTC/cable etc. Such forecasts imply a dramatic reduction in the market need for exchange copper based services but it is too early to say if they are correct.

¹⁷ Point Topic Market Report March 2014

If such a shift to fibre based access for virtually all does occur however then investment in the fibre should not be compromised by the need to maintain copper based legacy network services that are incapable of meeting the service need but which regulation and competition policy insist on being maintained beyond the point that it would be economic to do so.

- **Promote on line security and trust**

Building and operating a world class ICT network across the UK, and offering world class IP based services to end users will not deliver the expected economic benefits if UK customers and businesses do not trust the network and the data they make available through using the network to be secure and utilised to their benefit.

- Ensure resilient network assets and power supply.
- Ensure data security of consumer information to prevent fraud and misuse.
- Promote trust in the collection and use of customer data by government and service providers.

- **Ensure fact based, relevant benchmarks and performance data for the UK against key competitors**

Targets, benchmarks and performance data sets that track and compare UK performance with its key economic competitors are important as they can and do drive investment, policy and regulatory behaviour. However, an “obsession with league tables – and the UK position in them” particularly if these league tables are measuring narrowly focused or inappropriate data or comparisons, can be counter-productive driving ill thought out, reactionary or just wrong decisions. It is therefore important that any such benchmarks must be appropriate, relevant and fact based, focussed on relevant countries in an objectively comparable manner.

If specifically examining network performance between countries then metrics based around coverage and capability – encapsulating measures such as bandwidth, resilience, latency, etc. are likely to remain, the best metrics.

However, whilst important, this focus on infrastructure performance measures risks taking too narrow a view of how the market as a whole is operating. Measuring what country is best positioned to benefit from and exploit the infrastructure for the benefit of the whole economy requires examination beyond the performance of the physical infrastructure.

Therefore greater emphasis on wider economic measures and effective utilisation and exploitation of the infrastructure in the economy would provide a more comprehensive measures base from which to set public policy goals. This would allow the UK to measure not only take-up of broadband services but also give an approximation of the level of digital skills, digital engagement etc. of consumers, business and indeed government in the UK compared to other key nations.

Broadly based measure such as that in the EU Digital Agenda Scorecard approach or the BCG “e-intensity index¹⁸” that look beyond simple infrastructure availability into its use and exploitation across the wider economy go far further and offer a potentially more instructive view for policy

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https://www.bcgperspectives.com/content/interactive/telecommunications_media_entertainment_bcg_e_intensity_index/

setting and tracking. These wider based indicators give a far more rounded picture, and help inform debates around the public or private benefit of enhanced broadband connectivity.

Although all of the above offer potentially useful guidance on how tracking and monitoring could be improved it is also important to avoid an “obsession” with league tables. Any benchmarks/targets should only be used where they can support good policy actions and tracking. As a result the selection and use of such benchmarks needs to be strongly evidence based and relevant to the UK.

In addition to the positive actions outlined above, that UK government can take to encourage the delivery of this truly effective and efficient ICT infrastructure across the UK, there are a number of policy themes that we expect others may call for which will put UK infrastructure development at risk. We would encourage government to resist the predictable and self-serving calls for policy action in the following areas:-

- **Avoid distraction from “Gigabits for all”**

Resource and investment pursuing a “Gigabit access for all” approach, when there is no evidence to justify these speeds and their associated costs is wasteful and likely to result in lower overall benefit due to delay in delivery and at considerably higher cost. Gigabit solutions will be provided, where necessary via commercial solutions – policies that promote “GBFA” before there is evidence for their benefit will result in a misallocation of scarce resource and delay in delivering benefits of other more appropriate solutions.

The mixed economy approach has been shown by research in the UK and elsewhere to offer significant economic and societal benefits, and deliver those benefits earlier than an FTTP only approach. Government should therefore ensure that the mixed economy approach is fully enabled and not distracted.

- **Ensure continued investment in infrastructure by dismissing calls for “Dark Fibre” access**

Some responses by others to this consultation will no doubt call for BT to be mandated to provide dark fibre. Ofcom looked at such calls in their last market review and concluded that such a move was not only, not necessary but risked undermining the competition and benefits currently offered on the basis of the current regulatory framework. We believe such conclusions remain the case today and will be the case in the futures. At best dark fibre is likely to lead to cherry-picking in already competitive areas and is likely to lead to a reduction in wholesale fibre investment directly contrary to the UK vision.

- **Reject structural separation of access providers**

The current “functional separation” model approach that is a feature of the UK fixed access market through openreach, has delivered arguably the most competitive broadband market in the world, with hundreds of service providers operating across the UK delivering high quality low cost services to UK consumers and businesses. The integration with BT Group, enabled by this approach has also led to massive investment in the wholesale fibre access network that has brought the UK to the forefront of NGA coverage, usage and engagement measures across Europe and the globe. Calls for structural separation of this successful model will cause significant uncertainty for any future investment in fixed networks and should be rejected.

- **Avoid move away from merits based appeal**

Given the economics of building, maintaining and improving broadband access networks across the UK some form of regulatory oversight is expected to continue over these timescales. It is therefore important that appropriate redress in the form of an effective merits based appeals process against regulatory decision is maintained.

Appeals form a vital part of the regulatory decision-making framework'.¹⁹ Although making judicial processes more efficient, and harmonising the approaches in different appeals bodies and across different sectors, are sensible objectives this should not be at the expense of an effective appeals process.

Therefore a move from appeals on the merits to judicial reviews risks losing an important check and balance in the system, which could lead to poorer decision-making. Appeals on the merits allow for more thorough testing of the evidence and reasoning of the decision, including the economic aspects of the case.

Any weakening of the appeals basis increases risk of investment in these vital assets running counter to the governments wish to encourage investment.

¹⁹ Department for Business, Innovation & Skills (2013), 'Streamlining regulatory and competition appeals: Consultation on options for reform', 19 June, para. 1.9.

Responses to the specific questions in the consultation

Introduction

Q1 Views are sought on:

a) Is this an appropriate role for Government?

Given the importance of ICT networks to the future economy of the UK it is important that long term analysis and consideration of the emerging and evolving issues expected over time is conducted. BT therefore welcomes a fact based dialogue on what a wider ICT infrastructure strategy should encompass. This consultation is therefore a useful first step in helping to ensure that the UK actively considers how the future demand for these services might evolve, what trends are likely to be important, and how the positive aspects of this demand and service evolution can be optimised for the UK economy. Following such a dialogue government can help industry to achieve the optimal outcomes for ICT infrastructure by implementing optimal policies to assist and, equally valuable, avoiding adverse policy impacts. Developing an active strategy for government from this consultation is likely to take time however and require further consultation with industry and interested parties. A single consultation followed by a rapid follow up of a government strategy in response with no further consultation or opportunity to develop and iterate a UK strategy is likely to be counterproductive.

Government policy can have a significant influence – both positive and negative on the development of infrastructure and its utilisation. It is therefore important that every effort is made to ensure the development of that policy is effective.

b) What other high level principles the Government might adopt?

ICT networks are already significantly impacting and benefitting the UK economy. For example, research from the Boston Consulting Group based on OECD data but the value of the ICT economy in the UK at over 8% of GDP and set to grow to 16% by 2016. However at a time when the Government is looking to make major investments in all aspects of UK infrastructure from roads and rail, to power generation and distribution, the ability of an integrated and ubiquitous ICT network to assist with and lower the cost/increase the efficiency of these major investments appears not to be a focus?

Therefore a principle that the UK ICT infrastructure should be utilised wherever possible to improve the efficiency and cost effectiveness of all other UK infrastructure, e.g. through Smart monitoring, sensing, real time feedback and control etc. should be key.

In addition to this specific principle to help ensure the leveraging of ICT benefits into general UK infrastructure investments, we would also seek to ensure that the following policy development principles are adhered to:

- *evidence-based, with predicated on open and transparent fact-base and modelling assumptions;*
- *should be technology neutral;*
- *Government policy should not result in the crowding out market solutions – indeed should enhance them;*
- *policy must take a long-term view to enhancing investment and competition to achieve consumer benefits;*
- *policy and regulatory environment must reflect the converging markets of wireless, fixed access and content;*
- *policy should be consistent in interpretation and application.*

c) What resources do you consider the Government should aim to deploy to effectively manage its role?

Resourcing of government departments and roles is a matter for government, however, we would highlight that with the need to ensure that any UK regulatory action in the ICT arena is in keeping with EU level regulation including State aid etc. then it will be important that the UK is adequately represented and suitably resourced at EU level to ensure that its objectives can be achieved within current or changed EU rules and guidelines if it is to deliver on its objectives in this space.

Section 1

Q2 What potential opportunities are there for Government to leverage its combined buying power to support policy objectives?

The Government has already utilised its buying power to good effect in ensuring a consistent approach to government funding of NGA infrastructure across the UK combined with local government funding and engagement through the BDUK framework process. This approach is delivering a fully open wholesale access platform that delivers consistent service and price benefits to customers and service providers across the rural areas of the UK. Extending this approach to Cities and Urban “white areas” would ensure these benefits are available across the entirety of the UK.

Ensuring that this network is effectively utilised with high levels of end user take-up driven by a real understanding of the economic benefits to end users of these high speed services is a potential future area of government scale/leverage. e.g. by ensuring effective government service delivery and citizen engagement via these services.

Q3 If migration to IPV6 is required, are there any barriers to that migration and if so how might these be addressed?

IPv6, and the increase in internet addresses that it provides over IPv4, is important to the long-term growth of the internet, particularly with the likely explosion of connected devices as the Internet of Things ecosystem grows. In the near term, however, there is no reason to believe that providers will prove to be any less innovative in ensuring that supply meets demand through the use of technologies such as Network Address Translation (NAT).

In addition to the current lack of necessity, decisions over whether to transition to IPv6 have undoubtedly been affected by the incompatibility of the two protocols – networks will have to maintain both during what is likely to be a lengthy transition. This understandably has a cost implication for providers and helps explain why adoption levels of IPv6 have remained low over the past decade.

In summary, there are technical and commercial barriers to achieving this transition from IPV4 on the necessary global scale to effect a complete change. Therefore whilst transition should be encouraged it remains primarily a commercial decision to be taken by providers globally.

Section 2 - What might future demand look like?

Q4 Is an ongoing disparity of provision of broadband services inevitable? If so should this be addressed and how might this be done most effectively?

The level and quality of Broadband/IP services will always vary to some extent across different areas of the UK e.g. from city to rural, fixed to mobile, in home to out of home etc. this is economically rational in a world with varying topography, estate, demand density etc., and more critically with varying needs and willingness to pay. The extent that this practical “disparity” gives rise to a genuine disparity in service quality is not clear cut however. What is important is that individuals are not materially disadvantaged in regard to accessing services that are needed to meet their needs (in contrast to their wants.)

The “disparity” in service perception and likely demand across different households and also out of home demand has been examined in some detail by the Broadband Stakeholder Group recently both in terms of household demand and its variation with typical household factors (number of people, expected application use over time etc.) and also “out of home” use drivers that focussed on the key differences between usage in home and on the move and how persistent such differences are likely to be over time²⁰.

This research concludes that actual service parameters that end users need varies with their household and usage parameters and also varies from place to place as well, therefore the focus of government should not be on removing actual disparity, but on ensuring that any disparity is economically and practically justifiable. For example, ensuring a base level of performance across the UK geography that enables remote devices, sensors and IoT type applications is sensible, similarly

²⁰ see BSG Demand Study and BSG Out of Home usage study referenced earlier.

ensuring that very high speed, fully resilient and secure capability is available in major banking districts etc. is also sensible, but the fact that the higher level of service is not available universally is not a practical disparity.

On the issue of disparity we would also highlight that although effective wholesale access to NGA networks is increasingly available across the UK via openreach there are areas of the UK where this choice and flexibility is not being offered e.g. We believe the Government should be concerned about new site “lock-ins” where developers are seeking to either own or capitalise on the civils infrastructure by not offering open access and only offering service via vertically integrated and exclusive network providers. As a result there is a risk that the current regulation that is delivering investment and huge range of choice in low cost high speed network provision is not being uniformly applied across the UK.

Q5 How symmetrical will digital communications networks have to be in the future? Will this differ across user types? What implications does this have for fixed and wireless broadband provision?

On a similar basis to the position on disparity in Q4 the extent that service capability needs to be symmetrical, or perhaps more accurately how asymmetrical it can remain, will differ across, areas, geographies and customer types. Consumer/domestic applications are still expected to be dominated by video consumption type applications over these timescales and these are by nature asymmetric. Business services however, particularly business to business applications are more likely to be symmetric in nature or even asymmetric in the upstream direction. The issue for Government is therefore not about a drive to ensure symmetry everywhere, but to ensure that the capabilities of the infrastructure to deliver capability in both directions are appropriate to the end user and the applications they need and pay for.

Q6 Which countries should be our benchmarks on communications infrastructure to ensure that businesses remain in the UK and continue to invest?

The UK should continue to benchmark itself against our key economic competitors, both in the EU and globally. Analysis and benchmarking exercises already undertaken by Government and Ofcom in this area, for example the Ofcom EU Broadband scorecard provide a good base point for this, but private sector comparisons from Analysys Mason (covering EU and major global ICT leaders) and the Boston Consulting Group (based on the G20 major economies) and wider also provide and will continue to provide useful insight.

However, whilst important, this focus on infrastructure performance risks taking too narrow a view of how the market as a whole is operating. Measuring what country is best positioned to benefit from and exploit the infrastructure for the benefit of the whole economy requires examination beyond the performance of the physical infrastructure.

Therefore greater emphasis on wider economic measures and effective utilisation and exploitation of the infrastructure in the economy would provide a more

comprehensive measures base from which to set public policy goals. This would allow the UK to measure not only take-up of broadband services but also give an approximation of the level of digital skills, digital engagement etc. of consumers, business and indeed government in the UK compared to other key nations.

Broadly based measure such as that in the EU Digital Agenda Scorecard approach or the BCG “e-intensity index²¹” that look beyond simple infrastructure availability into its use and exploitation across the wider economy go far further and offer a potentially more instructive view for policy setting and tracking. These wider based indicators give a far more rounded picture, and help inform debates around the public or private benefit of enhanced broadband connectivity.

Comparing the wrong element or making comparison with the wrong country is unlikely to serve the cause of effective decision making. For example a comparison focussed on superfast speed/coverage only with countries such as the Netherlands or Belgium with their historic high cable TV presence that delivered early capability on these measures, would not have helped the UK achieve its high levels of on-line transactions, consumer spending and trust etc. These wider “engagement” factors of the UK e-economy are proving key in driving consumer and wider economic benefits however and underpinning the investment case for further growth and coverage.

Q7 What metrics do you think should or will become relevant in comparing network performance in different countries? What metrics should most appropriately be used as the basis to set objectives for government policy?

Speed has been the almost all-pervading measure of performance in this space over the past few years, both in terms of public perception and in driving UK Government and EU policy. It has driven the focus on access networks, access investment and access technology debates. This is unlikely to continue over these timescales however, and we believe it would be unhelpful if it did. Access speeds in particular available access speeds (rather than purchased access speeds) are now increasingly at a level that already exceeds actual demand for the vast majority of users, both now and over the timescales of this review. It is therefore important that at UK Government and at EU level the focus moves to a broader set of measures of the economic and social benefit and impact of IP networks. Issues of coverage, take-up, usage/economic benefit, service sustainability, reliability and more general service quality will become increasingly significant measures of the potential economic impact. The Ofcom Broadband Scorecard is a good basis for this wider measure but there are also more general economic readiness and exploitation measures published currently by private sector players that could add to this base and provide a degree of continuity.

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https://www.bcgperspectives.com/content/interactive/telecommunications_media_entertainment_bcg_e_intensity_index/

Section 3 - Scenarios

Q8-22 Do you agree with the various scenarios or elements within them? Where do you agree/disagree? If you disagree what alternative scenario do you envisage?

Covered by BT scenario explained in detail above.

General

Q23 Are there factors, for example technical or unrelated to the regulatory framework, that could create bottlenecks and delay future infrastructure deployment in the UK in this timeframe, that would result in demand not being met or the UK not being seen as a leading digital nation?

The case for the provision of near universal superfast broadband access services is well made in terms of economic benefits and in value for money from public subsidy (for example the SQW study²² that concludes that the current public investment will deliver an additional £17Bn in UK GVA by 2024 and return approximately £20 in net economic impact per £1 of government funding.) This general economic case underpins the current government targets for 98% of the UK to have access to NGA services by 2018. Therefore issues that present obstacles to achieving that target can create bottlenecks and potential delay. A number of these issues are covered elsewhere in this paper in relation to achieving our vision of the future, e.g. the need for effective converged regulation and the need for efficient use and allocation of spectrum assets etc. However, we would also highlight here the need to ensure there is an effective means of enabling intervention to address so called “white areas” wherever they occur. The current arbitrary distinction between NGA white areas in rural locations, with one set of access conditions and aid rules, and NGA white areas in “more densely populated areas” where the access conditions and aid rules are different.

As a result any intervention in these “more densely populated areas” such as cities cannot be targeted at the market failure identified in NGA and any assets resulting from such intervention must be made available to “satisfy all types of network access products that operators may seek” independent of the market they are seeking to address with such access products.

The proposed aid measure is therefore poorly designed because it removes the incentive for operators to invest in the Subsidized Network and for operators using it to supply NGA services to small businesses and residents in the Target Area. The limitless and indiscriminate conditions of access to the New Network have a number

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https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/257006/UK_Broadband_Impact_Study_-_Impact_Report_-_Nov_2013_-_Final.pdf

of adverse consequences which destroy the incentive effect. First, unrestricted access paves the way for multiple competing networks to be created in the Target Area and inefficient duplication of infrastructure. With revenues in the Target Area being finite, each network will have a reduced share. Any operator selected to build the New Network will have reduced revenue opportunities and will find it more difficult, if not impossible, to cover investment costs and make a reasonable return. There will, therefore, be no incentive to invest one's own money in the New Network. Secondly, again because the access conditions to the New Network are unrestricted, operators will be able to use it not only to duplicate the current and planned NGA network provided commercially using shareholder funds but also to duplicate non-broadband networks in the Target Area, in particular leased line networks. Typically in UK cities BT and multiple other operators such as Virgin Media have invested in leased line networks across the entirety of the city. There is no incentive at all for the existing NGA providers or others to invest in such a subsidised city network in the knowledge that third party operators may use it to threaten their leased line revenues in the Target Area.

This lack of clarity on aid in city areas has lead, and will continue to lead unless addressed, to inconsistent availability of NAG services across UK cities with consequent impact on the competitiveness of these areas and businesses within them.

Finally we would add that being a truly digital nation that reaps all these economic benefits is predicated on take-up, which is in turn dependent on strong competition which is only truly delivered if there is a regulatory framework that is consistent across the converging sectors of fixed, mobile and pay-tv.

Q24 Do you expect commercial providers to deliver future infrastructure and meet demand on a purely commercial basis, or is some form of public intervention likely? If public intervention is likely how might that work with the commercial provision of infrastructure? What form might that intervention take?

Commercial providers will continue to deliver future infrastructure wherever they believe there is a commercially viable case to do so. The deployment of these high capacity broadband capable infrastructures is however a long term, significant scale investment that only makes economic sense if their future use (driven by demand for the new capabilities they offer) can be realistically assured. The UK fixed market has demonstrated that a standardised deployment of high quality infrastructure offered on equivalent terms to a large number of competing service providers offers an effective way of ensuring revenues flow to the infrastructure provider whilst ensuring the benefits of competition to the end user. Other models for investment exist such as that in the UK cable market based on a vertically integrated and exclusive access deployment that secures both retail and wholesale revenues for the infrastructure investor as well as small scale investments at the city infrastructure layer e.g. the trials by City Fibre networks with sky and Talk-Talk in York. The lack of scale of this

“wholesale” approach however means that it is generally uneconomic for service providers to use when compared to a national scale infrastructure.

Therefore we expect the current model of competing infrastructures in high revenue, high density areas of the UK to continue with further investments to ensure the deployment of faster and more “fibre rich” services to continue on a commercial basis. Extending these services out to the rest of the UK will however require the completion of the current BDUK ambitions for fixed NGA deployment, intervention to ensure effective geographic coverage using wireless and potentially further government investment if demand for higher speeds emerges beyond the capability of these networks in the future. The EU State Aid rules provide a framework for ensuring such intervention can work with commercial deployments but they are based on a presumption of effective wholesale access to the infrastructure.

Therefore to ensure any Government intervention to ensure ubiquitous enhanced infrastructure is effective the UK should seek to align State Aid rules with the communications regulatory framework. The latter recognises that to incentivise operators to invest in next generation infrastructure, you have to achieve a balance between access requirements and the investment incentive. If access obligations are too stringent, the incentive to invest is lost. By contrast, the State Aid rules as currently applied by the European Commission require unrestricted and unconditional access to subsidised infrastructure, in particular in cities, and this removes the investment incentive. This explains why there are still many inner city areas where there is no superfast broadband. This in turn has an impact on the competitiveness of local business, on jobs and on quality of life.

Q25 Which current or draft legislation might prevent or facilitate the emergence of any of the scenarios?

The Telecoms Single Market initiative offers an opportunity for a comprehensive review of EU policy-making, to assess what the ‘digital’ economy and society offer Europe in terms of economic growth, competitiveness and a better future, and to address the key policy challenges in areas such as innovation and investment in networks and services, choice and competition for consumers and businesses, strength and competitiveness of EU companies, and skills training and employment for citizens.

The shifts in technology potential and use, the convergence of previously distinct sectors, and the interplay of national, European and global trade require a renewed emphasis on the strengths of a properly enforced and open Internal Market, and the leverage of European strengths on the global stage.

The policy approach should support growth in the communications sector and the broader EU economy, boost innovation and creativity, maintain global competitiveness and ensuring the EU realises the benefits of a world class infrastructure. This will require facilitation and encouragement of efficient private

sector investment in infrastructure, and enabling the evolution of a fair, consistent and equitable converged regulatory framework.

The 'Digital Single Market' initiative is an opportunity to draw a consistent and coordinated approach to several different areas of policy-making.

The principles underlying EU telecoms regulation and EU competition law are basically sound. However, the challenges of consolidation, convergence and of cross-border business service provision, require adjustments to the Electronic Communications Framework to deliver a more aligned, consistent regulatory treatment of converging markets and sectors. This should be underpinned by non-discriminatory wholesale access, and with focus on active rather than passive products.

Q26 Do you have views on which scenario (or combination of scenarios) is most likely and should influence the development of future strategy?

We believe the BT scenario 4 (that largely builds on scenario 3 in the consultation) described in more detail above should be the scenario that influences the development of future strategy. We have also set out in more detail elsewhere in this response the actions we believe the government needs to take in order to ensure this scenario is most likely.

Section 4 Competition and regulation

Q27 How might efficient investment in communications infrastructure be supported, for example by changes in the regulatory framework?

The regulatory framework will need to evolve to be much more consistent across sectors to reflect the converged network/service environment of the future if effective and efficient investment is to achieve to maximise the benefits to the UK economy, rather than a particular provider.

We have highlighted in our scenario view above that communications networks are likely to move to fully converged services across fixed and mobile access infrastructures with effectively all services offered as IP based over the top applications. As a result the government needs to ensure that the regulatory framework enables and supports the most efficient means of deploying such networks across the UK whilst ensuring that the undoubted benefits of competition at the service layer over these networks is maintained.

Access to the openreach fixed network across the UK is already available on the traditional copper loop and also on the new fibre GEA network, both commercially funded and in areas where government assistance has been utilised. Equivalent access to mobile access infrastructure would accelerate and enable the development of competitive convergent services whilst also ensuring maximum benefit in terms of coverage is delivered from the existing mobile access and efficient

investment in extending mobile coverage from its population based target today towards a UK area based requirement necessary for future services.

The provision of an effective wholesale access market to mobile access networks and/or spectrum and its benefits for UK investment and competition is explored in detail in the attached report compiled for BT by Coleago²³ but in summary it concludes that much greater sharing of spectrum, mobile networks and open access to those networks is needed to sustain competition, encourage the innovation and investment that are required for the development of the digital economy in the UK. In view of the challenges that face the deployment of mobile services, it is important that Ofcom and the Government has a clear vision of the target market structure that can best meet the future needs of the digital economy.

The central view is that relying on national retailers and wholesalers is insufficient. Instead of relying on the assumption that 4 national networks supported by two physical networks can deliver competition at wholesale and retail level and deliver innovation, it becomes imperative to look at increasing competition by strengthening sub-national players in the mobile access market as well as ensuring the development of MVNOs and innovators.

In addition to spectrum sharing options we believe that providing open access through a neutral host platform should be a key part of the solution. A neutral host is the most efficient way to make spectrum accessible to the widest number of players, will maximise the performance of the mobile broadband platform, and will require the least investment. A neutral host model will reduce the barriers to entry and expansion for facilities-based operators whose networks are not necessarily national in scope.

The regulation of fixed telecoms in the UK is a clear example of how to optimise network efficiency and promote competition to maximise long-term customer benefit. As in Fixed, the solution is to make regulated access to the “raw materials” of the service, i.e. the network, at the lowest level that is practical.

If competition at physical radio access network level continues to weaken, a neutral host network may be the only appropriate solution. A neutral host will also indirectly allow a number of service providers to share spectrum and this will help mitigate the impact on spectrum scarcity of a requirement for wide channel bandwidths to get the most out of new technologies such as 5G.

The user demand needs driving 5G research are as covered elsewhere in this document in particular how a potentially massive increase in capacity need on the mobile network at the “cell” level, driven primarily by video traffic, but also support for the Internet of Things and real time interactive services.

²³ Competition policy and Mobile spectrum auctions – July 2014

5G is currently at the research stage however there is an emerging consensus on the time line with standardisation with start in 2016 and the first deployments in 2020. Thus there is a need to align 5G development with any DCMS strategy for ICT in the UK. BT is a founding member of the 5G Innovation Centre at the University of Surrey and we believe this body will be influential in shaping the future of mobile technologies and standards for these technologies.

Other players may also hold spectrum and could operate networks in parallel with a neutral host. The ability to share spectrum will enable these players to deploy the highest quality mobile broadband networks. These networks, which are likely to be sub-national, but capable of being combined at the service layer with other national networks to provide effective converged services, may also be an important source of innovation in the future converged broadband service landscape that we envisage.

The convergence of broadband and broadcast technologies, which has the result that end-customers are able to consume any content on any device at any time by means of communications networks. Although technology convergence has been underway for some time, it is now fundamentally changing the way that communications and media markets operate in terms of competition, distribution and end-customer consumption. However, problems with access to key content that drives consumer take-up and retention, which has limited the emergence of effective competition in traditional pay TV services, will be amplified in a converged world, preventing the achievement of consumer benefits unless these problems are addressed. High quality content services are characterised by high fixed costs and very low marginal cost. As such, appropriate access to scale bottlenecks, which are substantial barriers to entry, will be essential if the full benefit of competition in converging markets is to be delivered to consumers.

Consistent regulation and a level playing-field for competition are a necessary pre-condition to ensure that UK industry remains at the forefront of competition and innovation and consumers enjoy the benefits of converged competition through enhanced choice, functionality, and pricing which will also lead to great utilisation and thus investment in infrastructure. In summary, we believe these outcomes can be achieved by:

- Putting in place a consistent approach to regulation to ensure competition across converging markets in communications and media;*
- Applying this consistent approach to economic barriers to entry in content markets, specifically in relation to pay TV and, more specifically, in relation to key pay TV content that is capable of driving consumer take-up and retention;*

- *Ensuring access to key content and scale platforms on a fair, reasonable and non-discriminatory basis;*

Q28 Are there any further measures necessary to incentivise the rollout of future mobile infrastructure in currently underserved areas?

National roaming requirements would provide a first step towards ensuring this wider coverage capability in the short term, but a more balanced regulatory approach between fixed and mobile access would ensure future investment is focussed on coverage gaps whilst simultaneously promoting service innovation and competition in converged services that consumers increasingly expect and value.

We believe that promoting the development of alternative facilities operators is the best and most practical way to address the structural problems in the UK mobile market and promote and incentivise further rollout of mobile infrastructure in under-served areas and ensure not just effective premise level coverage but geographic coverage as well. The market is more likely to be able to support additional sub-national wholesalers than national wholesalers and the trends suggest that the focus of technology developments is likely to be on sub-national networks in the next few years.

Alternative operators with different investment models and taking advantage of alternative deployment architectures such as small cell technology that enables much more efficient dense reuse of spectrum could bring substantial benefits for UK consumers; however, we believe that specific intervention is a prerequisite for the entry of new alternative operators and the survival of existing players in the market. Leaving this to the market may not lead to the best outcome for UK consumers, since mechanisms such as auctions do not take into account the wider benefits of competition and innovation that such players can deliver.

Hence, we believe that it is critically important that Ofcom intervenes in spectrum auctions to facilitate a move to a more diverse market structure in which alternative facilities operators can compete effectively. Ofcom should also ensure that network handover for national coverage is available, effective, and is not a barrier to entry for alternative operators.

Other players, in particular UK Broadband and BT hold mobile spectrum in the UK and could become significant alternative operators, but there are sizeable imbalances in the distribution of spectrum. Future spectrum auctions could address this, for example to ensure that operators with relatively small spectrum holdings can at least acquire one 40MHz block of TDD spectrum however if competition at physical radio access network level continues to weaken, a neutral host network may be the only appropriate solution. A neutral host will also indirectly allow a number of service providers to share spectrum and this will help mitigate the impact on

spectrum scarcity of a requirement for wide channel bandwidths to get the most out of new technologies such as 5G.

Q29 Is there a role for a revised USO or USC to ensure that minimum consumer demand requirements are met and to reduce the potential for a new digital divide? What might this look like?

The government should give serious consideration as to how universal broadband coverage across the UK at both a premise and geographic/landmass basis should be achieved, as well as the objectives of such a deployment. For example these objectives will need to carefully consider and assess the importance of social inclusion and affordability matters in addition to technical issues about speed and performance necessary. Such matters will require careful consideration and be assessed for impacts on funding and how responsibilities could be shared fairly across all market participants.

It is though far from clear to BT that such coverage should be met via a broadband USO at this stage or what level of service any Universal Service Commitment form government should be set at if the existing 2Mbit commitment were to change. Some form of USC may be an effective way to achieve this however there are a number of key features of such a commitment that would need to be considered. In particular; the extent of the commitment and any limitations, how such a commitment is to be funded/paid for, and at what level of service should such a minimum be set. In particular should a USC service meet all service needs or just those required to deliver societal/government services/benefits not personal benefits?

The existing voice service USO has a number of features that could be usefully applied to a future government commitment on broadband provision, particularly in terms of responsibility for payment and extent of the liability in very extreme situations. There are also aspects of the current USO that are already viewed by some as outmoded and irrelevant already (or else will cease to be relevant over these timescales). For example the requirement to maintain a network of public payphones in an era of effectively universal mobile phone coverage and ownership is expensive, duplicative and inefficient, and should be reviewed to ensure limited resources are focussed on areas that matter for the UK infrastructure.

There are potentially significant benefits for the UK economy generally and for UK consumers in particular to be derived from some form of universal broadband availability, not just at premise level but generically across the UK landmass. Our scenario above highlights the importance of services based on the Internet of Things, the expectation that devices will work wherever an end user is located, and the increasing prevalence of machine based devices e.g. connected vehicles that add further weight to the need for a ubiquitous geographic network.

I would also reference the importance of social inclusion and affordability matters too alongside speed. Such matters require careful consideration of funding and how responsibilities can be shared fairly across all market participants.

Q30 In terms of supporting future innovation and long-term investment in infrastructure, what areas of broadcasting regulation may have served its purpose by 2025 - 2030 (or indeed earlier). What future technical developments may also have longer term implications for regulation and wider public policy?

The broadcasting regulations are predicated on an industry structure and distribution technology that is incompatible with the future scenario for a converged ICT industry. As a result they are unlikely to support future innovation and long term investment as they distort the emerging converged IP market in favour of historic infrastructure.

A regulatory and industry structure that is based on wide-scale linear broadcast content consumption, with spectrum reserved and provided at low cost to support this model is already out of date. It will become increasingly out of step with both then nature of investment, competition, distribution and consumption (for example as shown in the recent Ofcom Market review comparing adult viewing habits for all adults and those under 26) and distribution needs and costs.

Our future scenario envisages that TV/Video consumption will increasingly be non-linear in consumption mode and IP delivered, with IP potentially replacing DTT from 2025, such that the requirement to reserve spectrum for DTT distribution of non IP, linear content will need to be questioned, to ensure that the most economically effective utilisation of this scarce spectrum resource can be ensured.

Q31 Are there changes to the EU Framework that the UK might seek to encourage more competition in UK markets?

The UK is already very competitive compared to any global ICT market and in particular when compared to EU markets. Therefore changes to the Framework need to be focussed initially on ensuring that these competitive benefits are replicated across the EU. A point recognised by the Single Market Regulation proposal for digital services of September 2013 recognised that subsidiarity was not working because of the divergence between the regulatory decisions of different NRAs. It follows that action must be taken here to deliver more consistency in decision making. In particular changes to the Framework should:

- a) re-enforce the flexible, pro-investment approach to fibre set out in the existing EU Recommendation;*
- b) promote VULA/service-level competition rather than the restrictive and uneconomic duct-based/passive infrastructure based competition model;*
- c) ensure availability of business grade active access products across the EU on equivalent cost orientated terms - which are obtainable in the UK but not always elsewhere – in order to enable and promote consistent cross border services for business.*

In addition to the short term focussed changes to ensure consistency of competitive opportunity across the EU changes also need to be considered to The EU

Framework to align it with the changed market. The framework based on an increasingly outdated view of the converged ICT market. The market definitions, differential treatment of fixed and mobile access, and differential between access to content and access to infrastructure services is not conducive to effective competition in the UK market and if unchanged will impact adversely investment in the market.

Therefore the pro-competitive principles of the EU Framework that have delivered competitive services over fixed infrastructure in the UK need to be extended to converging/competing platforms including the mobile markets and PayTV.

Finally any new legislation on Net Neutrality needs to be light touch and flexible if it is not to undermine innovation and competition in the infrastructure.

The UK should therefore seek to encourage review at EU level of the regulations that apply to fixed and mobile access markets to recognise the complementarity of these access methods in delivering services to end users. Regulations that favour ownership of one form of access over another e.g., by allowing differential wholesale access requirements based on access technology are not conducive to effective service delivery in a converged market, and are distorting investment in favour of existing mobile architectures.

In terms of regulation, in due course Government may wish to amend the wording in the 2003 Communications Act (specifically Part 4 (a) of Section 3) and the Wireless Telegraphy Act 2006 (Section 7) to no longer be prescriptive about the delivery mechanism for public sector television services.

Q32 Should Government seek changes to the European Framework which put more reliance on competition law and how might this be done?

If Government is serious about ubiquitous enhanced infrastructure investment then it should align State Aid rules with the communications regulatory framework. The latter recognises that to incentivise operators to invest in next generation infrastructure, you have to achieve a balance between access requirements and the investment incentive. If access obligations are too stringent, the incentive to invest is lost. By contrast, the State Aid rules as currently applied by the European Commission require unrestricted and unconditional access to subsidised infrastructure, in particular in cities, and this removes the investment incentive. This explains why there are still many inner city areas where there is no superfast broadband. This in turn has an impact on the competitiveness of local business, on jobs and on quality of life.

Q33 In what ways can you see competition driving technological change in the UK in the future?

Competition is the most powerful driver of innovation and it has proven very successful in driving technological change, investment and consumer and economic benefits in the UK market, particularly for the fixed network user, but it must be fair,

focused on the right parts of the value chain and in some cases, married with appropriate state intervention where competition alone is unable to address market failure

The Service level competition model enshrined in the UK fixed market and the undertakings has delivered arguably the most competitive broadband network in the world with prices amongst the lowest in the developed world and significant economic benefits. The infrastructure competition approach followed on the mobile sector however is proving increasingly problematic and restrictive to innovation and new investment. If this model is continued the UK risks creating a series of monopolistic and incompatible networks that will waste investment and not deliver efficient coverage, particularly when judged against a UK geographic coverage measure rather than the simpler to achieve premise measures

Competition has significant potential to drive technological change and its associated infrastructure investment in the UK over these timescales, however, to maximise the benefits of these changes and investment the Policy and Regulatory environment will need to be designed to encourage these developments. The scenario we describe in this response is based on our view of where the market for ICT infrastructure could lead to if the regulatory and completion rules allow effective investment and competition to occur. This is not a foregone conclusion, however, and the investment in and development of greater coverage and capacity in access networks, particularly in the mobile/wireless access networks will be heavily dependent upon the type of competition that is allowed to develop. A continued distinction between service level completion over a single regulated fixed network, but with infrastructure competition in the mobile network with no effective access to mobile access assets for competing converged service development will significantly hamper this development.

Competition alone, will not address the sometimes challenging economics of these networks. As a case in point the EU rules on State Aid have an implicit assumption that infrastructure deployment in cities will always be commercially viable, even though the costs of fibre deployment in cities can be very high in certain locations. It is therefore important to ensure that a flexible approach that is driven by competition but that can be supported by appropriate State Aid with relevant and appropriate restrictions and conditions on the use of that aid can deliver new technical solutions that can be deployed in some of the most challenging UK not-spots

Q34 How can the regulatory framework keep up to date with new business models and changes in technology?

We have set out elsewhere in this response our views on the key changes that are needed to ensure both policy and regulatory frameworks, both in the UK and at EU level, can be brought up to date to the new converged business models and changes in technology. In particular we would stress the importance of consistent regulatory approach and remedies applied across all bottleneck resources in the converged market i.e. taking the lessons learned from regulation of fixed market bottlenecks and applying them consistently and fairly across mobile (including spectrum) and content bottlenecks. It is also important that the unique position of the UK regulatory

model in fixed access, with functional separation resulting in equivalence of input access points at multiple stages of the value chain, that has driven the very competitive market in the UK can continue as EU level changes evolve.

The significant investments being made in new ICT infrastructure in the UK, by BT and others is long term and not without risk. This needs to be reflected in the regulatory environment with a longer term strategic approach to regulations that removes uncertainty and risk from these long term investments. For example by ensuring that market review periods better match the long term investment returns and the resultant uncertainty over future price regulation from short review periods is reduced. The long term infrastructure investment currently being made and future enhancements and improvements to them will be critically dependent on the returns that can be achieved from this new infrastructure. Therefore an overly aggressive regulatory focus that reduces infrastructure return will adversely impact the appetite for future investment that is likely to be needed if the ever increasing expectations of service level and service availability are to be met commercially.

In addition to these general principles historic regulatory issues such as appropriate amendments to life line requirements should be considered and enacted in the light of the move to all-IP and DECT phones and voice delivery via IP. A requirement for battery back-up on these services, especially when it impacts only part of the converged market, imposes significant costs on development plans and is arguably outpaced by technology developments and no longer required.

Q35 Are there any changes to legislation other than the Communications Act that would incentivise the provision of communications infrastructure?

Changes to legislation to enable legitimate NGA network investors to access physical infrastructure from communications and other infrastructure providers such as that already offered by BT through its PIA products, as envisaged by the EU Directive on network cost reduction²⁴, are potentially valuable. Although BT infrastructure covers large parts of the UK and thus access to passive infrastructure is already widely available to UK NGA investors it is not universal and there are areas of the UK where infrastructure access in addition to that provided by BT could be beneficial in reducing NGA deployment costs. Extending PIA type obligations to other infrastructure providers in addition to BT therefore has the potential to assist with addressing NGA coverage in “white areas” by enabling the effective re-use of existing assets as envisaged by the EU NGA State aid guidelines.

The long planned review of the communications code also has potential to reduce cost of deployment through easier planning, access and streetworks protocols etc. thus encouraging and enabling investment and we would urge government to complete this review and implement the required legislative changes.

We would also draw attention to our answer on potential State Aid changes in Question 23 and 24 in delivering potential benefits in UK cities.

²⁴ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014L0061>

In addition to the views above on potentially beneficial legislative changes we would also draw attention the issues we raise in section 1.3 of this response on potentially negative policy/legislative changes that would serve to compromise, reduce or eliminate the benefits of the current UK ICT market.

Q36 Would there be benefits to investment from a focus on broadband only services? Are there any barriers to the emergence and adoption of broadband only services, whilst still providing necessary access to emergency services?

The term “broadband only” in this question is we believe potentially misleading. In our scenario above we have highlighted that the ICT market and ICT infrastructure investment is progressing rapidly to a focus on IP only services (i.e. not specifically broadband, as many of the services such as IoT monitoring and information exchange, VoIP etc. are not “broadband” per se as they require relatively low bandwidths but they are or are rapidly becoming all IP). As a result we believe there are benefits to investment from a focus on IP only services, and how a resulting IP only network can be most cost effectively delivered.

In particular, as all voice services, including formal PSTN and emergency call support moves to an IP voice delivered service, as it increasingly will in these timescales, based on our scenario above, the ability of exchange copper based services and interfaces such as exchange based ADSL broadband, LLU and WLR to meet basic customer demand may be limited. It is impossible to predict how quickly base service demand will move to a point at which all customers are most economically served via fibre based IP delivery networks carrying voice and data as over the top IP services but it is possible such a point could be passed in these timescales for many areas of the UK. As a result although the copper in the final drop into homes and premises is expected to be more than capable of delivering the bandwidths required by the majority of consumers in conjunction with ever deeper fibre deployment to the cabinet and beyond such that “copper switch off” is highly unlikely in these timescales, services that rely on copper deeper into the network to the exchange level may become incapable of meeting the level of service required at an economic cost and thus risk becoming a drag on future investment and technical innovation.

There is therefore a potential risk that the emergence and adoption of this IP only network (as opposed to a broadband only one) may thus be dependent on the speed at which broadband demand for the majority of users rises to a level that is unsustainable over an ADSL/Copper access and the extent to which regulation and competition policy insist on the maintenance of these legacy services beyond the point that it remains economic to do so.

Section 5 – Facilitating and Encouraging Investment

Q37 How might copper access networks evolve over time alongside other access technologies? Is there a role for policymakers in helping manage any transition from copper to other access networks?

It is important to consider the evolution of the “E side” and “D side” copper access networks separately over these timescales as their transition path could be very different assuming this is driven by economics and efficiency rather than being driven by regulatory or policy positions. We have therefore provided below an overview of E side and D side copper evolution and access technologies, along with our views on the role of Policymakers in assisting this transition.

The D side of the copper network is low cost, efficient, reliable and very costly to replace. As a result technological advances that enable it to meet and exceed the peak bandwidth requirements expected to be placed on it by households and end users in general, whilst avoiding its actual replacement will be economically efficient. With forecast peak bandwidths for many household currently set to stay well within current FTTC type speeds out to 2025 and beyond for the vast majority of end users a wholesale replacement of D side copper does not make economic sense. This is even more apparent when the potential for faster and more reliable bandwidths over copper are still being realised and deployed cost effectively through such technologies as vectoring, G. Fast etc. and this commercial investment in further copper improvements is set to continue.

The E side copper network however is at a different level of development. With plans firmly in place to get the UK to over 90% fibre availability within 3 years and potentially 99% soon after the, coupled with the expected migration to IP Voice networks it is unclear how long a copper/ADSL based access can continue to meet customer expectations. Thus the economic justification for running a fibre and copper E side network is likely to be dependent on the speed at which the majority of the market moves to a service requirement that cannot be effectively met by ADSL/Copper type speeds. It is therefore possible, although unclear that the market could thus reach such a tipping point within the timescales of this strategy.

If copper in the E side is unable to meet the service demands of the vast majority of customers then it will be necessary to ensure that the policy and regulatory environment allows for this and it does not risk becoming a cost burden on network investment. This would require clear and effective policy support at UK and wider EU level to ensure unnecessary costs are avoided and the savings of a fibre E side could be fully realised to support and enable continued IP network investment if the market demand requires it.

Q38 Views are sought on whether there are any additional actions the Government should consider to ensure:

- a) That the provision of all areas of the UK’s digital communications infrastructure remains competitive in order to ensure that the UK can take full advantage of growth opportunities in the Digital Age;**

Competition on digital communications infrastructure particularly at the service level of common infrastructures, is critical to ensuring the UK can take full advantage of growth opportunities in this space and is an area we have covered in some depth elsewhere in this report,, both in our vision of the future and calls for consistent regulation and equivalent access across the converged sectors of fixed mobile and content and specifically in our responses on competition questions elsewhere in this response.

b) Aside from legislation and adapting the regulatory framework in the broad sense which other actions should the Government take to encourage investment in communications infrastructure?

The Government is already taking significant action to ensure the deployment of a suitable communications infrastructure at both fixed and mobile level although there are areas where the regulation and policy can be further developed to improve this situation and which we have covered elsewhere. It is important however that the network infrastructure that is created by both private and government investment is fully utilised by UK consumers and businesses to deliver economic and societal benefits. Commercial investors in the network will of course promote the take-up and use of these networks as far as they can, but this is an area where government and government policy more generally can assist e.g. in ensuring that consumers and business have the skills and the knowledge to understand and exploit the benefits such an infrastructure is capable of delivering, ensuring that government on line services are the “go to” method of interaction for the vast majority, and ensuring that consumers are aware of and encouraged to take up these new faster services etc.

c) That potential investment in the provision of digital communications infrastructure offers a suitable risk and reward profile to ensure that they can be financed by the private sector

Investment by the private sector in digital communications infrastructure is, like any business investment, a risk/reward calculation. The new infrastructures now being deployed tend to have much longer pay back periods than has been normal in these sectors however which increases the investment risk and uncertainty of future revenues. Government should therefore seek to ensure they reduce other risks that impact the case, including risks impacting the deployment costs, and risks impacting the revenue over time to ensure that the business case for investing is sufficient to attract private funding wherever possible.

Q39 Views are sought on:

a) The case for the UK to invest to gain ‘early mover advantage’;

The UK is already well placed to ensure that is at the forefront of the ICT driven economy. The UK is at or near the top of virtually all comparative measures of ICT readiness and enablement and the current and future contribution of ICT to UK GDP is at the forefront of G20 economies with the UK lead set to grow further. There is therefore a clear case that the UK already has “early mover advantage” in areas such as NGA coverage, use of ICT and ICT applications in the economy etc. It is of course important that this advantage is maintained and built upon and this will require further investment driven by real and effective returns by those who have already invested in getting the UK to its current position. It is important however to

not invest in the wrong area, or where perceived benefits are not based on any justifiable evidence. For example the apparently widely held belief that “gigabits capacity to every home” is a necessary pre-requisite has no basis in fact, no discernible economic benefit and massive cost impacts, as explored in detail in the recent Australian cost benefit analysis²⁵ therefore a “build it and they will come” approach to say FTTP deployment appears to have assign potentially negative “early mover advantage”. Other areas for potential early mover advantage e.g. in effective converged sector regulation, applying common access principles and rules across fixed, mobile and content, could deliver benefits but may be dependent on wider EU level agreement and changes.

b) What areas in particular the UK should aim to see investment;

Investment to ensure that effective access to an IP network and the wider internet across the UK with service levels and speeds necessary to enable economic growth to thrive and continue should remain a priority for the UK. This needs to include both fixed and wireless infrastructure to ensure a robust and reliable capability for all services. This will need to be supported by continued investment in the core networks and content storage and delivery capability to ensure cost effective and robust end to end capability.

c) Are there any actions not covered elsewhere in this report that the government should consider to ensure digital communications infrastructure is in place before it is needed and such that it helps generate need.

As covered in our response to part a) above there are potentially significant risks to government seeking to ensure that infrastructure “is in place before it is needed” as it may never be needed or not in the form or function that was decided at the time of the early intervention. However, intervention from the government to ensure commercial deployments are available across the economy as a whole and at consistent prices and service levels from the full range of commercial service providers has had demonstrable economic benefits in the fixed access sector and could usefully be extended across the ICT market place.

Q40 How can we maximise the current R&D and innovation UK landscape to help take advantage of the opportunities provided by future technologies? What needs to be done by Government and its agencies, and industry to tackle any gaps?

The priority for the UK research & innovation ecosystem remains to capitalise on the academic excellence of its Universities, translating the opportunities into economic benefit to the UK as a whole. This is recognised in initiatives such as the Catapults however significantly more could to be done, in particular:

- a) Reengaging large industry in the innovation process. There has been a clear focus in recent years towards creating & supporting small companies at the expense of large industry. A vibrant start-up culture is an essential component*

²⁵ See Australian Cost benefit study referenced earlier.

& measure of a healthy innovation ecosystem. However opportunities such as the Internet of Things and indeed the UK's future digital communications infrastructure are also dependent on the innovation & investment of large companies such as BT. The strategic objectives placed on InnovateUK and the Catapults should be rebalanced to include large industry.

- b) For strategic UK opportunities, for example IoT, BT believes it is necessary to move towards a more integrated, directed programme approach utilising all the instruments in the UK ecosystem e.g. Research Councils, InnovateUK, HEFCE etc. and Industry. Key to this is that there is clear accountability to ensure that success for all involved is measured on the impact of the programme as a whole and not the individual components.*

Q41 In which future communications technologies do you consider the UK has, or could achieve, an international leadership position?

The UK has a long history of research and innovation in communications technology and in the application of that technology to real world commercial deployments. These innovations range for early work and deployment of monomode fibre technology that is now the “universal” fibre technology for ICT networks across the world to work on blown fibre and other low cost deployment techniques. The UK is also at the forefront of ever faster and more efficient ICT technologies from the latest core fibre Transmission speed records²⁶ to the work on G.fast²⁷ and other technologies that are pushing the capability of hybrid fibre/copper access networks. The UK is also investing in Smart Cities and other IoT applications that could see this universal ICT network at the heart of other technology innovations and applications that have global appeal. The development of standards to enable these IoT applications e.g. through the HyperCat²⁸ consortium is a key area for UK leadership.

Q42 What more might government and industry do to exploit future technologies, associated new applications and emerging business models?

The UK ICT industry operates within the EU regulatory framework. It has consistently shown the benefits of competitive service provision, driven by effective wholesale access to genuine bottleneck resources. As a result it has consistently driven low cost, competitive services that act as benchmarks for other EU major economies. As the various sectors of the ICT market continue to converge, these benefits, largely driven by a focus on fixed access regulation will increasingly be dependent on effective access to bottlenecks across the converged sectors wherever they are. If the UK is to be able exploit future technologies and applications, it will be necessary to ensure that EU regulation supports and enables this converged network model, rather than applying arbitrary and historic differentials.

²⁶ <http://www.btplc.com/Innovation/Innovationnews/Alcatel-Lucent/index.htm>

²⁷ <http://www.btplc.com/Innovation/Innovationnews/gfast/index.htm>

²⁸ <http://www.btplc.com/Innovation/Innovationnews/HyperCat/index.htm>

Q43 What role might local bodies have in facilitating the future delivery of digital communications infrastructure?

The engagement of local bodies in the deployment and use of this infrastructure is key to ensuring rapid take-up and use of the technology as well as integration of local government services delivery with the digital environment. The BDUK model of common national procurement standards and specifications, centralised State Aid clearance combined with local government funding, buy in and engagement has proven successful in delivering effective public private partnerships to deliver the physical infrastructure at local level. This needs to continue through the remainder of any deployment process to ensure that delays and fragmentation in the network standards and accessibility do not occur at the “edges” of the network. This political engagement and local partnership approach also needs to continue and develop to ensure the infrastructure is effectively utilised across local government and the wider local business and resident community.

Q44 How can council's maximise the digital communications infrastructure in their local area to support their work on economic regeneration?

Local Councils need to engage with the next phases of the BDUK infrastructure deployment process to ensure they maximise the coverage and deployment of fibre infrastructure in their area as quickly as possible. They also need to work locally to stimulate take-up and use of the infrastructure that their funding is helping to deploy particularly through engagement with the local business communities, to ensure that the maximum benefit is made of this infrastructure, underpinning the business model for further deployment to all sectors of the community and all parts of their intervention area.

Annex 1 - Current Position of UK Infrastructure

Coverage (Fixed)
99% of premises connected to ADSL enabled BT exchange
95% of premises connected to an LLU ADSL enabled BT exchange
44% of premises able to receive Virgin Media cable broadband
67% of premises passed by BT Openreach fibre network (Q1 2014)
SFBB available to 78% of premises (June 2014)
28% of UK fixed lines provided using LLU
Coverage (Mobile)
99.5% of premises had outdoor 3G coverage
73% of premises had outdoor 4G coverage
Take Up (Fixed Broadband)
household internet take-up at 82%
proportion of adults with broadband (fixed & mobile) at 77%
ADSL broadband at 70% of all fixed connections
SFBB take-up (excludes non corporate) 26.7% of all fixed connections
BT share of SFBB subscribers 35% (Q1 2014). VM has largest ISP market share of SFBB subscribers 56% (Q1 2014)
BT largest provider of fixed residential/SME broadband at 31%
total fixed broadband take-up 73% (Q1 2014)
Speed (Fixed Broadband)
Average actual broadband speed 17.8Mbps (Nov 2013)
Price (Fixed Broadband)
SFBB price premium £5 to £10 a month
real average monthly price of a residential fixed broadband connection (in 2013 prices) £16.96 for average actual speed of 17.8Mbps

Source: Ofcom Communications Market Report 2014 (Aug 2014)

Date is at end of 2013 if not specifically stated.

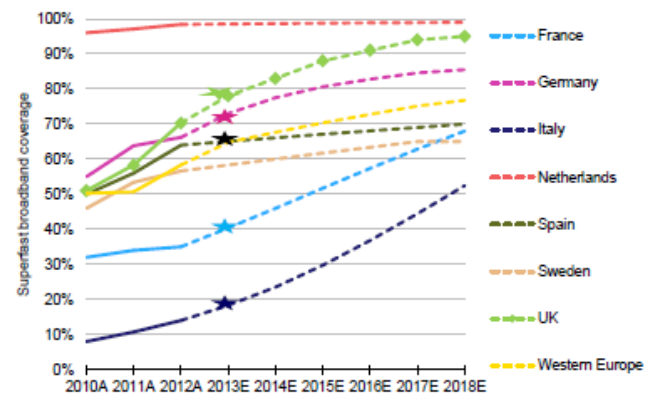
Current Position of UK Infrastructure

UK's position on 2014 Ofcom EU Scorecard

	EU5 ranking	Data
Standard broadband coverage	=1 (=1)	95-100% (95-100%)
Superfast broadband coverage	1 (3)	70-75% (55-60%)
Mobile broadband coverage	=1 (=1)	95-100% (95-100%)
Fixed broadband connections per 100 households	1 (1)	83 (77)
Fixed broadband connections per 100 people	3 (3)	34 (32)
Superfast broadband connections per 100 people	1 (3)	9 (2)
Mobile broadband connections per 100 people	1 (2)	84 (64)

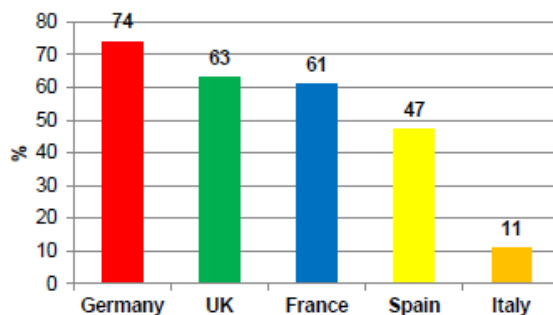
Source: Ofcom EU Scorecard 2014 (2013 in brackets)

Superfast broadband coverage ★ Latest EU/DEA



Source: Analysys Mason 2013

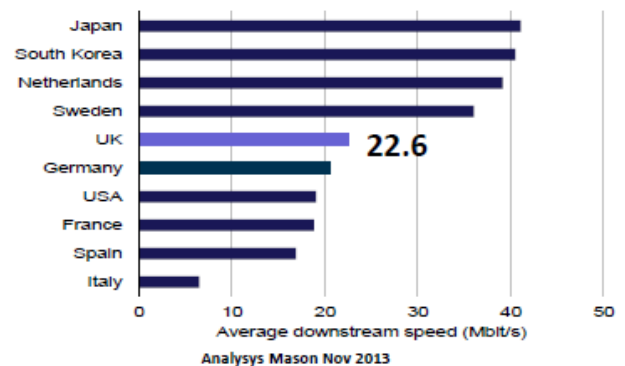
4G coverage 2013



Source: EC Digital Agenda Scoreboard 2014

3G coverage at or above 95% in most EU Member States

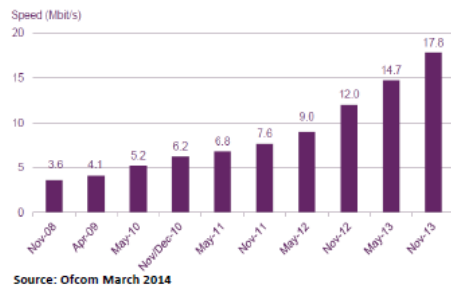
Average speed



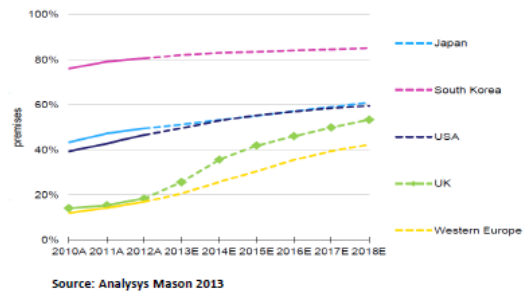
Analysys Mason Nov 2013

Current Position of UK Infrastructure

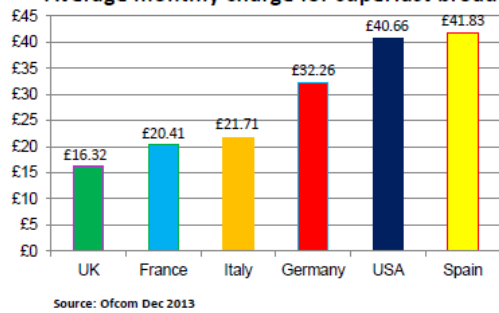
Growth in speed



SFBB take up as a % of all premises



Average monthly charge for superfast broadband



Annex 2 – Overview of BT business broadband services

BT offers a range of internet connection services for businesses at various price points and service levels. In overview however these products break down into 3 broad categories for business connectivity as follows:-

1. Standard and NGA broadband connections:

These utilise the same infrastructure and underlying product set from openreach as our residential broadband service i.e. they are either standard ADSL copper broadband or fibre and VDSL based NGA product delivered using existing broadband technologies, ADSL, fibre to the cabinet (FTTC) or fibre to the premise (FTTP) technology. Our NGA access products are by design a shared/contended fibre product (using GPON²⁹ technology) where the fibre transmission capability is split/shared across a range of different customers to increase efficiency and reduce cost of deployment. As a result these business NGA products are essentially the same as the residential broadband services in terms of performance but they come with various levels of business grade support, including faster repair times, dedicated technical help desks and Microsoft office for business software etc. they also offer the option of static IP addresses if businesses are running web servers etc. from their site. These products are sold under the “Infinity for business” brand, and are eligible for government SME connection vouchers. More details of the BT Infinity for business NGA products, features, variations and prices, are included in the attached Table 1.

2. BT Net – Ethernet leased line connections

This is the standard Business connectivity service provided by BT to business users where connectivity is critical to their business. It is fibre based and is available across the UK, subject to connection charges, and the products are available in a range of speeds from 2Mbit/s through to 10 Gigabits/s and all are available as symmetric products with range of service guarantees, resilience options, back-up systems etc. that ensure that critical communications infrastructure is always available for the customer business.

Standard features of BT’s business connectivity products include dedicated/uncontended capacity using Point to point Ethernet technology where a unique dedicated line (fibre, copper or hybrid depending on speed) is used for each customer across the entire network i.e. no shared/split capacity. Thus for each customer/line these services ensure that the connection always runs at the speed offered and is independent of activity of other users on the network, the service offers completely symmetric data rates and unlimited download/upload capability suitable for businesses to transfer large files and data to and from sites and other users across the globe or to and from the public internet, guaranteed 100% availability targets with service credits as well as various options for resilience and back-up systems. In short they are the ideal product for any business that relies on their data connection to do business, as they provide dedicated, guaranteed and consistent data

²⁹ Gigabit over Passive Optical Network (GPON) : http://www.slideshare.net/fullscreen/mansoor_gr8/gpon-fundamentals/1

connections across a whole range of speeds suitable for various business needs. These services are available across the UK but are subject to a connection charge to the nearest fibre access point to the customer's premises. Because of the bespoke nature of these products and the need for dedicated connections to be made to the network prices are provided on application, however UK leased line prices are consistently amongst the lowest in Europe. A comparison between the features of NGA broadband connections and leased lines for business is provided in Table 2 below.

3. Hybrid BT Net systems –

As well as the dedicated point to point fibre leased lines BT business also offer two lower cost variants of leased lines that use existing copper based technologies in the final connection to the customer premises. Ethernet in the First Mile³⁰ (EFM) is a lower-cost version of BT's leased line service. It provides a tough and reliable high-speed business internet connection. But unlike our standard leased line, EFM uses existing copper lines (instead of fibre) to connect to the local BTNet exchange. This means it's cheaper and quicker to install than a standard leased line.

The product is offered at speeds ranging from 2Mbps up to 35Mbps, over multiple pairs of copper lines as required and is offered together with all the benefits of standard BTNet Leased lines such as service guarantees, symmetric capability, resilience etc.

Because EFM uses copper lines that are already in the ground, it typically avoids the need for - sometimes costly – digging and installation of dedicated fibre access links that are part of our standard BTNet fibre products.

As a result, if you are in an EFM area business connectivity grade services are available via EFM but with the following advantages over dedicated fibre access links:

- **Lower cost:** EFM is up to **45% cheaper** than our standard BTnet service
- **Faster installation time:** connections in around **half the time** it takes for other leased lines

Although EFM isn't universally available across the UK yet, we're constantly increasing the areas where it is available.

BT also offers an additional Hybrid variant to EFM based on our openreach NGA access product Generic Ethernet access (GEA). Put simply, in order to ensure that the benefits of our NGA roll out programme are available to as many customers and types of customers as possible we have introduced a new way for us to deliver business connectivity circuits in bandwidths of between 2 and 30Mbps. This GEA leased line uses Fibre to the Cabinet (FTTC) and Fibre to the Premises (FTTP) last-mile infrastructure installed as part of the NGA deployment programme to offer our BTnet leased line services to more people. i.e. it utilises the GPON fibre (and copper in the case of FTTC) in the access network and combines lines together as with EFM to produce the required bandwidth and grade of service that the customer wants and expects from a dedicated business connectivity leased line.

³⁰ http://business.bt.com/assets/pdf/broadband-and-internet/BTnet_LeasedLine_Ethernet_FirstMile_EFM_Customer_Brochure.pdf

In addition to the various retail level business products detailed above BT also offers a range of wholesale fibre products into the market via openreach that enable other retail providers to offer their own competing retail services to businesses utilising the openreach access infrastructure. These are offered on equivalent terms and conditions to all ISPs from openreach and support the highly competitive market that exists in the UK. As a result ISPs can construct direct point to point fibre connectivity from their customer's premises to their own network hand over point including aggregating multiple fibre access connections into higher level backhaul links in manner to suit their business needs and those of their customers.

Ethernet Access Direct (EAD)³¹ offers point to point fibre connectivity at various symmetric speeds up to 1Gbit/s for communication providers to use to connect their customer's buildings directly using fibre or to connect their site to customer buildings, enabling the creation of leased line services for their customers into the ISP network.

Ethernet Backhaul Direct (EBD)³² offers point to point fibre connectivity for communication providers and their customers at speeds above 1Gbit/s up to 10Gbit/s it is a highly efficient, cost effective way of delivering large volumes of data, quickly and securely. It delivers permanently connected, uncontended bandwidth from an Access Serving Node (ASN) to an openreach Handover Point (OHP). It can also be extended from BT exchanges to nearby ISP handover points if required using the Bulk Transport Link product.

Bulk Transport Link (BTL)³³ is a high capacity, resilient solution that works with Ethernet Backhaul Direct (EBD) in order to efficiently transport multiple 1Gbit/s services from an openreach Handover Point (OHP) to a communications provider network site, where the site is not located in a BT Local Exchange.

³¹

<https://www.openreach.co.uk/orpg/home/products/ethernetservices/ethernetaccessdirect/ead/downloads/eadfactsheet.pdf>

³²

<https://www.openreach.co.uk/orpg/home/products/ethernetservices/ethernetbackhauldirect/downloads/ebdfactsheet.pdf>

³³

<https://www.openreach.co.uk/orpg/home/products/ethernetservices/bulktransportlink/bulktransportlink/downloads/btlfactsheet.pdf>

Table 1 – Features of BT Infinity for business product options.

Feature	Standard infinity	Infinity Unlimited	Premium
Download speed	Up to 38Mbps	Up to 38Mbps	Up to 76 Mbps
Upload speed	Up to 9.5mbs	Up to 9.5mbs	Up to 19 Mbps
Usage	50Gbytes	unlimited	Unlimited
Connection cost	Inclusive	Inclusive	Inclusive
Wi-Fi	FREE unlimited access to over 5 million UK hotspots	FREE unlimited access to over 5 million UK hotspots	FREE unlimited access to over 5 million UK hotspots
Payment	Direct Debit	Direct Debit	Direct Debit
Support	Standard care.	Prompt Care. We aim to fix any faults by the end of the next working day	Prompt Care. We aim to fix any faults by the end of the next working day
Business Hub	Hub 5 included (£8 postage charge)	Hub 5 included (£8 postage charge)	Hub 5 included (£8 postage charge)
Microsoft Office 365	-	1 licence for Microsoft Office 365 Small Business included	1 licence for Microsoft Office 365 Small Business included
Extra IT support	-	-	1 licence for BT Tech Heads included
Email	10 addresses	10 addresses	10 addresses
Webspace	50 MB	50 MB	50 MB
Installation	We take care of everything	We take care of everything	We take care of everything
Throughput	You'll always get at least 80% of the maximum possible speed your line can give	You'll always get at least 80% of the maximum possible speed your line can give	You'll always get at least 80% of the maximum possible speed your line can give
Static IP address (e.g. for secure VPN or running web site server over the connection)	Available as an option	Available as an option	Available as an option
Price	£25 per month	£32 per month	£40 per month
Excess charges	If you go over your monthly data limit there are extra charges	None	None

Table 2 - How does a leased line compare to broadband?

	<i>BT Business Broadband Standard</i>	<i>BT Infinity for business Superfast fibre optic</i>	<i>Leased Lines including "Hybrid" options</i>
Maximum upload speed	Up to 1Mbps	Up to 19Mbps	Choice of 2Mbps to 10Gbps
Maximum download speed	Up to 17Mbps	Up to 76Mbps	Choice of 2Mbps to 10Gbps
<p><i>Shared:</i> Customers share the lines that connect them to the exchange. So when everyone uses the internet at the same time, speeds can slow down as the lines become congested.</p> <p><i>Dedicated:</i> You have your own line connecting you to the exchange so you always get the same speed.</p>	Shared (contended)	Shared (contended)	Dedicated (uncontended)
<p><i>Symmetrical:</i> Download and upload speeds are the same.</p> <p><i>Asymmetrical:</i> Download speed is greater than upload speed.</p>	Asymmetrical	Asymmetrical	Symmetrical
Usage limits	10GB or Unlimited	100GB or Unlimited	Unlimited
<p><i>Resilience options</i></p> <p>Each option provides varying levels of diversity and resilience to suit what you need your internet connection for.</p>	Not included	Not included	Backup, failover, loadbalancing
Service level agreement	Not included	Not included	Included
Connection availability target	Not offered	Not offered	100%

