Response to DCMS consultation:

Digital Communications Infrastructure Strategy

October 2014

About Arqiva

Arqiva is a communications infrastructure and media services company, operating at the heart of the broadcast, satellite and mobile communications markets. Arqiva provides much of the infrastructure behind television, radio and wireless communications in the UK.

The company supports cellular, wireless broadband, video, voice and data solutions for public and private sector customers.

Arqiva is a founder member and shareholder of Freeview. Freeview is the largest TV platform in the UK delivering 50 digital TV channels and 24 radio stations free to the UK public covering 98.5% of UK households with the public service channels and around 90% of households with commercial services. Arqiva owns and operates the networks for all six of the established Freeview multiplexes and more recently has rolled out a further Freeview multiplex (making seven in total) to deliver additional high definition programmes on the platform for the BBC, C4 and other channels. Of these seven multiplexes, Arqiva holds the broadcast licences for three of them providing access to the Digital Terrestrial Television (DTT) platform for Broadcasters and content providers.

Arqiva is also a shareholder in Digital UK which is responsible for co-ordinating the DTT platform's technical developments. We own Connect TV, the first company to launch a live IP streaming channel on Freeview. Arqiva was also a key launch technology partner for Freesat and is the licensed operator of Digital One – the national commercial DAB digital radio multiplex.

We are building and running a national Internet of Things (IoT) network, starting with 10 of the UK's largest cities. In addition our smart metering communications service will connect 10 million homes using long-range radio technology, and will be one of the UK's largest machine-to-machine deployments.

Arqiva operates shared radio sites throughout the UK and Ireland including masts, towers and rooftops from under 30 to over 300 metres tall as well as a number of international satellite teleports. In Arqiva WiFi we own one of the UK's largest WiFi hotspot providers that enables us to build a unique proposition for WiFi hotspot and outdoor WiFi provision in the UK.

Our major customers include the BBC, ITV, Channel 4, Five, BSkyB, Classic FM, the four UK mobile operators, the emergency services as well as Airwave and the RNLI.

Arqiva is owned by a consortium of long-term investors and has its headquarters in Hampshire, with major UK offices in London, Buckinghamshire and Yorkshire.

Arqiva's Business

TV and Radio

"**Market leader** in terrestrial TV and radio broadcast infrastructure"

Satellite

"**Market leader** in UK channels uplinked"

Telecoms and WiFi

"Own **largest independent** portfolio of WiFi/wireless sites"

Smart Metering and M2M

"Building a smart network for **10m homes** and a **national IoT network**"

BBC

Executive Summary

Despite the proliferation of media services clamouring for consumers' attention, average daily viewing of linear audiovisual content has held up well, and is likely to continue to do so. Catch-Up TV, far from hastening the demise of broadcast, is actually reinforcing it. High profile failures of "Over-The-Top" services also reinforces the position of broadcast at the heart of an increasingly hybrid viewing experience.

Freeview's role, as the universally available subscription-free content platform, isn't challenged by broadband, which is neither universal nor free.

Superfast broadband is being pushed out to 95% by 2017, but with only half of the population having a choice of provider. Average broadband speeds continue to increase, and the disparity of provision between rural and urban/suburban consumers has shrunk. This is all good news, but there is no costed plan to drive availability closer to 100%, and many consumers who could take fixed broadband (of any speed) still don't.

The UK mobile networks are highly competitive, with consumers benefiting from a wide range of subsidised access devices and some of the cheapest data tariffs. LTE/4G should be available to 98% of the population by 2017. But WiFi's role as a reliable high speed alternative is undiminshed by the arrival of 4G mobile.

For the UK to establish itself as a Leading Digital Nation requires connectivity being available to substantially every home and business, but there also needs to be considerable improvements to mobile and WiFi access on public transport and major roads. That won't happen without public intervention, whether in respect of subsidising rural connectivity, or incentivising the provision of greater connectivity on public transport (including the award of new rail franchises, on London Underground, and new rail lines such as Crossrail and HS2).

In addition to traditional "consumer-to-consumer" communications infrastructure, there will be an explosion in "machine-to-machine" communications, commonly called the Internet of Things. Even at this early stage, it is clear that the potential applications are endless, some with clear end user benefits, others with industry benefits, some with both. Government has a clear role to co-ordinate the many IOT activities across the public sector, and to promote open data with standard protocols, for third party developers to mine for data on public transport, air quality, available parking etc.

But the nascent nature of IOT suggests that there is no need at the moment for government or regulators to seek to pick winners or to establish standards on interoperability, encryption etc.

Introduction

Q1 Views are sought on:
a) Is this an appropriate role for Government?
b) What other high level principles the Government might adopt?
c) What resources do you consider the Government should aim to deploy to effectively manage its role?

The Government has clear roles to:

- encourage industry to innovate and invest, with a stable and supportive regulatory framework;
- drive connectivity to assure the UK's place as a leading digital nation, investing public funds to address market failures and providing incentives to increase connectivity on public transport and on major roads.

The establishment of the Digital Economy Unit and the Digital Task Force is welcomed, as these will build on the long-standing support for the tech sector.

In the rapidly growing Internet-of-Things markets, and in particular Smart Cities, the Government can play a role in ensuring that the UK is a leader (see Q27 below).

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?

By 2017 public sector investment is expected to have driven access to superfast broadband to 95% and at least Telefonica (although, in reality, most of the mobile operators) will have made LTE ("4G") available to 98% of the population. Achieving that will have transformed UK connectivity, especially in rural areas.

However that will still leave over a million consumers without access to reliable broadband.

The conclusions of the 2009 Study by OECD, that a 10% increase in broadband penetration results in 1% increase in the rate of growth of GDP, is well known. With some 30% of SMEs being in rural areas, wider availability of reliable, fast enough broadband will help those businesses stay and thrive, and new businesses be established - addressing rural drift, giving each year's rural school leavers more reason to stay. Driving up broadband adoption is a key element of increasing the efficiency with which public services are provided.

But this is also an instrument of real social change:

- Improving the life chances for the unemployed
- Widening access to online educational materials and resources, raising children's grades and life chances
- Enabling the financially-disadvantaged and less knowledgeable, or media literate, to pay the same discounted prices for commercial products and services as everyone else.

Economic and social benefits are maximised if broadband, from at least one network infrastructure, is universally available and it is adopted by substantially everyone for whom it is practical to do so.

This is recognised in the target of the EU Digital Agenda 2020 that nearly all households should have access to speeds of at least 30Mbit/s by 2020.

There is an ever-greater social and economic cost to each person who falls, or is left behind on the wrong side of this 'digital divide'. Being able to connect has become an increasingly important public policy issue that requires government intervention (consistent with State Aid rules) to build upon what the current BDUK[1] (including MIP[2]) programme should achieve.

Yet achieving universal access at home isn't currently costed, nor is there agreement as to which technologies may be used to achieve it. Arqiva believes that the Solution Hierarchy is to offer consumers:

- fixed superfast where it makes sense;
- wireless (e.g. LTE, perhaps with consumers using a directional antennas) for those who cannot economically be offered fixed technologies;
- satellite for the most remote and rural areas.

This would necessarily mean that there would be a permanent disparity of provision of broadband, with hundreds of thousands of rural consumers and businesses unable to obtain the broadband speeds available in urban areas (especially those marketed to by Virgin Media). Yet so long as consumers could stream HD content from Catch-Up TV services or Netflix without buffering, even in evening peaks, then it isn't obvious that the public investment to offer fibre to every consumer in the UK could be justified – especially in these times.

[1] Broadband Delivery UK, part of DCMS.
[2] The Mobile Infrastructure Project.

In respect of disparity of provision, it's worth noting that:

> *Ofcom's analysis[3] suggests, however, that in the six months to May 2014, rural customers experienced a bigger increase in average broadband speeds (up by 20% to 13.6Mbit/s) than people in urban and suburban areas (up by 5% to 33.4Mbit/s and 22.9Mbit/s respectively).*

Disparity of provision isn't simply a rural issue. Coverage expectations increasingly aren't confined just to where people live. Consumers are demanding connectivity where they work and study, and on the trains and roads (with connected cars about to hit the public consciousness, increasing dissatisfaction with patchy mobile coverage on even major roads) in between.

This will require considerable investment in supporting infrastructure with far easier and quicker means of access to public land (e.g. Network Rail and London Underground), street furniture and buildings than is the case now.

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?

The truth is that no-one knows how symmetrical data demand is going to become. Uplink demand is rising, but so is downlink demand. While we see user generated content picking up (e.g. Facebook, YouTube, Go-Pro, Twitch), it is very difficult to imagine a scenario where users on average produce (upload) more data than they consume (download). Even with a lot of user generated content, this usually gets uploaded once to the cloud and then viewed (multiple times) by multiple other users, contributing to the asymmetric traffic.

Most IOT devices are likely to have highly asymmetrical data demand, which will be mostly data capture (e.g. GPS location or flags for "I'm full, empty me" or "I'm empty, re-fill me") rather than control.

What is clear is that no service has emerged yet which needs fibre, the ideal infrastructure to meet more symmetrical data consumption, and if it does who knows how symmetrical the resulting data usage will be? A sensible planning assumption would be that, for the foreseeable future, asymmetry will be the norm.

Currently mobile networks deploy paired spectrum (i.e. symmetric spectrum allocation) to meet asymmetrical data demand, resulting in half of that spectrum being relatively lightly used. On the face of it this isn't particularly spectrally efficient and, unless data demand met by mobile (as opposed to WiFi) networks is expected to become more symmetrical, there is an argument that greater use should be made

[3] Ofcom's eleventh report into broadband speeds, published 03 October 2014.

of unpaired spectrum for TDD[4] networks and/or the introduction of Supplemental Downlinks, something being considered for L-Band[5] and for 700MHz (duplex gap), should Freeview be required to vacate that spectrum for re-use by mobile.

Section 3 – Scenarios

Long-term forecasting is an inherently risky business, and in the TMT sector looking 10-15 years out is an eternity. With this consultation, industry views are being sought on only a few scenarios which appear principally to have been arrived at as a result of assumptions made about 2 market trends:

1. Near-universal *take-up* of superfast broadband, with resulting inevitability of IPTV substitution for broadcast TV;
2. Growth in data demand from mobile devices, which will be met by *mobile* networks.

For both of the above trends there has been a series of high-profile forecasts from equipment vendors and deployers of fibre which have attracted considerable media attention and, we believe, has attracted undue political support.

This is currently most evident in widespread political support for the early introduction of 5G, whose cause is championed by equipment vendors and other companies hoping to inject Intellectual Property into the patent pool. Yet it is far from clear which applications couldn't be met by upgrades to LTE, largely using spectrum already held by the mobile operators – plus consumers don't want to pay any more. Revolution takes time, plus capex, and may require re-arranging spectrum (requiring time, investment, and causing disruption). Yet received wisdom is that 5G is needed by 2020.

Yet those purveyors of a medium-term vision where a combination of fibre and mobile networks satisfy virtually all digital communications demand tend to ignore available consumer time (notwithstanding that younger demographics often do 2 or 3 things at the same time); the impact of retail pricing policies on data demand; digital exclusion (resulting from lack of connectivity, cost, or skills); the cost and time required to achieve ubiquitous connectivity; social habits, and plain old inertia.

Additionally, for meeting mobile data demand, investment in infrastructure and technology upgrades will also play a part alongside more 3GPP (IMT) and WiFi spectrum. More 3GPP spectrum – in particular, ever more *paired* spectrum – cannot be the only answer.

[4] Time Division Duplex, which offers flexibility in allocating the spectrum between uplink and downlink.
[5] 1452-1492MHz, in the UK this spectrum is currently owned by Qualcomm.

In summary we would urge government to be sceptical of forecasts showing rapid change in consumer consumption habits, which may appear to call into question the longevity of Digital Terrestrial Television ("Freeview"), specifically its right to occupy spectrum.

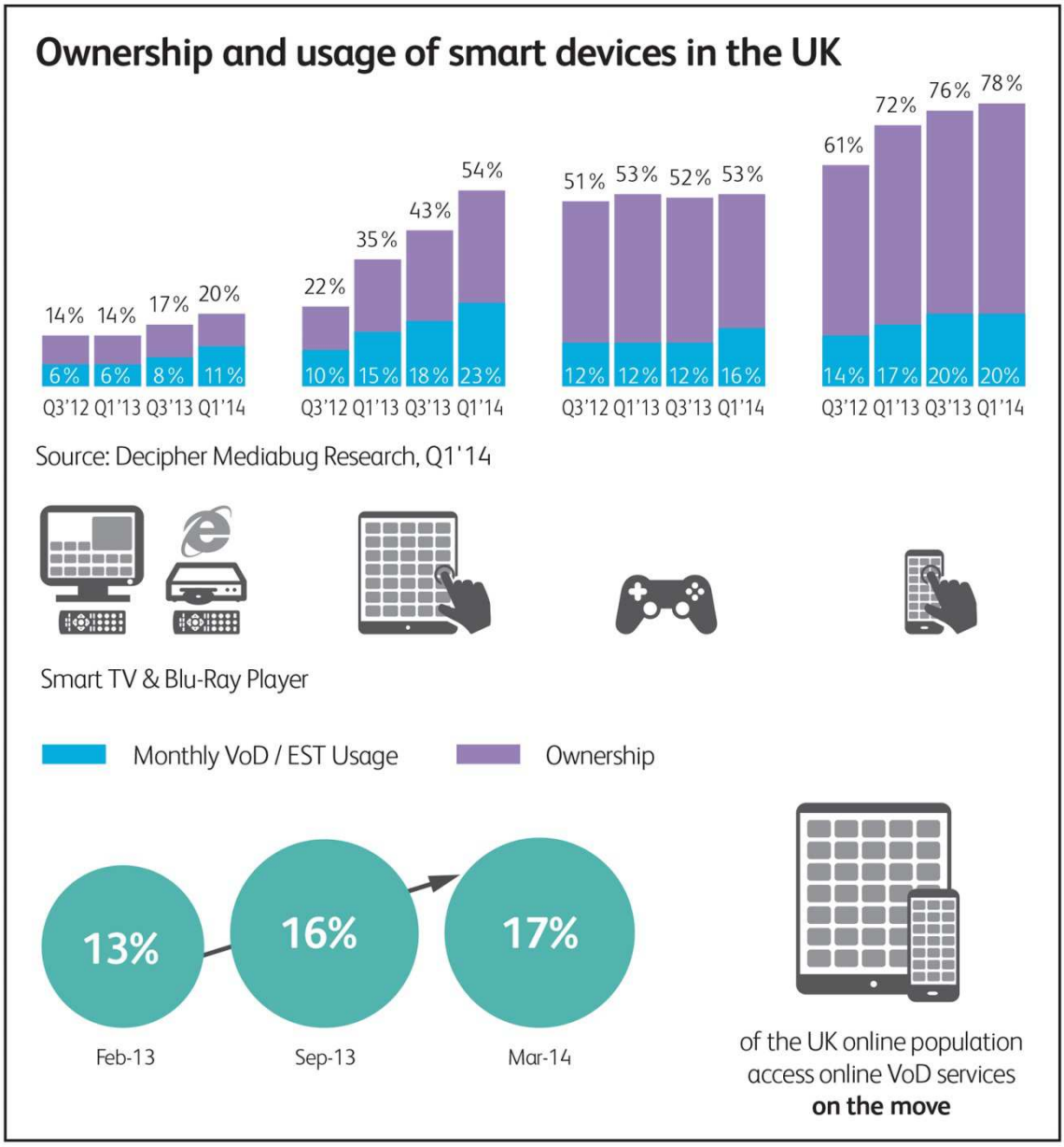
Government policy formulation needs to be guided by the fact that consumers tend to be slower to adopt new technology than vendors anticipate. For example, despite their considerable added value to consumers, it has taken 14 years for the penetration of Personal Video Recorders to reach some 60% of homes, and most viewing in PVR households is still live and many advertisements also still watched live.

If the future really is one in which virtually all consumption of long-form audio-visual content is on demand delivered by an IP network; where consumers have selected their viewing based on a combination of searches of metadata and recommendations based on search and viewing history; with targeted advertising based on those histories; then we would suggest that that future for most consumers probably won't have arrived by 2025, or maybe even 2030.

Rather than commenting on each of the offered scenarios in turn, resulting in considerable repetition, we comment below on trends in each major digital communications infrastructure market in turn.

Television

The vast majority of households subscribe to broadband; more than a quarter of homes contain 4 screens (TV, computer, smartphone and tablet) capable of showing "television"[6]; some 60% of homes contain a PVR; and "Smart TV" screens are now in almost a fifth of homes.



And yet over the 3 years 2011 – 13 average daily linear viewing remained robust at around 242 minutes[7]; this varies by age group but the overall story remains strong.

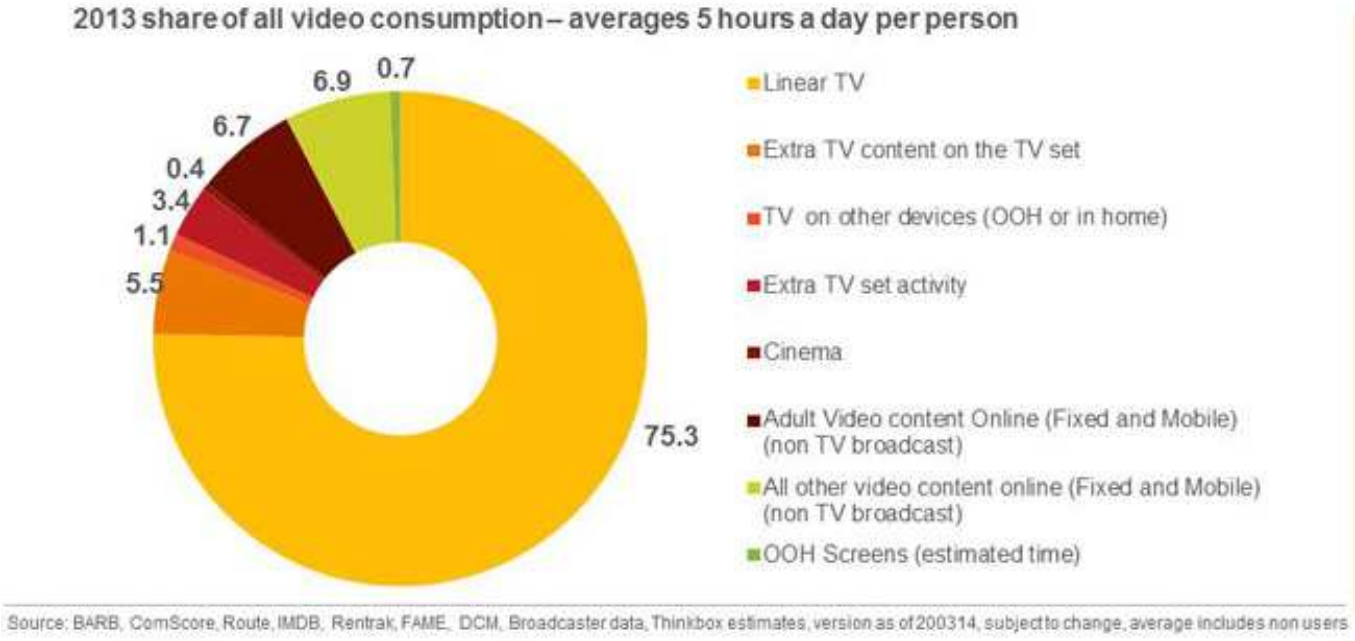
[6] Source: Kantar Media, futurePROOF, 2013.
[7] Source: BARB.

Even more astonishing, Ofcom report[8] that on average some 74% of viewing remains live, with a further 17% recorded from broadcast and played back (usually fairly promptly) from a Personal Video Recorder (PVR) or DVD recorder/VHS.

Ofcom also state:

> *In the absence of a single source for measuring viewing across devices and services, 3 Reasons' estimates show that the majority of all viewing across all devices was to live broadcast programming (86%) in 2013.*

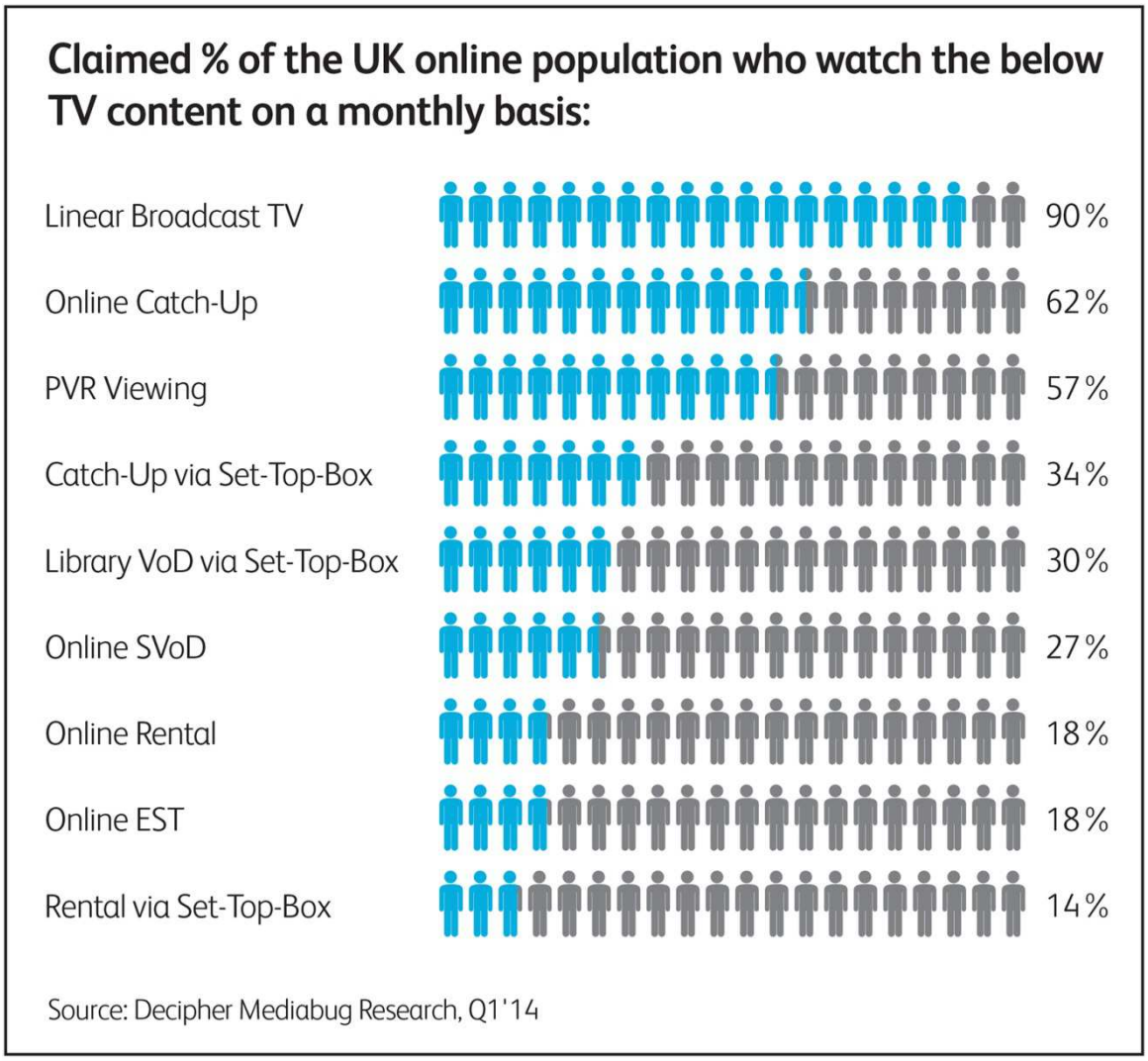
Thinkbox estimate that UK adult average video consumption across all screens (including out-of-home screens) was 5 hours per day in 2013:



Consumers spend about the same amount of time watching content on physical media as they do watching Catch-Up TV (about 5% of total viewing time, each)[9]. True Video On Demand, whether paid for services (e.g. Netflix) or watching short online video clips, comprises the remaining 5% of viewing.

If US VOD consumption, where Netflix dominates the video streaming market in terms of time spent with the service, is an indicator of future UK trends, it is worth noting that reported average consumption by 18-24 year olds (the most prolific users of web video) is just 21 minutes per day, usage by 25-34 year olds is under 19 minutes per day, and by 35-49 year olds just 15 minutes per day[10].

[8] Source: Ofcom, The Communications Market 2014.
[9] Source: Ofcom, The Communications Market 2014.
[10] Source: Nielsen data for Q1 2014.



Despite the rapid rise of internet advertising, in 2013 TV's proportion of total advertising spend was only slightly less than it had been in 2008, and spend on content by all UK TV channels rose by 3.7%[11]. That matters beyond linear TV because the majority of long-form audiovisual content viewed online has been commissioned by, and first shown (and therefore it complies with prevailing broadcast regulations), on broadcast TV. And broadcast TV channels provide the public with the news that they trust the most.

If the revolution is to be televised, it will be watched live over a broadcast network.

This isn't just inertia, or familiarity and social norms fading slowly. Brands also matter – and major broadcasters often have the kind of brand value which disruptive new entrants would kill to have.

[11] Source: Ofcom, The Communications Market 2014.

Since its launch in 2002, Freeview has gone from strength to strength. Currently 40% of UK households have DTT as their sole television platform. Irrespective of which distribution platform serves content to the main display, Freeview dominates secondary viewing in bedrooms and kitchens - and that secondary viewing amounts to about 14% of total viewing[12]. Freeview, like analogue TV before it, reaches 98.5% of households and is free at the point of consumption.

Freeview has become more spectrally efficient over time. Terrestrial TV has always shared spectrum, with its "white spaces" available for re-use by PMSE[13], and this continues with the transition to digital. In addition, with the introduction of statistical multiplexing, and continuing investment in improved coding, the number of SD services per multiplex has doubled since Freeview's launch and, with the upgrading of one multiplex to the DVB-T2 transmission standard, the platform now offers 5 HDTV services.

Looking to the future, we expect demand for HDTV to continue to grow. Last year Arqiva launched the first of 2 new DVB-T2 multiplexes, which are currently carrying 6 HD services and 3 SD services.

Last year Arqiva also launched Connect TV, a service which offers broadcasters the ability to deliver their services by broadband and have them listed alongside broadcast-delivered services in the Electronic Programme Guide, removing any requirement on consumers to consciously toggle delivery platforms as they decide what to watch. Connect TV has extended the range of services available to consumers who have connected displays, the additional services consisting of:

- sister channels to a channel already on Freeview;
- channels already available on satellite from broadcasters not on Freeview; and
- channels which aren't carried on a linear distribution platform.

This hybrid TV world, still nascent despite millions of "Connected TVs" having been sold (if not necessarily connected to the internet), points the way to the future of TV; a future where choice isn't limited by spectrum-related capacity constraints.

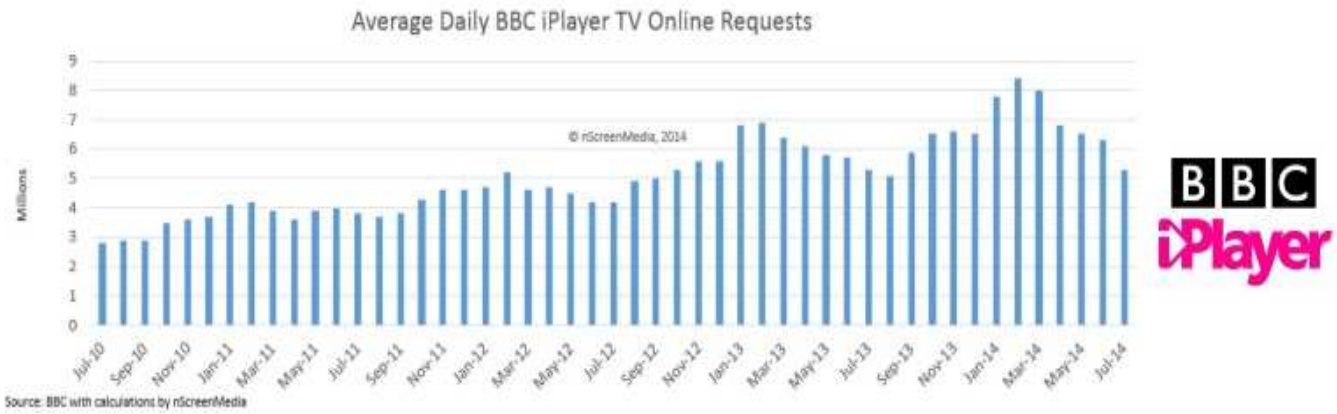
In theory broadcast schedules also cease to be a constraint on which content may be viewed, but familiarity and broadcast brands far stronger than online brands will maintain the influence of the TV schedule (and therefore the consumer appeal of broadcast TV) for years to come. Indeed most programming watched on "Catch-up" services is watched within 24 hours of first broadcast and, while some consumers are happy to binge on "box sets" of content after the broadcast run has ended, others Catch-Up with missed opening episodes so that they can join the broadcast

[12] Source: Ofcom, The Communications Market 2014.
[13] Programme-Making & Special Events (e.g. radio mics, wireless cameras).

schedule later (the linear success of *Broadchurch* was a high profile example of this trend).

Indeed the social aspects of sharing enjoyment of topical programmes (enhanced by online social media) increase the value for some consumers of watching programming (even if non-live) at the same time as almost everyone they know. Previously a disruptive alternative to broadcast, Catch-Up has gradually been separated off from the bulk of VOD and repositioned, within backwards EPGs, as a support function for broadcast channels. Instead of being the successor to linear it was once expected to be, Catch-Up now reinforces linear.

Recent analysis of iPlayer statistics by media planning and buying specialist Carat suggests that social media has encouraged consumers to return to watching more during the original linear broadcast, with 35% of UK TV viewers planning their evening around the TV schedule. That's an increase of 5 million live linear viewers over 4 years ago. The BBC's iPlayer performance pack for July 2014 showed a year-on-year growth in TV requests of only 0.6%.



The fact that over the short-medium term virtually all new displays are likely to be connectable, means that the replacement cycle should result in most DTT-only households have access to hybrid TV (even if only on their main display) by 2025. Despite the consumer appeal of wider choice, Freeview will remain at the heart of hybrid for virtually all DTT-only households well into the next decade as it offers the resilience which consumers and advertisers will still demand, especially for the most popular content which Over-The-Top (OTT) delivery (with no control over quality of service) struggles to deliver with mass live audiences (e.g. sport).

High profile examples in recent months of OTT failing to match the resilience of Freeview or satellite have been service failures affecting the German Grand Prix, the opening match of the World Cup, and Manchester City winning the Premier League. There would have to be considerable investment in IP networks and multicasting capability before IPTV could match the resilience of broadcast networks, and we have seen no evidence that consumers and advertisers are becoming more tolerant

of picture loss (far less the complete service failures we have seen recently) – especially with live sport.

There is also no funded strategy to make superfast broadband available to at least the 98.5% of the population which could access Freeview, and broadband isn't free at the point of consumption. Additionally, hybrid TV and pure IPTV potentially introduce new gatekeepers, not necessarily from a broadcasting or content-creation background (or even of European origin), which may come to influence the types of programming and advertising viewed in unpredictable ways.

Arqiva is confident that by 2025 broadcast television infrastructure will still be in use across the UK providing the most watched TV content to many millions of homes. If 700MHz spectrum has been cleared by then for re-use by mobile, then Freeview may have undertaken a platform-wide upgrade to DVB-T2 (the most cost effective, and least disruptive, time to do so would be as 700MHz was being cleared). In that case, Freeview wouldn’t be the capacity-constrained platform it has historically been, but would have the capacity to match rising consumer expectations, transitioning from mostly SD with some HD simulcasts; to mostly HD with some residual SD; to mostly HD with some UHD simulcasts.

And with broadcast television infrastructure at its heart, by 2025 Arqiva expects many consumers to have upgraded to the next development stage in TV: Connected Broadcasting, an increasingly networked and converged TV ecosystem, spread across multiple screens and devices. The latest generation of TV devices show that the nature of box and screen connectivity is changing from the closed IP world of the multi-function era into an open-web ecosystem. The rise of the connected device means we are now at a point where TVs and set top boxes are able to blend the best of broadcast and web technology to create a connected and converged TV outcome.

In the previous TV era, new functionality like PVR and Catch-Up were positioned as alternatives to broadcast. What is key about the emerging Connected Broadcasting era is that functionality is beginning to move back towards broadcast. New backwards EPGs allow broadcast to be the gateway into the timeshift world. The next stage for Catch-Up is allowing the viewer to jump to content from WITHIN the broadcast stream via interactive overlays. This capability is already live on some boxes in the UK. Further integration will allow true ‘start-over’, where a viewer only has to press rewind on a live channel to jump backwards into Catch-Up.

In addition, red-button interactivity means that new forms of content can be overlaid and integrated with the linear broadcast experience. On top of the direct links to Catch-Up described above, these new content forms can include short form and interactive content.

Arqiva believes that it would be many years before broadcasters and advertisers would have sufficient faith in IP networks to enable a jump to a total cloud TV service, but on top of network supported EPGs, remote management services, and

links to web players and short form content, the TV industry is bringing cloud storage into the mix. Whether it results in network PVR, movie hosting accounts or more complex on-demand offerings, cloud storage is being firmly connected to the set top box and smart screen.

That trend can only continue – as will linear at the core of audiovisual media consumption, because broadcast is the most cost-effective, resilient and universal means of distributing the most popular programming. And the appeal of the PVR may not be dimmed by the addition of cloud services, as PVRs offer the much-valued “Pause Live” functionality, plus the reassurance to consumers that their content is “just there”.

Satellite

Our comments above in relation to television largely apply similarly to Freeview and to satellite, although until the 700MHz spectrum has been cleared (expected 2019-2021), and the DTT platform has upgraded to the DVB-T2 transmission technology, then satellite will be better placed to offer consumers a wide range of HD and UHD services than DTT.

Within linear TV, although the speed of consumer adoption of HDTV (and subsequently of UHD) is hard to predict (and will be driven by platform provider technology roadmaps and access to spectrum) the direction of travel is clear: where the higher picture quality (a combination of number of lines on the screen, whether transmitted progressive or interlaced, and of frame rate) increases consumer enjoyment, especially of the content where the benefits are clearest to see (sports, films and high-end drama). For such content HD is fast becoming a “hygiene factor” for their viewers.

As such, in 2030 we expect satellite to still be a commercially viable distribution platform for linear TV. Additionally the UK is the scheduling, content aggregation, playout and uplink location for many pan-European TV services whose end users are in countries with less advanced communications infrastructure – we see no reason why London wouldn't still have that role in 2025.

Satellite infrastructure is also a key component of the national DTT and DAB networks, and – although technically not UK infrastructure - provides GPS on which ever more services depend.

Satellite will still be essential to provide communications for geographic areas which are hard to reach by other means, such as rural areas including broadband direct to

consumers' premises and the enterprise market such as SCADA[14] (provided by Arqiva for the National Grid) and VSAT[15] communication services to offshore oilrigs.

Radio

Radio listening remains healthy. In the face of ever more devices and music streaming services vying for consumer attention, average listening to radio has declined by only 11 minutes per day since 2008, supported by its status as a largely secondary activity, its mobility (particularly in cars), and radio's long-standing position as the most personal of media. Local commercial radio advertising is also benefiting from the decline of local and regional press.

Despite the competing attractions of YouTube and Spotify, radio remains a major platform for music discovery (and music is something the UK is good at – the labels may no longer be based here, but much of the creativity is).

Almost half of UK adults own a DAB set and digital's[16] share of total radio listening is now almost 37%. While digital's share is short of the 50% threshold before Digital Radio Switchover (DRS) could be triggered (based on the growth rate of the last 3 years, that threshold will be reached in 2017Q1), the direction of travel is clear: the audience is switching over from analogue to digital, mostly switching from FM to DAB with IP delivery (including apps) complementing broadcast radio, but comprising only 6% of total listening.

Sales of stand-alone DAB sets are fairly consistent at just under 2 million p.a. (around a third of all radio set sales), while sales of analogue-only sets have fallen by two thirds over 5 years. Most new cars now have DAB radio fitted as standard (and UK cars sales are currently high). Indeed the rapid increase in standard DAB for new cars is one of the most impressive indicators of growing support for radio's digital future.

Arqiva expects an ageing population to translate into a continuing slow decline in average radio listening, which we expect will still comprise more than 2 hours per day in 2025. The digital share will continue to increase, driven by more consumers discovering internet radio combined with greater DAB coverage (the national multiplexes expected to reach FM equivalence by 2015-16[17]); ever more services available on DAB[18] (which is contributing to a switch in listening from local to national stations) – something the imminent "D2" multiplex will contribute to; DAB sets

[14] Supervisory Control And Data Acquisition – the collection of data from remote sensors.
[15] Very Small Aperture Terminal.
[16] DAB, mobile, online and digital TV.
[17] Additionally Digital One launched in Northern Ireland last year and considerable investment is being made to considerably increase the coverage of local multiplexes over the next couple of years.
[18] Where 5 digital-only stations now have a weekly reach of more than 1 million listeners.

continuing to be popular gifts; and DAB-equipped cars spreading throughout the second-hand market.

So radio looks likely to still be an attractive medium for millions of consumers, and for advertisers, into the next decade. What is harder to call is whether industry will still be required to simulcast all but the smallest stations on FM and DAB.

Not only is simulcasting inefficient, but until the decision is taken to start switchover, then industry is highly unlikely to commit to completing the rollout of DAB. Additionally, by 2023, industry would need to make a sizeable investment replacing the analogue networks.

Even amongst opponents of DRS, it's seen as when, not if. The decision to start the switchover process, and re-direct investment from propping up analogue into enhancing DAB, will help the medium stay healthy, providing focus to station groups (which currently cannot adopt a 100% digital strategy), and offering more choice for consumers and advertisers.

Mobile

The direction of travel is clear: ever increasing data demand from mobile devices, driven both by an increase in numbers of devices and by increasing per subscriber demand. EE has seen data demand doubling over the last 18 months, and their network capacity has doubled over the last 12 months. However increasing consumer data demand is not generally marked by a greater willingness to pay.

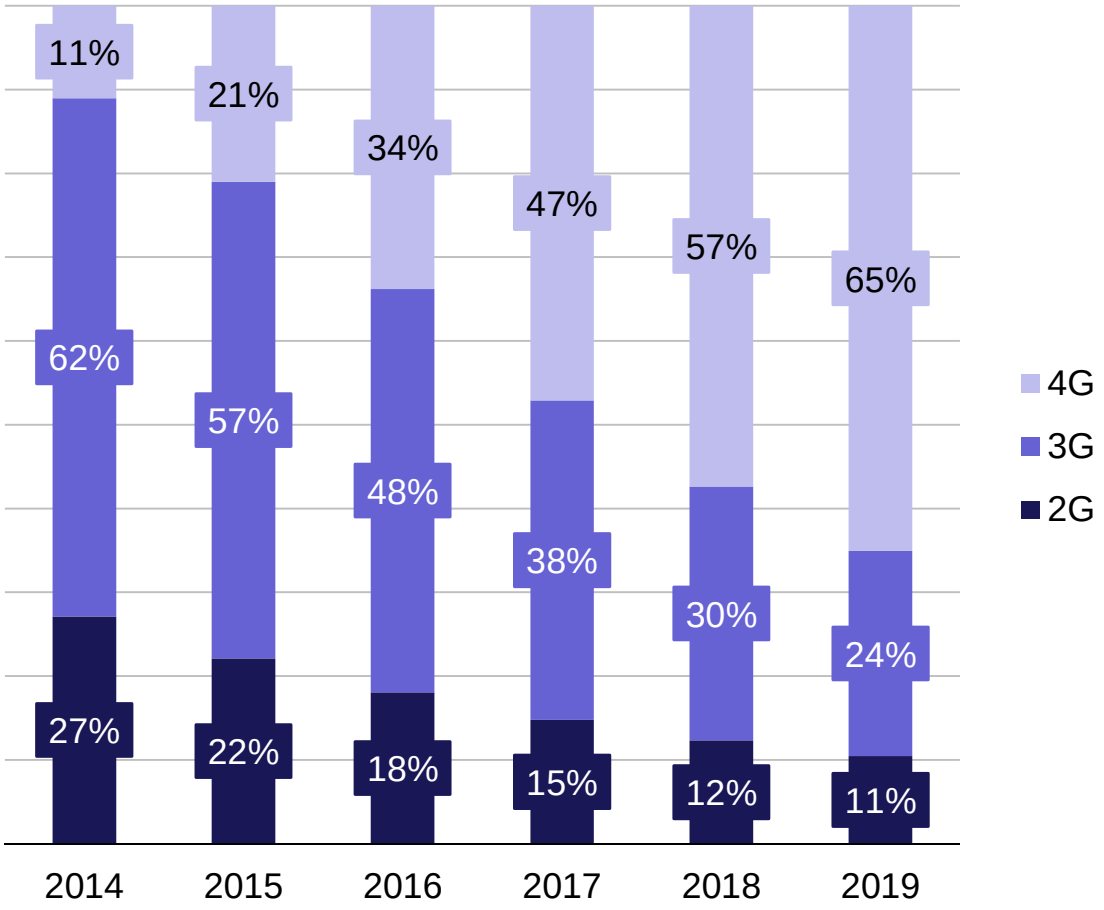
As consumers upgrade to faster connections, and adjust their expectations accordingly, their data demands increase, but demand for cellular data hasn't grown as quickly as high profile forecasts from equipment vendors said that it would, requiring successive annual forecasts to be adjusted. This calls into question when more 3GPP spectrum might be required, alongside upgrades in technology (to LTE-Advanced and then 5G), and/or greater investment in small cells.

Indeed one consistent theme of recent years has been the crucial role played by WiFi in meeting demand from mobile devices, such that data demand by mobile devices is therefore not synonymous with actual mobile (cellular) usage, where most of that demand is generated while users are stationary. Notwithstanding on-going deployment by MNOs of 800MHz spectrum, and re-farming of 1800MHz for LTE, Arqiva expects that consumers will continue to use WiFi when available, either consciously or as part of service provider bundles - a process that technology upgrades should make far more transparent than it is at the moment.

Recent research[19] by Analysys Mason on behalf of Arqiva explored consumers' perception of public Wi-Fi services, finding that 4G subscribers:

- are as likely as non-4G subscribers to use public Wi-Fi networks;
- place a slightly higher monetary value on access to public Wi-Fi networks than non-4G subscribers; and
- would be more likely to switch to a mobile operator that provided public Wi-Fi as part of their contract than non-4G users.

Forecast mobile subscribers by handset generation[20]



Additionally it must be recognised that changes to MNO pricing, particularly "all you can eat" tariffs, could influence consumer demand, acting as a break on total per user consumption and shifting data demand further to WiFi (potentially supported by the introduction of WiFi calling).

19 *Public Wi-Fi networks in a 4G world*, Analysys Mason 2014.

20 Source: Analysys Mason "Western Europe telecoms market: concise trends and forecasts (8 countries) 2014–2019", http://www.analysysmason.com/Research/Content/Regional-forecasts-/WE-forecasts-concise-8-Jul2014-RDDG0/

Within the next 10 years we would expect at least one of the MNOs to have started migrating use of 2G to LTE[21] as a prelude to re-cycling spectrum, although alternative technologies would have to have achieved equivalent coverage by that point and there would have be a knock-on impact on M2M uses relying on GPRS.

Methods of construction for new buildings (offices and some homes) are often good at blocking radio waves - rendering them “Faraday cages” - which often will increasingly require the deployment of small cells indoors to ensure that consumers and employees can enjoy reliable access. We expect WiFi provision increasingly to be included with such “in building” deployments in offices. But affected householders who don’t have fixed broadband would be unable to install femtocells to provide indoor mobile coverage.

One trend which it is hard to be conclusive on is the substitution of dedicated networks for commercial cellular networks, reflecting the increasing availability of public IP network connectivity and the pressure for public services to be delivered in a manner deemed to be more cost-effective.

The resulting tension between service and cost can currently be seen in the Government’s ESMCP[22] procurement. Currently Airwave provides a dedicated, resilient network for the emergency services with coverage far higher than any cellular network has so far achieved. This raises the question of the extent to which safety of life services could utilise commercial networks.

The availability of suitable backhaul (where cellular networks have become ever more fixed, interconnecting with the nearest fibre breakout point) may still be a constraining factor in the deployment of high bandwidth mobile services outside urban and suburban areas.

WiFi

When smartphones and tablets (the overwhelming majority of which are WiFi-only) are outside the home, most of their data demand is met by WiFi in retailers, coffee shops, restaurants, rail stations, shopping malls, hotels etc.

Where WiFi is unavailable, cellular networks do face a capacity crunch, although that is highly localised geographically and temporally, and there are a range of solutions.

Where high data demand is nomadic, rather than mobile, and doesn’t require handover, then WiFi will probably still be central in the next decade. WiFi will increasingly be a transparent, and essential, complement to mobile networks – and simply essential for millions of WiFi-only tablets.

[21] Where we note the proposal of AT&T to close its 2G network by 2017.
[22] Emergency Services Mobile Communications Programme.

The latest WiFi standard (802.11ac) offers consumers 5G-type throughputs of multiple 0.5 Gbps today (e.g. in iPhone 6) and up to 8 Gbps in theory (subject, as always, to appropriate backhaul).

EAPSIM, Hotspot 2.0 and ANDSF are all various standards available today to let handsets make use of WiFi seamlessly We expect widespread deployment of Hotspot 2.0 over the next 5 years.

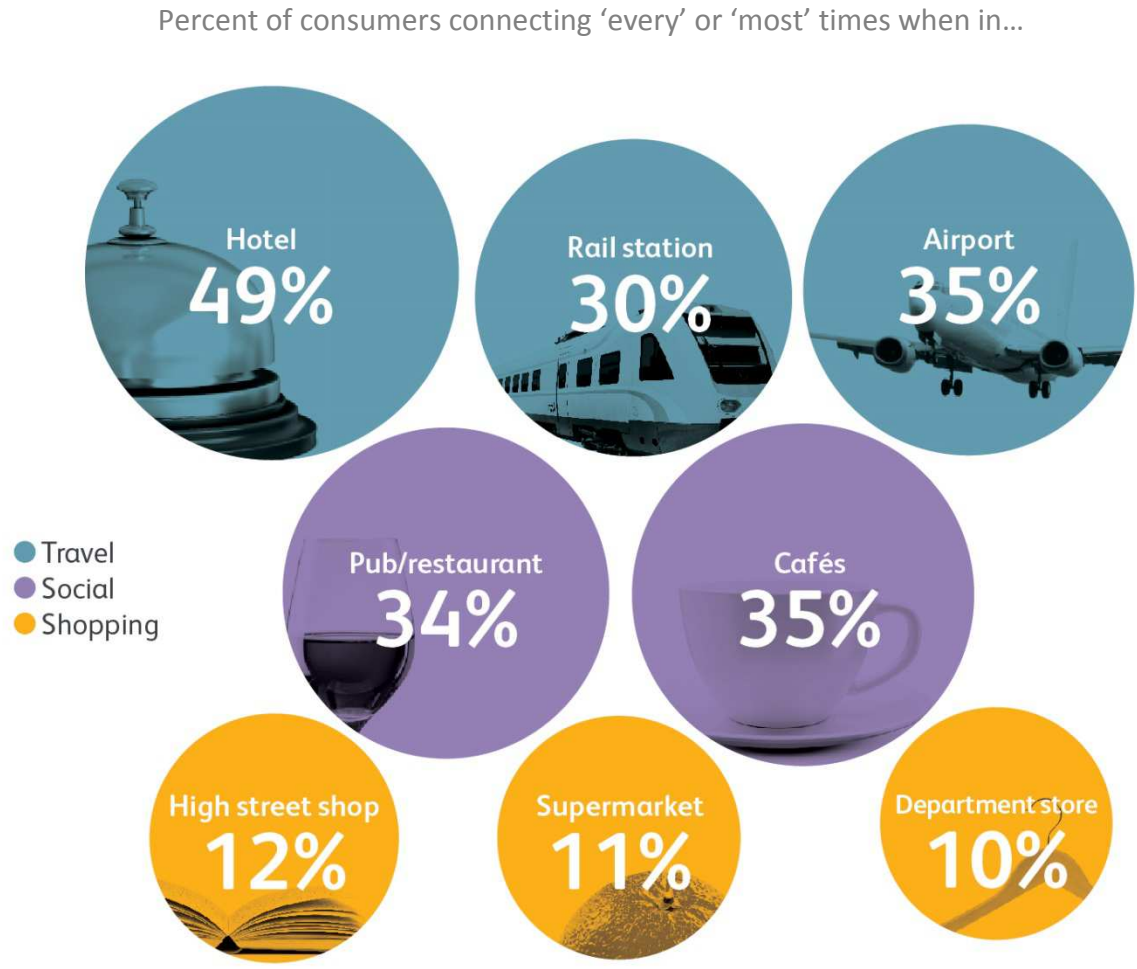
However while the distinction for the user between mobile and WiFi connectivity will blur further; it is likely that the two will remain two separate domains for 2 reasons.

Firstly, the technology perspective. WiFi standards are driven by IEEE, a very different standards body to 3GPP. IEEE comprises only 3 main vendors and is much quicker than 3GPP in setting standards and turning them into hardware available in the market.

Secondly, the funding perspective. In the UK, we are moving to a world where the site owner more often funds the WiFi (usually operated by BT, Sky, Arqiva, or O2) and gets value from directly interacting with their customers on their site, which they don't want to completely lose to the mobile operators (e.g. through EAPSIM). Therefore site owners will want to decide on a case by case basis, whether or not they would allow a mobile operator to authenticate their customers on a WiFi network seamlessly or require some form of interaction with the site owner first (email login, Facebook etc).

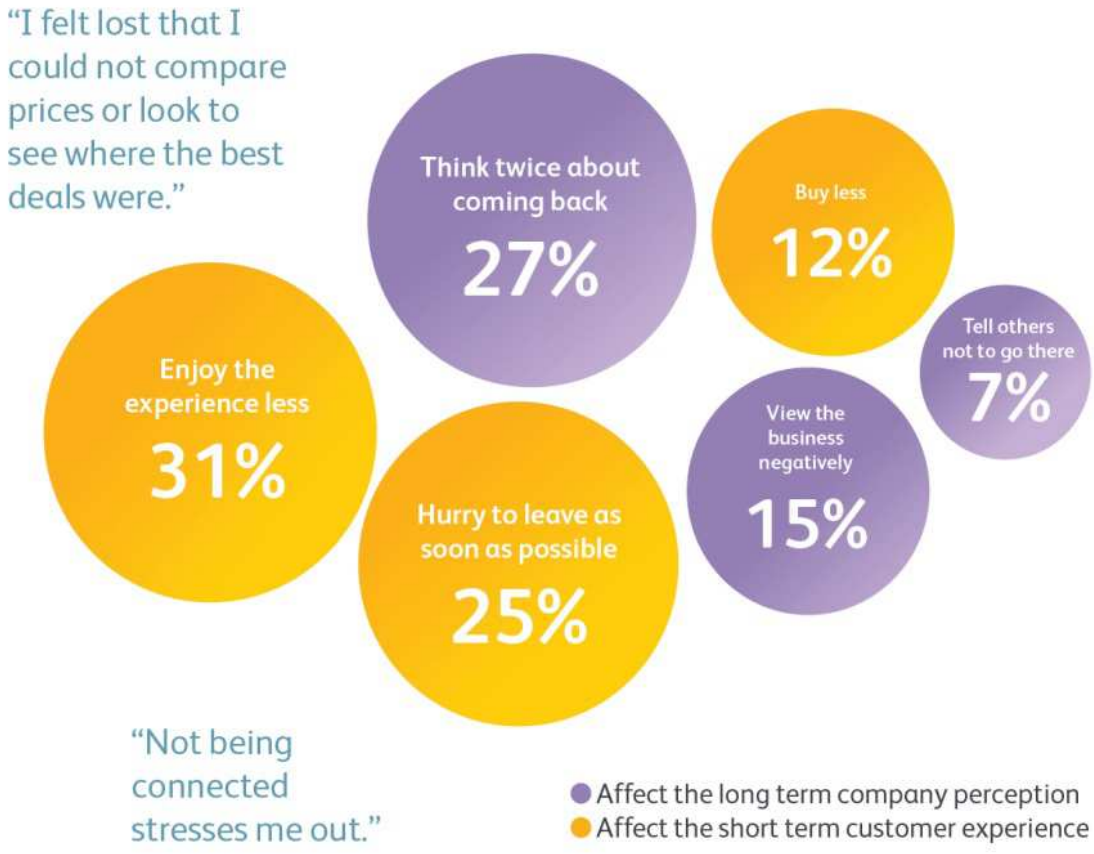
The current considerable investment in WiFi deployment, now a priority for local authorities and public transport (where cellular coverage is often patchy), will continue. Indeed Arqiva, which 2 years ago had no WiFi operation, is now the 4th largest operator of public hotspots, and growing rapidly.

Consumers increasingly see WiFi as the “third layer” of network connectivity alongside fixed broadband and mobile, and have high expectations of its availability in public spaces. Indeed research[23] conducted earlier this year for Arqiva has shown that one in four customers have actually left a business’s premises because they couldn’t connect.



Indeed not being able to connect while in businesses' premises triggers some strong customer emotions, many saying they feel “frustrated” and “annoyed”:

[23] Wireless Nation: http://info.arqiva.com/wireless-nation/retail



Despite the effects on customers, 74%[24] of whom now own a smartphone, a recent survey by the Internet Advertising Bureau mobile retail audit found that only 14% of the top 50 retailers offered in-store customer WiFi. Arqiva's research found that 51% of customers regularly found that there was no retailer WiFi available, and 35% experienced poor quality retailer WiFi. Those experiences directly affect those retailers' profits:

The inescapable conclusion is that the current frantic pace of investment in WiFi deployments is set to continue.

So by 2025 we expect to see far more extensive public WiFi availability, in virtually every retail outlet with significant consumer "dwell time", in the public spaces of Central Business Districts[25], and on public transport. However the ability of WiFi

[24] Source: comScore, February 2014, 3 month average.
[25] WiFi typically doesn't carry very far outside of retail premises, so public authorities cannot rely on overspill from commercial provision.

operators to meet this demand in urban areas may require the availability of additional 5 GHz spectrum, where we welcome Ofcom's continued efforts to secure additional Wi-Fi spectrum in the 5 – 6 GHz range in line with the recommendations of a recent study for the European Union. We see this as an important opportunity to expand the spectrum available to Wi-Fi platforms in the future as traffic on these platforms continues to grow predominantly as a result of increasing levels of mobile off-loading.

In homes we note that WiFi is the most popular means of connecting smart TV functionality (including PVRs, blu ray players) and in-home M2M (e.g. connected smoke alarms, thermostats); we see no reason why that would change over the next 10 years, although there is now market interest in connecting smoke alarms to a wide-area network.

The Internet of Things

The terms "Internet of Things (IOT)" and "Machine-To-Machine (M2M) communications" tend to be used interchangeably, although technically IOT implies a degree of value add to M2M (communications that do not have any human intervention in the connection that is made), such as data analytics, perhaps on data sets from more than one source. In this response, we will use the term IOT to encompass both.

These new machine-to-machine connections form a vital part of the UK's digital economy, delivering cost-savings that will make us more competitive and driving growth through the creation of a host of new services. Indeed, the UK can take a leading role in the global market, if no undue obstacles are presented.

The IOT market is already growing exponentially, leading to a requirement to connect billions of new and existing devices over the next decade. The applications – and the benefits they can bring to businesses and consumers – are endless, from finding a parking space in a busy town centre, to identifying and quickly fixing faults, to locating critical items of equipment (or, indeed, tracking pets, bikes and cars). Healthcare applications offer benefits for patients and cost-savings for healthcare providers. Another (current) IOT use with clear benefits for both industry and end users is connected smoke detectors where in France, at the time of a fire in a home, one in four smoke detectors[26] aren't working, usually due to dead batteries. Connected smoke detectors can warn householders and their insurance companies of the state of the batteries.

However in general IOT will be characterised by the collection and use of information and data. The majority of IOT devices will provide services that will require data

[26] Source: Sigfox.

harvesting networks providing highly asymmetric collection of data from low cost, low power, long battery life sensors that have medium to long range.

A current example of an IOT deployment in scale is the GB contracts placed last year to connect by 2020 around 53 million smart electricity and gas meters, in every home and most business premises. This represents one of the largest IOT deployments in the world so far.

Smart meters should deliver energy savings by managing down cumulative energy demand and, in the process help to keep the lights on as demand threatens to exceed generating capacity. Energy suppliers will generate cost savings from removing the need to send field engineers out to read meters. Whilst consumers should benefit from tariff innovation from energy retailers as well as the introduction of smart technology into their homes that allows them to manage both their energy usage and home environment more effectively.

Arqiva expects smart water meters to be deployed in a similar timescale to smart energy meters. These will greatly improve leak detection and reduce the growth in demand (enabling, for example, water supply in London to be better placed to meet the demands of a rapidly growing population), while also potentially reducing the size of investment needed by the water companies in new reservoirs.

The deployment of smart meters will be followed by investment in smart grids, the additional intelligence made available from the edge of the electricity distribution network making for rapid and cost-effective fault detection and coping better with increasing volatility in local electricity distribution networks due to emerging electric vehicle charging and local energy generation. Indeed there seems no reason why, after a smart grid has detected a fault, a message to that effect couldn't be flashed up on the smart meter In-Home Displays of affected premises, providing reassurance to consumers and forestalling those consumers calling their energy supplier (currently the way that power cuts are usually detected).

The diversity and fragmentation of today's IOT market also means that collaboration is essential, between different businesses, with local and central government as well as with academic and technology centres of excellence. The more effectively these stakeholders work together, the more the UK can turn its undoubted creativity into tangible business and the greater the share of the IOT value-chain that can be captured locally.

The Government announcement earlier this year of £73 million in funding to support IOT research and innovation is one welcome and positive step in the right direction, as is the focus from multiple workstreams of the Technology Strategy Board (now Innovate UK). All of this support comes on top of this government's long-standing support for the tech sector, from where we expect many innovative IOT applications to emerge. But there is more, particularly in respect of Smart Cities, that government could do (see Question 27 below). Furthermore, government could proactively

explore the opportunities for IOT applications to transform its own processes and citizen experiences across a wide range of areas – including health, transport, social services and many others.

The investment case for IOT

There are multiple drivers behind the increasing uptake of IOT technologies, coming from businesses, consumers and technology providers:

- The continuous drive to achieve cost-efficiencies, where improved monitoring and control of "things" can cut energy, operational and equipment replacement costs
- Opportunities to shape new services for both businesses and consumers
- Consumers' desire to be in control - from the energy they use, to the appliances they own and the safety and security of their homes
- The growing recognition that the National Health Service and Social Services departments will struggle to meet demands from an ageing population which, alongside an awareness that investment in prevention is more cost effective than in investment in cure, aligns with a growing desire by many consumers to monitor their health.
- Falling equipment costs, including the chipsets/modems that go into machines to enable IOT communications.
- The emergence of new IOT connectivity technologies that are making it economically attractive to connect devices with low-bandwidth requirements.

For many industrial IOT applications the benefits of deploying IOT will be clear and quantifiable (e.g. fault detection, asset tracking, energy saving) justifying an investment case.

Connecting buildings, businesses and cities

The opportunity for, and benefits from, IOT are wide-ranging, with some of the greatest potential coming from services for connected homes and cities, as well as in smart utilities and manufacturing which will support the re-balancing and diversification of our economy.

Examples of IOT applications with strong growth opportunities over the next few years include:

- Connected buildings present one of the largest and most diverse opportunities for IOT, ranging from: connecting smoke alarms and security systems for peace of mind; HVAC (Heating, Ventilation and Air Conditioning) systems to

control air temperature, humidity and air quality; through to monitoring the energy use and condition of kitchen appliances

- Connected cities: improving the lives of citizens in endless ways, from the convenience of finding a parking space quickly to monitoring waste levels in rubbish bins to checking how public transport is running to monitoring air quality[27]; providing opportunities for businesses to benefit by connecting devices in public spaces, from tracking stock levels in vending machines to ensuring that electronic advertising billboards keep working
- Smarter utilities: connecting to smart electricity and gas meters in every home; using smart water meters, currently being procured by some water companies, to save water and money; and electricity network operators will need real-time monitoring and control for the "smart grids" that will connect widely distributed low-carbon energy "micro-generation" and new electricity-consuming "things" including electric vehicles
- Manufacturing and supply chain: including the monitoring of equipment for proactive maintenance as well as the tracking of raw materials and goods throughout supply chains.

Health applications

Looking ahead to the next decade, it is highly likely that we will also see mass adoption of Telehealth remote monitoring and supervision. Applications include devices to monitor consumers' known conditions (e.g. long term conditions such as diabetes, blood pressure, blood glucose, weight or pace-maker performance) and preventative health checks for common complaints.

Patients with long term conditions are high users of health services, accounting for 55% of all GP and 68% of all outpatient and A&E appointments[28]. Telehealth services will cost-effectively give patients extra months or years of life of a reasonable quality and ensure that existing physical health infrastructure and processes aren't overwhelmed (an otherwise increasing risk as the population ages).

Public and private sector collaboration will be vital to realise the benefits in many of these areas, such as smart cities where local government and businesses need to come together to provide improved services to citizens.

A mix of communications technologies will be needed to maximise growth

As IOT applications spread, and consumers and businesses increasingly rely on them, the demand for pervasive connectivity will increase. These IOT connectivity requirements differ widely, from frequent two-way communications to simple device

[27] Where diesel particulates are a health risk to asthmatics.
[28] The 2005 Household Survey of Great Britain.

status updates. The fastest growing area is to provide low-cost connections to devices with low bandwidth/data requirements.

Coverage is one vitally important factor. For example, it is unlikely that the availability of public services will be restricted to those areas where commercial networks have already been deployed. Wireless communications technologies with long range will ensure rural inclusion, especially when these can reach devices deep inside buildings to bring the benefits of connected homes and workplaces to all. In some cases, for example data-rich CCTV connectivity in buildings and underground car parks, WiFi will be a strong option.

Cost and complexity are also key considerations. Currently most IOT connectivity is usually provided by 2G which has proved effective for areas like in-car telematics, but 2G can be costly especially when it comes to connecting devices with low-bandwidth communications requirements. It also has to be assumed that, by the next decade, the UK will follow the example of the US[29] and start to withdraw 2G services. Emerging low-power narrowband communications technologies offer a viable alternative due to lower connectivity costs, with a simpler set up, lower modem costs and longer-lasting batteries that avoid the need to frequently replace equipment.

Whatever the optimal connectivity for an IOT application, those developing innovative connected devices/services will in many cases assume that the connectivity they need will be already there when they launch.

For services requiring high bandwidth, access at speed (e.g. connected cars) and/or low latency, then the mobile networks will be the natural source of connectivity (although coverage would have to be substantially improved on roads and trains).

But as cellular is expensive (both devices and connectivity) and energy-hungry, there will be many IOT applications for which the mobile networks would offer sub-optimal connectivity. Given the excessive signalling requirements of LTE for small packets of data, arguably attempts by MNOs to meet the demands of that market segment would be an inefficient use of their spectrum.

At Arqiva we are investing in a number of technologies that enable a very wide range of IOT devices:

1. We are rolling out a long range radio network using 412MHz licensed spectrum. This will be used for smart gas and electricity meters in Scotland and the north of England and has the potential to be used for a variety of other applications in the utilities sector and other areas;
2. We are rolling out a national ultra narrowband network using SIGFOX technology that enables devices to connect with extremely long battery life

[29] Where AT&T has announced that it intends to switch off 2G by 2017.

(100 times more energy efficient than GSM[30]) and lower cost than existing wide area network technologies. The first 10 cities will have full coverage by summer 2015.

3. We are significant investors in creating WiFi networks covering large portions of cities and public spaces, and
4. We provide satellite data communications services to enable IoT connectivity in very remote areas

Arqiva expects that in 10 years' time as many as 90% of IOT communications will be ad hoc, small data packets, sometimes requiring high resilience, often from devices which are "fit and forget" i.e. recharging or replacing batteries may not be a practical option, so a 10-15 year battery life will essential. Such applications, which we expect to be the source of most IOT innovation and which are principally about data capture rather than control, will require a form of connectivity better suited to their use case, such as the Sigfox network Arqiva is currently deploying.

Many in-home IOT applications (as Nest thermostats and smoke alarms do now) will rely on consumers' existing WiFi for connectivity, although even here there will be specific use cases for which WiFi won't be suitable, for example because routers can be switched off or where a high degree of data security is required.

The widespread availability of wide area, low data rate, resilient networks is the missing piece of the connectivity puzzle to ensure that the UK positions itself as an IOT leader, both in innovative applications and customer take-up.

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?

To be a Leading Digital Nation requires ubiquitous connectivity. Consumers, businesses, and potential inward investors will expect nothing less. That means:

- broadband (fixed, mobile or satellite) available to every premise;
- mobile data available to virtually every premise, and along every motorway, and (with WiFi) available on every overground and underground train (tunnels, too).

[30] Source: Sigfox.

- As IOT expands its presence, benefitting every consumer and every market, it will be essential that suitable widespread connectivity for the many millions of devices is available.

Government has a major influence on achieving this, including:

- Public investment in access infrastructure where the market won't deliver;
- Setting mobile coverage obligations (including public transport and major roads) for new spectrum;
- Stimulating demand for connectivity with digital public services;
- Addressing those for whom cost and/or skills are barriers to adoption and usage;
- Incentivising easier and quicker means of access for communications infrastructure to public land (e.g. Network Rail and London Underground), street furniture and buildings;
- Encouraging and setting direction for Smart Cities, including smart public services (where a central government strategy would speed things along and help the UK establish a leading position in this area).

Section 4 Competition and regulation

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

Broadcasting Act licences, whose scope was devised when the television and radio markets were very different to today, can act as obstacles to investment. For example Ofcom has total control over the technical parameters that govern the operation of the Freeview and DAB multiplexes and as such this frustrated those platforms' ability to grow. Satellite and cable have no such legacy constraints. Sky and Virgin Media are free to fine tune their consumer appeal in response to the market and to upgrade their technology without having to obtain the regulator's permission first.

In addition, a lack of certainty over government intent for Freeview doesn't provide the optimal conditions for Arqiva and its broadcast customers to make investment decisions.

For Freeview that uncertainty relates to the spectrum it uses, where Ofcom is currently planning to clear Freeview from a 2nd slice of spectrum[31] to auction to the mobile operators. It is far from clear what Ofcom and the Government will determine that Freeview should look like post 700 MHz clearance, where spectrum availability has a direct bearing on the platform's consumer appeal, the regionality of TV channels, and whether it will continue to be universally available.

We note that Ofcom has recently said of Freeview's long-term future:

> *"…whilst we cannot exclude the potential for more radical changes, our base case view remains that [Freeview] will continue to be an important delivery technology for free to view TV over the next decade. We do not currently expect a full switch-off of [Freeview] until post 2030, unless there was significant policy intervention to support a more aggressive timetable."*

While Arqiva is pleased that Ofcom and the Government have made recent statements recognising the long term potential for Freeview, provided it is given sufficient scope and opportunity to develop, investment in Freeview would be made most efficiently if the broadcasters could be certain that government and Ofcom wouldn't make a policy intervention to degrade, or switch off completely, Freeview that wasn't based on market conditions (i.e. that consumers hadn't chosen to watch content by alternative means instead).

In the rapidly growing IOT markets, the Government can play a role in ensuring that the UK is a leader through a number of actions:

a) Establish a clear Whitehall responsibility for IOT (which straddles many Departments) with a team to co-ordinate the many initiatives Central Government has in this space. For the Smart Cities segment Central Government should be prepared to share best (international) practice, share the results of UK trials/demonstrators, encourage cities to make their public services connected; and to establish open data with standard protocols to facilitate autonomous collaboration among machines and for third party developers to mine for data on public transport, air quality, available parking[32] etc.
b) Continuing to support business cases and initiate public sector programmes that utilise these new technologies to deliver cost efficiencies that ultimately flow through to the tax payer, and improvements to quality of life for citizens. Sectors in which the government has the potential to play a role include, amongst others, healthcare, agriculture, local authorities and energy.
c) Continuing to support investment in new technologies in this growth area through initiatives such as the Technology Strategy Board (Innovate UK).

[31] 700MHz spectrum. The 1st slice of spectrum Freeview was required to be cleared from was the 800MHz spectrum, subsequently auctioned by Ofcom to the mobile operators and BT in February 2013.
[32] So, for example, SatNavs could display empty parking bays in any city which had deployed connected (smart) parking.

d) Ensure that the EU Horizon 2020 programme includes significant funding directed at IOT, and support UK businesses to gain a share of this funding.
e) Work with business to ensure that that UK has strong involvement in the creation and evolution of standards and languages for IOT.

However, given that the IOT market is at the start of explosive growth, and the market is increasingly moving towards a mixed economy of solutions reflecting the very different needs of customers, markets and applications, Arqiva would suggest that there doesn't appear to be any need at present for further licensed spectrum to be allocated specifically for IOT. If spectrum is awarded on a licenced or unlicensed basis in bands that may be suitable for IOT then Ofcom should follow its service and technology neutral principles while ensuring that the licence conditions are not set in a way that precludes IoT use.

Similarly, there does not appear to be a case at this stage for policy makers to:

- mandate specific standards or interoperability requirements on all IOT devices (although there is a role to ensure that the UK's voice is heard in the international forums where the standards are developed),
- mandate encryption standards generically, as security should be proportionate and appropriate to the level of risk associated with particular applications and early regulatory intervention could result in security overheads that cannot be supported by lighter protocols, or could even make some technologies uneconomic;
- introduce additional regulation on data privacy as there is already an established and well understood regulatory and policy framework in the area of data privacy and IOT should be treated in the same way as other services and technologies.

In short, the IOT market is still nascent and so neither the Government nor Ofcom should be attempting to pick winners or making decisions too early, while the market is still developing.

Section 5 – Facilitating and Encouraging Investment

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;

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?

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.

Our answer to Q27 above identifies the desirability of providing certainty to broadcasters of a long-term commitment to broadcast distribution, plus there is a clear role for the Government in respect of IOT, and particularly Smart Cities.

In addition, if Freeview is required to clear 700MHz spectrum, the licensing of that spectrum for mobile use would provide a “once-a-decade” opportunity to set coverage obligations appropriate to address prevailing market failures. The 800 MHz Telefonica licence had the most challenging coverage obligations of any 3GPP (i.e. mobile) spectrum licence awarded up to that point, reflecting the increasing importance of mobile data connectivity (especially where there was no reliable fixed alternative).

At the very least we would expect spectrum licences for 700 MHz to match those obligations, although given the recognition of the inadequacy of coverage obligations focussed solely on where consumers live, which ignore public transport plus where consumers work, shop and study, Arqiva expects that new obligations may well be the most challenging yet.