Review of Ofcom's Communication Market Review 2019

An examination of the implications of the data – with strategic insights on the development of UK markets

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This paper examines *implications* of the market data and identifies *why* the outcomes/numbers seen have occurred rather than the values themselves. Full evidence and extensive justifications for the insights are not provided (available on request Telzed). In some cases, insights are based on opinion, but this is backed up by author's experience with the industry plus knowledge of the technologies and costs. Some statements are designed to provoke further discussion. This is needed, as the UK has some difficult issues (variations of which are seen elsewhere). There are pressures to invest in fibre/mobile-coverage/5G, but there is a lack of obvious new revenue sources. Additionally, there is the fundamental financial/technical inability of 4G/5G to realistically fill the future need for broadband delivering an average of several 1000Gbyte per month per premises.

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Document history

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1 Report purpose and summary of findings

1.1 This report provides insights into the UK markets, but this is also useful globally

Decision makers and workers in the communications industry need to fully understand the markets. As a global industry, an examination of trends and outcomes in other countries is often as valuable as looking at home markets. Therefore, this UK focussed report is likely to be of use in other markets. How do trends differ and why do similar approaches cause different outcomes depending on the national status? Such understandings can help improve plans, targets and decisions.

Understanding of the markets needs more than knowing the figures and the basic facts that demand is rising or falling. A deeper understanding is needed – what are the implications of the changes? Such insights are not within the numbers themselves but can be inferred based on experience and on a deeper understanding of the industry. This wider thinking is needed to assist with strategic planning and policy. Are falling prices good or bad, and if so: from what perspective? This report helps with the such thinking.

The author of this report has over 30 years' experience, obtained globally. This is used to give informed views on the deeper implications. To avoid unnecessary additional analysis, in many cases additional data and explanations are not included. On request, Telzed may assist with further work to provide additional evidence. However, most of the insights should be seen as: "obvious." In some cases, the insights lack firm evidence, but drift into "informed opinion." Discussions on the solidity of these, are welcomed. The purpose of providing such views is to help with the development of a better understanding and to provoke discussion and deeper analysis. In turn this may ensure better decisions, which is important given the major fibre and 5G investments that are underway and the pressures to deploy "full fibre" in the UK. This is in a market where there are significant problems, some of which are discussed below.

Investors, regulators, managers, strategists should all gain from understanding what is happening - and why. This assists with some predictions of what *may happen* in the industry. This is of more than academic interest:

- Telecoms is littered with failures. In some cases, these were partly due to a lack of understanding of the markets, trends and technologies
- There are diverse claims frequently being made. The divergence means they cannot all be right. Evaluating the views espoused needs in-depth comprehension
- Some claims may be simply erroneous, but others may be "biased." These may be legitimate - a CEO *should* promote his/her company's services - but others may be paid to promote a cause and might be looked at with more suspicion. A more careful evaluation of these claims is needed, based on a deep understanding. Biased/wrong claims need to be identified
- Actual/future outcomes and strategies vary globally. This diversity must be understood in order to define local and national plans.

This report is not intended to be a totally comprehensive report on the UK. The insights are still be useful. The approach used can be enhanced and adapted for other countries: similar data to that obtained by Ofcom is often available from regulators/ministries or may be estimated if not in the public domain.

1.2 Ofcom's market reports

Ofcom in the UK publishes an annual Communications Market Reports (CMR)[1]. In addition, other reports have been developed over time and are issued periodically, so not all data is now in a single report – see Connected Nations reports for example that must also be studied ("CMR" is used below generically to include the other reports and Excel files).

The data provided has changed over time. This reflects the changing industry. For example: revenues by call minute are now bundled with monthly rental and data. So the report has to change. The areas of interest also change. So, there is now more of a focus on *availability* of superfast broadband or of fibre (percentage of users who could obtain the service). This reflects policy changes such as from DCMS – the UK government department responsible for telecoms - and from EU targets.

Ofcom's CMR rightly focusses mostly on the key values. It still usefully provides some additional insights to the results' implications and underlying causes. These are not repeated here. This Telzed report moves further into implications and causes.

A Telzed review of the CMR 2012 was carried out[2]. This is recommended to be studied as many of the *same insights* and comments remain valid for this CMR 2019. In itself, this is significant. This can be a good or a bad sign. This may be a surprise in some cases as telecoms is a rapidly changing industry and few are able to confidently predict the outcomes seven or more year hence. It does imply that some of the more radical "game changing" outcomes that may have been predicted in in the past have simply not happened. Telecoms is currently full of new game changing predictions – will they occur in the next seven years?

Some other insights to the UK market were also made in the Ofcom's Digital Strategic Market Review of 2016. A Telzed reply to that consultation provided some additional market insights[3].

1.3 Key findings

The key findings in this review are:

[1] CMR 2019 and others are available from: https://www.ofcom.org.uk/research-and-data/multi-sector-research/cmr/cmr-2019 and Connected Nations reports: https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research & https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-update-spring-2019 also https://www.ofcom.org.uk/__data/assets/pdf_file/0020/147332/home-broadband-report-2018.pdf

[2] Telzed CMR "UK Ofcom market report 2012 Beyond the figures – implications for the telecommunications industry"

[3] Telzed DSR: "Ofcom Strategic Review of Digital Communications Response to the Ofcom Consultation document"

- The **fixed and mobile markets remain remarkably similar**, *relative to each other*, as in 2012. The broadband traffic and speed of services have increased in both markets in similar ways
- **Mobile coverage remains an issue** with 4G in much the same way as it did for 3G in 2012. This suggests 5G coverage will be a major problem – lack of in-premise signals, lack of roads and geographic coverage. The same economic factors will surely apply, unless there are some totally new additional revenues and new 5G services (more/faster data is *not* a new service)
- There is **no sign of major substitution of fixed lines by mobile**:
    - Fixed broadband lines numbers have *increased*
    - A fixed line has about 100x more traffic than an average mobile device
    - Mobile traffic remains roughly constant relative to fixed – *just over 3%* of the total
    - With ~30%+ growth of both fixed and mobile, **in less than two months the fixed line traffic *growth* on its own is more than the entire mobile networks' traffic**
    - There is no evidence of significantly changing revenues in either fixed or mobile
    - Customers use more data over both networks, but even if mobile took some data from fixed, this would have little impact on fixed operators as services are unlikely to be terminated. Any significant substitution of fixed traffic by mobile would result in the need for many more masts but without obvious new revenue sources
    - The Ofcom data should be combined with basic traffic theory and mast number analysis. Moving traffic from fixed lines causes a major commercial/network-capacity problem in mobile networks. This implies that **it is fanciful to expect major substitution of fixed broadband by 5G** (without some unlikely assumptions).
- The **evidence is counter to the apparent move to mobile and contradicts some "mobile is the primary future" claims**. Mobile-only customers may be more common and most people now make more use of mobile devices. This has not reduced fixed line numbers or fixed traffic. Mobile devices use many web sites for short downloads, but the majority of *traffic* is consumed over fixed lines. The evidence shows that traffic *is not* moving to mobile (and *away* from fixed):
    - Customers use mobile differently – to access many web sites but for low volumes of traffic. Hence the site numbers per Gbyte is high
    - The short-use applications make mobile more relevant as a medium. Arguably the number of applications and web sites provides more value than more traffic, to the user. But the *traffic volume* drives mobile costs and most revenues
    - Most "mobile only" customers with no fixed line contract probably still make extensive use of fixed line services whenever large traffic volumes are downloaded

- Average **fixed line speeds have increased but the rate of increase has significantly reduced to much less than Nielsen's law.** This suggests that more fibre is not yet having a significant impact. Customers have been upgrading to BT's FTTCabinet (FTTC) from xDSL and to better cable TV services, but the customers seem not to take the fastest available service. This suggests the current average UK speed (54Mbit/s) is "about good enough," and customers with more than ~30Mbit/s mostly do not feel strong pressures for taking FTTP or >100Mbit/s services when available. This will change as traffic downloads increase and more applications require faster downloads, but the significant slowdown in the average speed increase suggests many users are content without fibre/cable based services >100Mbit/s. This has significant strategic implications

- **Service speeds are asymmetric, but many applications need symmetric speeds**. However video streaming, web browsing and shopping type applications do not, and they dominate the total traffic. This asymmetry has not yet been addressed, but could become an issue in the near future, if symmetric applications become more important (this demand may be debated). This needs technical changes – which should be possible with FTTP and cable TV. Mobile is unlikely to be able to deliver equal upload speeds

- **Lack of incremental revenue, lack of take up of faster services, implied reluctance to pay for more speed, counter desires for more FTTP.** Major investigation work is required to identify both the investment and how it can be paid for in an almost constant-revenue telecoms market. This has major implications for UK government plans, Ofcom and operators' strategies. How can the investments in fibre and 5G be paid for?

- The Ofcom focus on coverage by fibre or faster broadband is sensible to move the markets in the right directions, but **there are dangers that it leads to solutions that cover areas or customers, but would be more expensive in the long run.** It might also lead to solutions that are not radical enough:

    - Major changes to access fibre structures plus the removal of legacy networks and copper are surely required to reduce costs significantly. Without this the UK has a persistent copper/legacy structure that parallels access technologies with fibre and cable

    - This needs further study but current customer numbers on old technology, trends, customer preferences to take slow/low-priced services etc., combine to make the introduction of fibre *with high customer take up*, problematical

    - Providing fibre coverage, without customers making use of it, is surely almost pointless

- **UK average fixed line speeds are reasonably high (54Mbit/s)** by international standards despite the lack of fibre. This is a reminder that customers buy a service, not a technology. Maybe fibre is not vital in the near term, from the customer perspective. It is speed and especially traffic (#Gbyte) that matter

- **The UK has low fibre access levels**, by international standards (say Korea or Japan). This also impacts fibre for mast-backhaul. This may be a poor start point but it does provide an opportunity to optimise approaches that lower costs and integrate mobile, fixed and USO aims. This is important as even countries with advanced FTTP[4] have issues with getting high penetration (take-up) levels
- **Current fixed line traffic volumes make the UK USO specification out of date.** The 100Gbyte/month specification implies USO customers could be unreasonably disadvantaged
- **The wider context of UK fixed and mobile operators is also important**. Revenues, profits and share prices impact investments, strategies and competition development. Customer preferences, government/Ofcom plans for mobile coverage and FTTP, et al combine to give major headaches as investment may well not give the outcomes desired without large government intervention. Some intervention of course does exist. Is this sufficient to give the required outcomes? This is a current UK debate but the issues will be seen in many countries to varying degrees.

[4] See FTTH Forecast for Europe FTTH Council Europe Conference March 12-14th, 2019 Amsterdam. Spain has 45% take up of FTTP with 98% coverage. Arguably 45% is still a high figure as UK take up is only 13% on just 10% coverage

2 Market analysis

2.1 The approach

This report selects key market data and looks the values, but focusses on the deeper implications. Only a selection of the data is looked at.

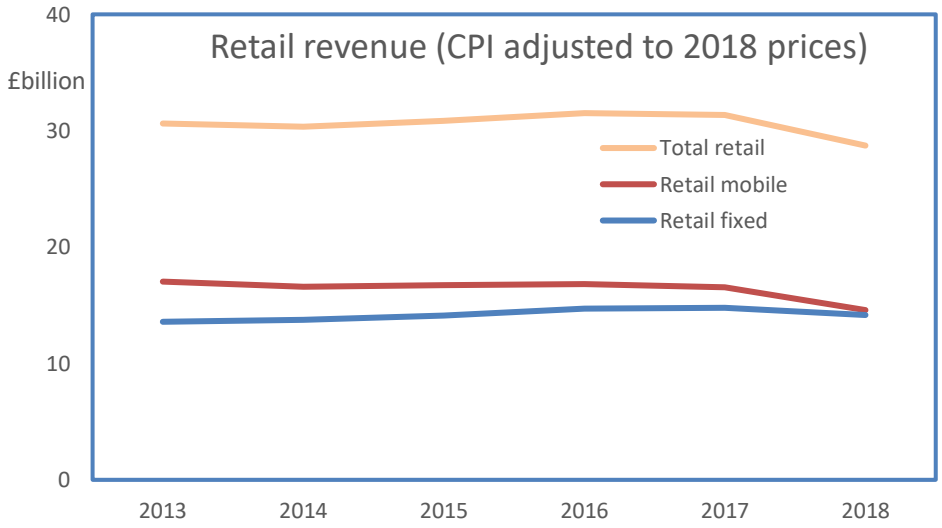
Where appropriate additional data or analyses are provided. Some comments or analysis from the Telzed review of CMR 2012 are included.

The approach also moves away from direct analysis of just the numbers but also links in wider issues relating to strategies, investments and fixed/mobile alternatives. This is included to stimulate discussion and to show the broader thinking that is required when interpreting market data. This needs to link to what directions are desired for the country and to the current circumstances. The latter varies hugely by country (e.g. some countries have mobile traffic that is greater than fixed and have few fixed lines), but the below commentary on the UK may still help with similar analysis in other markets.

2.2 Overall revenues are flat or possibly falling

The total retail revenues in fixed and mobile are shown below.

Figure 1. Telecom retail revenues



Source: Ofcom CMR 2019

Note that account reporting rules altered in 2018 so mobile revenues are not directly comparable to previous years. The drop in mobile revenues therefore may not be significant. Even allowing for this, the notable message is: the lack of real revenue growth. Comments below assume 2018 actually has no significant change.

Wholesale revenues are not included as they are inter-operator payments and so do not show significant net contributions to the industry.

2.2.1 Headline messages

Key messages:

- At best, revenues are flat, or close to
- Mobile revenues remain (probably) almost constant with respect to fixed markets.

These figures mean:

- Mobile has not increased the share of the telecom market spends. We may all use more mobile data and more often use mobile devices, but total spends are almost constant. There has been no switch to using mobile, with a resulting loss of revenue for fixed
    - Alarms are surely already raised in the mobile industry. Increased data usage and investment in 4G to deliver the data capacity have not resulted in any revenue increase. This is also reflected in the ARPU data
    - Mobiles have to deal with the huge pressures to: increase coverage; increase data capacity; and to deliver 5G. Yet there is no evidence of significant revenue growth to pay for it
- Any embryonic 4G IoT as a new service seemingly has negligible impact (subject to the accounting uncertainty). As many such services could also be sent as OTT [Over the Top as Internet data] within retail data packages, optimised for low volumes, this probably limits the potential for any premium pricing. Logically this limitation to IoT revenues will carry over to 5G
- Mobile operators have to be realistic/pessimistic about the potential for 5G revenues. This is not in the data or CMR report, but new 5G services have been recently launched in 2019. Inspection of some shows the service is simply "data" – albeit faster and with larger monthly allowances. Will 5G lead to new revenues or services or follow 4G history of "simply" providing a better technology than 3G that is cheaper and has more capacity to meet the rising demand without increasing prices?
- 4G is able to provide fixed line type speeds (adequate enough for most users – see CMR) but there is no evidence shown above of customer revenue movement from fixed to mobile and, as shown later, there is little evidence of traffic or customer movement from fixed. Mobiles have therefore to plan sensibly with 5G and consider if the trends (or rather: the *lack* of a trend to mobile) will really alter over the next few years.

The above points relate to a key debate in the telecoms industry – will 5G change the industry and radically change the flat outcomes shown in the graph? Other Telzed papers have considered this and these align with other views[5]. Mobile can substitute for fixed line broadband, but substitution has not been seen extensively. Basic broadband data is certainly not the only service for 5G, even if data is about the only one announced so far, but

[5] See various Telzed papers that align with DCMS, Vodafone, Ofcom, ITU et al. E.g.: "Fixed-line broadband substitution by mobile"

broadband data will surely dominate the traffic volumes and hence will drive the investment. Note that it is *traffic*, not speed that is the primary cost driver in mobiles.

The CEO of BT in November 2017 stated: "*I talk to other CEOs around the world... and we've all been struggling a little bit to make the* [5G] *business case work.*[6]" So clearly some industry leaders have a pragmatic view that fits with the above trends and other data/analysis provided below.

2.2.2 Deeper implications

There are serious implications for the general fixed line market:

- No fixed revenue growth is accompanied by probably no new services in the near future (contrast: mobile has the debated *potential* that 5G could alter the landscape). Fixed has faster fibre broadband as a new service, but arguably this is just a variation of the existing broadband services and customers buy the service/speed and not a fibre. New TV services are not likely – they exist as cable/satellite/Freeview[7] and OTT. New TV delivery over fixed lines is now unlikely as TV/video moves to OTT viewing, so any increase in *telco* revenue from video/TV on top of PSTN and broadband data is unlikely to be significant or to even occur[8]
- The pressures to: deploy more fibre, deal with the Broadband Universal Service Obligations (USO) and improve broadband speeds and availability remain. Yet this needs to be done without increasing costs – there is no clear revenue growth to pay for it.

Of course new capital investment in fixed (as in mobile) is normal. This is how more traffic and faster speeds are achieved without increases in revenues. The new technology works far better and has lower cost per unit of use (such as Mbit/s or Gbyte downloaded). An additional implication of flat revenues is that fixed line businesses may need to reduce costs, if (reasonable assumption) fibre investments are large. This opens a wider discussion than can be addressed here on: long term and short-term costs – both opex and capital. Saving money in the short term may increase costs later. Better fibre architecture could reduce costs by avoiding dual copper/fibre parallel networks and by radically reducing node numbers (cabinets and exchange sites) – this has long been discussed/known but this fibre-only direction was not pursued by BT. It has been taken up by the new altnets, and this seems (arguably) to have resulted in recent moves by BT to follow with its own FTTP.

Will increased capital costs on FTTx be offset by reduced operational costs when looked at in the long run? Recent examinations by Ofcom of the costs of fibre to premises relate to this. Adding fibre of course adds costs. But legacy operational (and capital) costs of copper and exchange site systems could be altered. So costs of FTTx should not be modelled on their

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[6] https://www.theregister.co.uk/2017/11/16/bt_boss_yeah_making_a_biz_case_for_5g_is_hard/ Just because BT and the last CEO could be easily criticised [BT has many problems dating from his tenure], the pojnt is particularly valid as there is no benefit in the CEO not "talking up" mobile and 5G – BT is a also major mobile operator. Honesty on this is therefore likely being demonstrated and contrasts to some others who have vested interests in overstating the likely 5G gains

[7] The UK broadcast TV network of multiple channels

[8] Note that the role of TV and cable TV vary hugely by country, so inferences from the UK need to be circumspect

own but as part of a wider change to alter the network to remove legacy systems and so remove costs. This may need a radical approach. Without this there is a "cost hump[9]" which will not go away: caused by new fibre *plus* legacy systems and network designs remaining alongside. Arguably a pure fibre network is optimum in the long run – and that is what is being deployed by new entrants. It is the modern equivalent asset. This discussion needs more space than possible here as it moves too far from CMR-related inferences.

2.2.3 The headline numbers can be linked to wider industry insights

Share prices, accounts and press stories of BT, Vodafone, TalkTalk, Virgin (Liberty Global) *et al* suggest there are deeper industry problems than "just" the almost static revenues – falling share prices and lack of profit growth make investment and risks harder to justify. This has deeper implications for investment in fibre, 5G, improving coverage, dealing with USO costs etc. It also is critical to Ofcom and how it regulates prices and sets targets or incentives. Far more thinking is needed by regulators everywhere than "just" calculating "how to set an efficient LRIC based price." High prices might be good or bad – a reminder of the basics is sensible here, due to: the evidence that revenues are flat; large investment is needed; markets are not fully competitive; but there are political/commercial pressures to deploy fibre and mobile. The altnets and incumbents are not totally equivalent competitive players in the fibre market, even if they all are building FTTP for the first time. Regulators in all countries have to consider the priority of getting investment (helped by higher prices and returns) versus getting low prices and high take-up with resulting consumer benefits. The approaches everywhere need much more than a cost model.

The BT share prices, announcements of sales of part of the business and other news stories suggest problems with the company/management. This is beyond the Ofcom CMR and this paper, but it emphasises the need to have a full understanding of the industry – from "technology through markets to dividend payment." BT arguably matters most to the UK development due to its dominance in fixed markets and it has a major position in mobile markets. Business problems (partly reflected in share prices) also exist with the other major players. Government or regulatory actions should be influenced by the operators' current positions and histories. Outcomes are not simply those of "an operator" in a competitive or part competitive market but an operator that has the particular problems set by its legacy (commercial and technical) and current investor pressures. Regulators need to understand the operators' businesses [strategies, financials, technologies, competencies etc.].

2.3 Broadband speed changes have altered

2.3.1 The broadband speed increase per year has slowed

A huge focus has been placed on broadband speed in recent years. This is due to EU Digital Agenda targets and other national regulator's or ministry's targets. As Telzed papers have noted *the traffic* is at least, if not more important:

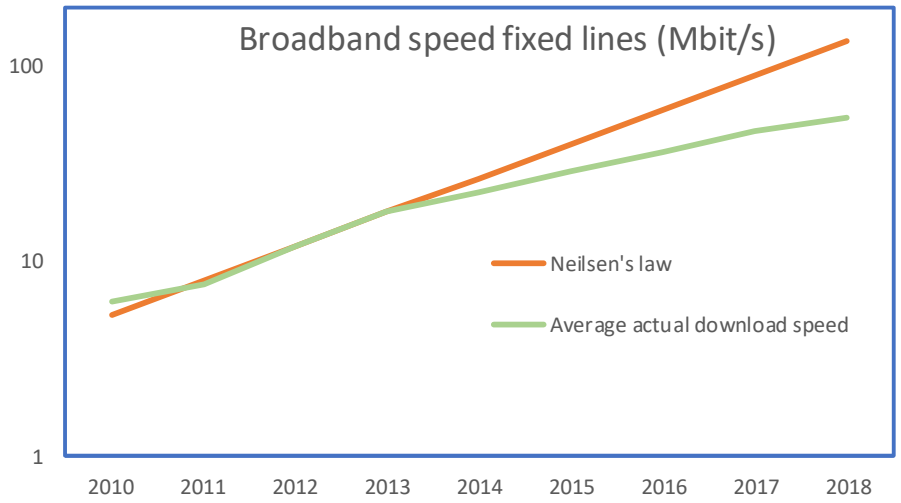
- The costs of *mobile* are primarily driven by the traffic volume (#Gbyte per month)

[9] This has long been identified by the author and others

- Fixed line costs are driven by the speed as that dictates the technical choice (and vice versa). More fixed traffic causes small cost increases, in contrast to mobile
- The benefits to the end user is often related to the total traffic and much less to how long it took to get the information, so long as the time did not reduce the quality of the information or stop the download in the first place (excessively slow)
- Once above a minimum acceptable speed, users do not hugely increase the downloads (see below).

The speed does still matter of course. A major focus has been on faster services. The trend over time is interesting. Earlier Ofcom data, than in the 2019 CMR, has been included.

Figure 2. Broadband speed



Source: CMR 2019, CMR 2012 and Telzed

The speed increases are clearly now *not following* Nielsen's Law. This is a measure of outcomes seen globally that shows leading broadband speeds rise ~50% per year. The UK followed this, but averaged increases are now only ~25% per year (18% to November 2018). **This is a significant difference** as the Nielsen's law trend has been observed for a long time and is tracked internationally. Further, the UK policy has focussed on increasing speeds to achieve EU and UK targets. In recent years a major shift has been to encourage FTTP (or close to premise) rather than FTTC, as used by BT. FTTP is needed to achieve >100Mbit/s and long-term migrations to Gbit/s speeds.

Clearly the recent investments in fibre (much reported upon) and the policy for faster broadband have not maintained the rapid improvement in broadband speed. This *suggests* a failure by Ofcom/DCMS to ensure the industry deploys fibre or fibre-based technologies (FTTC or cable) that delivers higher speeds. Yet more fibre *is* being deployed [as seen in regular announcements in the press from BT, DCMS, and other operators] but it has resulted in slower increases than prior to c2014 when "only" cable, copper xDSL and FTTC were the primary new deployments. The seemingly contradictory outcome is thought to be a combination of the following factors:

- BT and Virgin (UK cable TV operator) were competing on speed as a differentiator in the earlier years. This helped users to take the latest/best offerings

- BT invested strongly in FTTC, and moved users from slower xDSL copper to this fibre-copper solution. Once users moved to FTTC they have not chosen to take faster offerings (no changes in recent years to a faster service)
- FTTC speed offerings are often limited in any case by the underlying technology – users get what the copper can deliver, and cannot opt for 100Mbit/s, even if they wanted it. Slight speed increases occur from limited technical improvements with the FTTC solution. This is likely to have given only a small improvement over time
- Virgin did not need to radically improve its technology as it delivered fast broadband even 5+ years ago. Virgin has not increased its market share (see Figure 3 below) significantly, suggesting its Project Lightning to increase service speed/numbers has yet to show major impact
- Many ISPs re-sell BTs service on a wholesale basis so are pinned by the underlying technical limitations of FTTC
- The main operators have been reluctant to forego speed as a value proposition. Therefore faster services have been priced higher, even though the underlying costs of a faster service are almost the same (assuming the technology remains the same – one of: cable TV, FTTC or FTTP). So FTTC 50Mbit costs the same as 20Mbit/s. Fibre or cable 300Mbit/s costs the same as fibre/cable 80Mbit/s, or almost. Consumers are quite price sensitive and take the lowest speed that works and will "bear the pain of slower services" rather than upgrade until the pain gets too much[10]
- The BT migration to FTTC is well advanced, so there is no technical or major FTTC-coverage development underway to provide rapid increase in average speed
- The FTTP builders – these are mostly alternative network providers – are small and do not have large enough market share to influence the average speed significantly.

The average speed in 2018 was 54Mbit/s, which is arguably still reasonable, when looked at globally[11]. This speed has been achieved without significant FTTP.

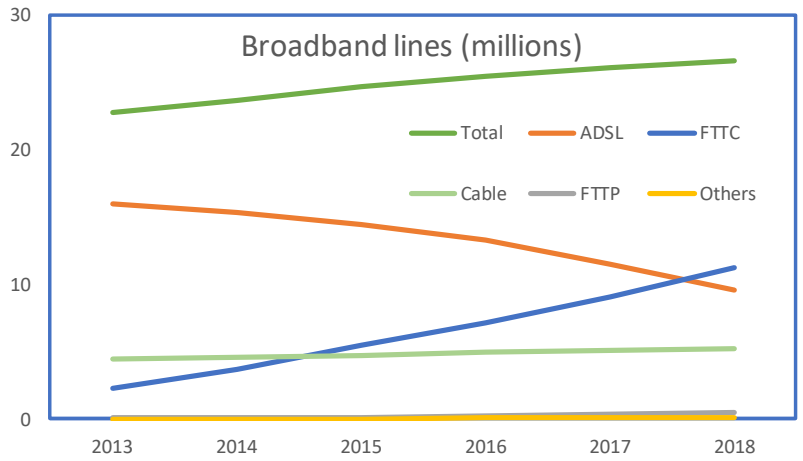
2.3.2 The number of lines has increased steadily

The trends of each technology (below) support the above conclusions. Of course, a degree of supposition is included as the data does not prove the proposed reasons behind the outcomes.

[10] This is one implication of the heavy use of 20-40Mbit/s services (large downloads per month) compared to the downloads by 100Mbit/s+ users. This is shown in the Connected Nations report and discussed in Telzed "Need for Speed" paper. Ofcom data: Connected Nations 2017 Detailed Analysis "Figure 20: Distribution of average data use compared with the average download speed." This is examined further later in this Telzed report

[11] E.g. https://www.speedtest.net/global-index

Figure 3. Broadband fixed lines by technology



Source: CMR 2019

Note the total broadband line numbers consistently rises ~ 3% per year. **This means that there is no evidence of any significant substitution of fixed services by mobile.** Of course some individuals surely do move to being mobile only, but the net impact on the fixed-line numbers is clearly not large.

The data shows that cable (Virgin) has not increased line numbers significantly. This implies that any investment has not focussed successfully on increasing the customer base significantly in new areas. That surely would have also assisted in increasing the average speed.

2.3.3 Upload speed is much slower and symmetric broadband is rare

The average upload speed is only 7.2Mbit/s. This is significantly less than the download. This may develop as a major issue in the near future. Video streaming and downloading data files or shopping are currently the far largest driver for broadband speed and traffic. But, most other broadband services really need *symmetric* services or at least faster uploads than often seen today:

- Gaming
- Video interactive services - healthcare, education
- Conferencing
- Shared use of large graphics files and data bases
- Home web sites and servers etc.
- Virtual reality interactions and tactile sensors. Readers may speculate on the likely most popular opportunities for this.

This has some significant implications for the industry, if the symmetric service demand rises:

- Investment in technologies that cannot upgrade to symmetric speeds will be proven to be short term, possibly causing greater expenditure to upgrade later than if done when the original technology was deployed

- Mobile has probably even less potential to substitute for symmetric fixed. Fast mobile upload speeds would need high transmit powers – likely to breach safety limits, even if the GSM protocols enabled the upload speed. If a user needs fast symmetry, then 5G/4G probably cannot be the solution (it would be nice if this can be proved wrong)
- A new focus by service providers on symmetric services might be sensible, though there might not be much ability *to charge* for the faster upload speed - it only needs a few operators to offer symmetric services for such a premium to be competed down. This is a possible competitive benefit for the altnets deploying FTTP over BT's FTTC.

BT has started to look at symmetric services, but this is only a trial[12]. It is likely that the FTTC technology could not simply upgrade to symmetric services (to be confirmed). BT has widely been reported as having plans to move to FTTP[13]. This arguably implies an effective admission that the FTTC choice was either wrong or only short term. FTTP has long been a viable technology and the pros and cons versus FTTC have not changed – nothing fundamentally new has happened other than new FTTP altnet providers have started to have an impact. An alternative view is that FTTC was indeed the "best" as it minimised investment, stopped any unbundling and worked just about adequately for most consumers in the short/medium term. Contact Telzed for a more detailed analysis of the pros and cons of FTTC and FTTP.

This line of thinking implies a FTTP/x (or other) approach that does *not* enable symmetric services would be a flawed technical choice – the service is limited by the slower upload.

Symmetric applications are not used often. Arguably this is because upload speeds are insufficient. Uploads speeds will not increase without applications creating a demand/need and applications usually do not attempt to make use of fast uploads.

2.3.4 Fixed line speed is (arguably) reasonable but held back by copper and pricing

As noted above the fixed line average speed is 54Mbit/s. Arguably this is adequate for most users using the current downloads. Some more issues need to be understood:

- Inherent skewness in the statistics mean that the median value will normally be less – many customers might wonder why they do not get this average
- The average is pushed up by relatively few users on FTTP or cable that can deliver 100s of Mbit/s
- The marginal cost of say 500Mbit/s over 100Mbit/s is low (if fibre or DOCSIS/cable is used) and so some operators (altnets) may decline the price premium for faster services. This implies that FTTC or other services with speed as a price factor could

[12] https://www.ispreview.co.uk/index.php/2019/06/openreach-set-to-trial-symmetric-1gbps-uk-fttp-broadband-speeds.html

[13] This reports an aspiration for 10million lines based on FTTP: http://www.fcs.org.uk/image_upload/files/UpgradingtheUKcondocfinal_Mar2019.pdf Note that the consultation also implies a need by BT to get other service providers to align and contribute to the BT investment – FTTP is therefore not simply within BTs financial or business control. 10million lines investments if not taken up, could be an almost fatal mistake. Telzed highlighted FTTx risks in 2012 but were well known before then

be competed away once fibre take up is more widespread. Even now Virgin has a price premium for 350Mbit/s over 100Mbit/s of "only" £10 on top of £33/month. With competition this should reduce – the fundamental cost differences should be low[14]

- The lack of correlation of traffic with speed (see below) suggests that the take up of 100s of Mbit/s may exceed the real need for it. Of course users will take a higher speed if the price premium is low/zero.

The above statistics of Figure 3 shows a significant number of lines still on xDSL. This reduces the average. xDSL (and FTTC) have limited ability to improve speed performance on the copper section, therefore the sub-Nielsen's law speed increase can be better understood. Another factor is that FTTC is often not able to deliver the UK average speed – it is a service that has no guarantees and has to be taken on a best endeavour's basis. It can deliver more speed than xDSL but if the copper is long it cannot even meet the current UK targets or the current average. There are other reasons why FTTC may prove to be significant problem for BT and UK broadband – contact Telzed for details.

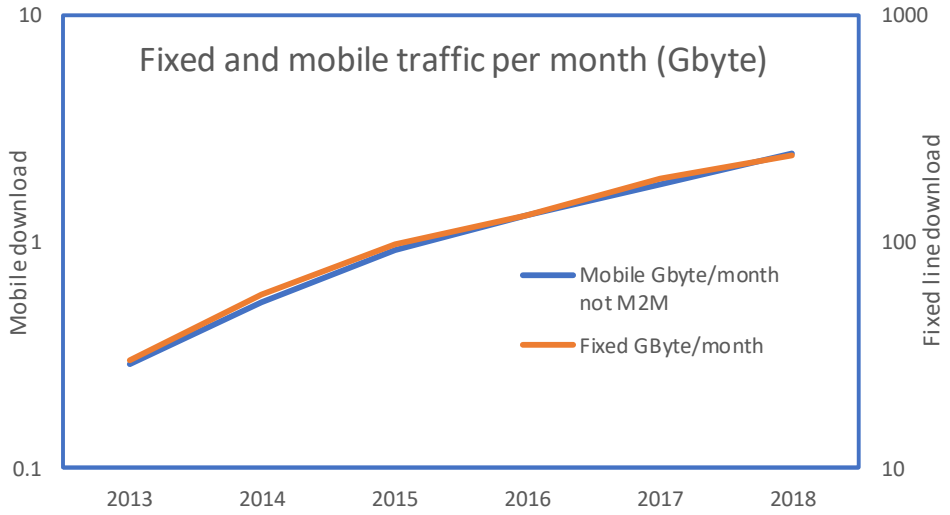
The average speed arguably compares well with many countries. Significantly it is a high value based on a large customer base. It is worth noting that high average speeds may be reported upon (often with high percentage over fibre to the premises) but in total there are possibly few broadband fixed lines in the country. International comparisons should be wary over the average value without appreciation of the penetration levels. In this respect the UK performs well on speed/penetration even if FTTP levels are low.

2.4 Fixed and mobile broadband traffic (download)

The download per month shows the relative usage of fixed and mobile networks. The differences are shown below.

[14] Retail prices may use speed to counter the risk of large traffic usage (which does have *some* cost implications)– which is more likely in a fast service. But, fixed lines are hard to sell with a clear volume restriction. Recent wholesale prices show small price differences for faster services: 1000Mbit/s (nearly 9 faster) is only ~81% more than a 115Mbit/s service, demonstrating the underlying lack of cost versus speed with fibre

Figure 4. Monthly traffic per line or per mobile device



Source: CMR 2019

The following sub-sections develop insights on the downloads.

2.4.1 Mobile downloads

The mobile traffic per device is close to 1% of fixed line downloads per premise. This is consistent over time. The growth of both fixed and mobile is almost the same – 50% per year overall. Mobile growth has slowed in recent years to ~40% per year. This is still a huge increase – causing ~10x capacity growth every ~7 years.

The implied 2019 downloads are ~3Gbyte per month per mobile device. There are significant implications for 5G and 4G evolution:

- 5G will surely take many years to deploy fully in the UK, as evidenced by the 4G history
- If 5G takes 5 years to build significant coverage, then it has to cope with >5x traffic growth in that time. An even more-rapid increase in traffic is possible if new 5G services are promoted and high definition video usage increases (not currently attempted much on mobile devices)
- This means that *adding significant fixed-substitution traffic is surely fanciful*. Coping with the known truly mobile traffic growth is a major burden.

The total mobile traffic has been fairly consistent at about 3.1% of all traffic (fixed and mobile) since 2013. This takes account of the fact that there are many more mobile devices than fixed lines (compare to the ~1% of a fixed line per mobile device in Figure 4). This same fact is also shown in BT data[15] – which also adds predictions that show no swing of traffic to or from mobile/fixed. Both grow similarly to 2024. This data also shows the almost flat

[15] BT Technology business briefing 25 June 2019

(declining) revenue trend as in Figure 1 (note: BT did not normalise the values to account for CPI).

The implications include the following:

- Despite mobile services having respectable speeds and 4G coverage having also improved, there is no evidence of *significant* movement from fixed to mobile: the rising fixed line service numbers, rising traffic and the consistent low traffic usage in mobile networks compared to fixed, confirm this
- 5G has more data capacity and a faster service, but it is unlikely that it will enable significant substitution on fixed lines – 4G had no major impact. This is a point of debate, but basic analyses show this is to be likely without fanciful numbers of masts and the related large investment.

These are important messages, especially as there are proponents that mobile will replace fixed lines. This raises a much wider discussion than possible in this paper: it has been covered in other papers[16]. It is fanciful to consider mobile taking *major* traffic from fixed. The required additional mast numbers is huge. Even if new 5G masts have ~1Gbit/s capacity, and are all utilised close to their limits[17], taking just 10% of fixed line traffic needs mast numbers that are simply unlikely to be feasible. See Telzed papers. More mobile data is also unlikely to give significant revenues – so what pays for the additional masts on top of upgrading existing masts to be 5G capable?

Supporting logic for the dismissal of the "mobile is the primary future" view includes:

- Fixed line traffic growth is unlikely to slow significantly – high definition TV/video, interactive video, gaming etc will surely drive growth. However 50% is a high growth rate and it has reduced (see Cisco VNI data and Ofcom), but even a "low" 30% growth requires 10x more capacity every ~9 years
- Huge traffic growth has been seen for ~30 years in telecoms. Predictions that such exponential growth cannot continue have been made. They were all proved wrong – look at the numbers and sizes of international cables and gateways, for example.
- 10x more capacity is *not a major concern for fixed lines*. The marginal cost of more data is low (larger core networks have huge economies of scale and the equipment – routers and transmission – have falling costs and advancing performance with time)
- 10x more traffic in a mobile network requires almost 10 more masts unless mast capacity increases (which will happen). This increased mast capacity is needed just for meeting the existing/known truly mobile traffic growth
- Examination of the numbers shows that:

[16] See "Fixed-line broadband substitution by mobile" - an analysis of the potential for mobile to replace fixed broadband lines on Telzed site.

[17] With rapidly growing traffic engineering design rules consider the growth to avoid expensive, repetitive upgrades, especially where field deployment is needed (masts). So fully loading systems when deployed, is not usually done as systems are normally built for several years of growth – at up to 50% per year – so, when deployed, a router or mast may be only 30% utilised initially. The rapid growth rate has huge implications for investments that trade off low utilisation (low return on investment) with reduced site-upgrade cost. Assuming close to 100% utilisation of a 5G 1Gbit/s mast is unrealistic for more than a few masts – this directly results in many more masts

- UK has ~50,000 masts
- Assuming "normal mobile traffic growth" rises ~10x in ~7/8 years, this *can* be carried if most masts upgrade to ~1Gbit/s. Mast upgrades are usually cheaper than adding new masts. More masts for the same revenue is a problem
- But adding incremental fixed line traffic (substitution) would need hundreds of thousands of new masts, just to take a small percentage of the growing fixed line traffic, unless mast capacities were huge

- The evidence above is that consumers do not willingly pay more for telecoms. The revenues are roughly constant. We all use more but pay about the same.

The lack of mobile influence may seem counter intuitive to some – we nearly all use mobile more and it plays an increasingly major role in daily life. There seems to be more people who do not need a fixed line subscription. Mobile-only users probably make use of fixed lines/WiFi and employer's WiFi. How else can the average UK download still be close to only 3Gbyte[18]? Large-volume use is surely done on a fixed lines. Mobile use is more intense – about 10x more web sites are accessed per Gbyte than over fixed[19]. Many background tasks are done on mobile devices and short tasks are done. But, clearly the substantive traffic use of broadband is done over fixed lines.

Of course some mobile customers do make fixed-line type downloads per month and new 5G services have seemingly unlimited data. This can be successful so long as the density of heavy-using customers is not too high. If the #Gbyte/month/km^2 is high then the mast density must rise.

It requires a brave person to claim there will be some new revenue stream from new 5G-based services that have not been possible on 4G, *and is enough* to create enough monies for large numbers of new masts. Most fixed line users already have a mobile package, so even if the fixed line were terminated (note: no evidence of this happing in significant volumes is shown in the CMR), there are limited/no additional revenues. Customers will have more data on an *existing* contract. The data and trends do not prove that this new "mobile UK" will not happen, but a service or business plan that is based primarily on data consumption, is unlikely to succeed:

[18] Certainly there are many devices (SIMs) that are low data users so the average Gbyte value is diluted. Even considering this, it is unlikely that many mobile users approach even 10% of the fixed line usage – a 30Gbyte per month mobile tariff is a significant price and surely very few use the 300Gbyte/month needed to replace an average fixed line. Fixed-mobile comparisons need to consider that there may be ~4 devices per household so average mobile traffic might be ~12Gbyte/month which is a significant level of activity, but it is far from the 300Gbyte on a fixed line.

[19] This should be obvious from a little ratiocination. The Hootsuite report shows the UK accesses 38% of web pages on mobile but CMR shows this is done with just over 3% of total traffic. See slide 45: of "DIGITAL IN 2018". Note this data seems sometimes to be incorrectly reported as showing the traffic level – mobile traffic is **not** 38% of the total. This emphasises how we use mobile a lot, yet in reality most ***traffic*** is actually sent over fixed. This may partly explain why some fanciful claims for mobile keep being made – they reflect how we think we behave, not the reality of real network usage. The numbers in CMR and the fundamental limits of mobile masts to carry traffic (#s of Gbyte) *must* be understood (see Telzed papers)

- Trends show the consumer expenditure in mobile and fixed are almost constant: any increase in (say) mobile 5G based services would reduce the spends in other mobile services and in fixed services
- It is very likely that telecom spends are closely tied to total household expenditure on video and TV. There is a major move to online viewing and paid for video/TV (Netflix etc). Could this be sacrificed for a new 5G service?

2.4.2 Fixed downloads

The average download was 240Gbyte/month in 2018 (up 26%), and this implies ~300Gbyte in 2019. This is a slower rate of growth (it was close to 50%), but it is still significant.

The median download is 124Gbyte (up 50% from previous year). This is expected by statistics to be less than the average. The fast rate of growth is probably due to much larger usage from those starting to use more video, but the high-volume users have not increased their downloads by so much (they were already video users). This explains the lower average increase.

The median download is now greater than the UK USO specification (100Gbyte per month). This implies that the specification *is already no longer valid/sensible*. This is a serious matter, given the recent USO definition and the availability of traffic and trend data. Given the traffic growth rate, the USO specification obliges those customers to be in the lowest quartile of users and they will lag yet further behind over time. The more significant implication is that the specification was not properly thought through in the first place[20]. The USO speed target is also slow (10Mbit/s), but this is just about acceptable to many – as shown by the numbers remaining on slow services despite faster being available. This is probably a slightly surprising conclusion, for some readers. This is discussed further below.

The USO specification of 10Mbit/s does not give consumers a choice, and so USO areas could always be held back, if just the service specification is delivered. Given technical options and advances of FWA/mobile and fibre, such a slow speed specification remains questionable.

It is interesting to note that the Ofcom data shows a huge variance in the download versus line speed. There is a relatively low correlation of download with speed:

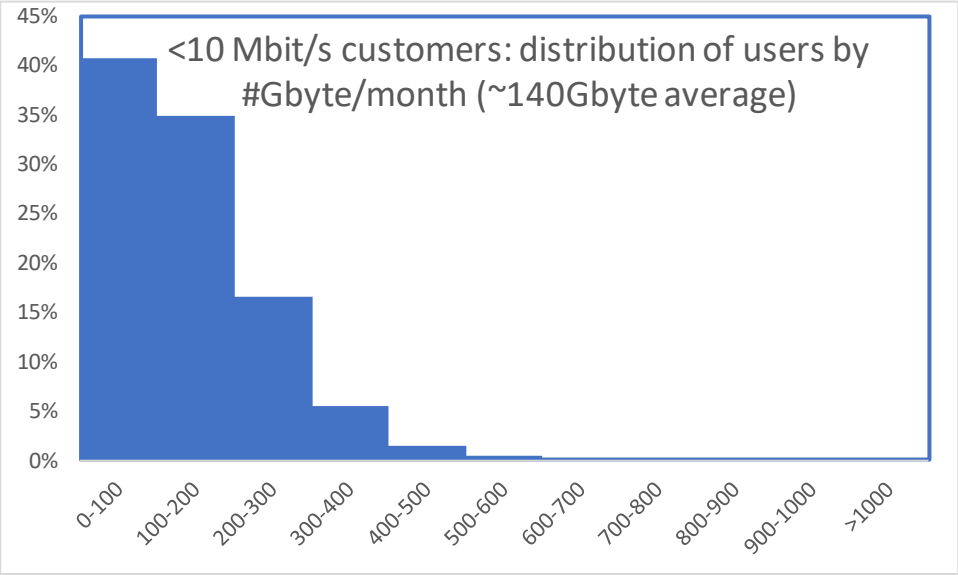
- Once above ~30-50Mbit/s the download does not rise hugely with speed. This implies that users are mostly able to do the majority of desired downloads without excessive delay
- Below 30Mbit and especially below 10Mbit/s the downloads are reduced. This implies that, at these speeds, users are significantly held back. Of course some users may choose the slow speed to reduce expenditure and do not need the higher download, but this is likely to be less common

[20] See Telzed comments on the USO. Example: the specification has contention ratio of 50:1. Contention ratios are not a sensible way to specify the service. The service has no change over time (to the speed or download targets).

- There is a large variance of downloads being made. Even slow lines may download 500Gbyte, and high speed lines might only download 100Gbyte.

This is shown in the figures below.

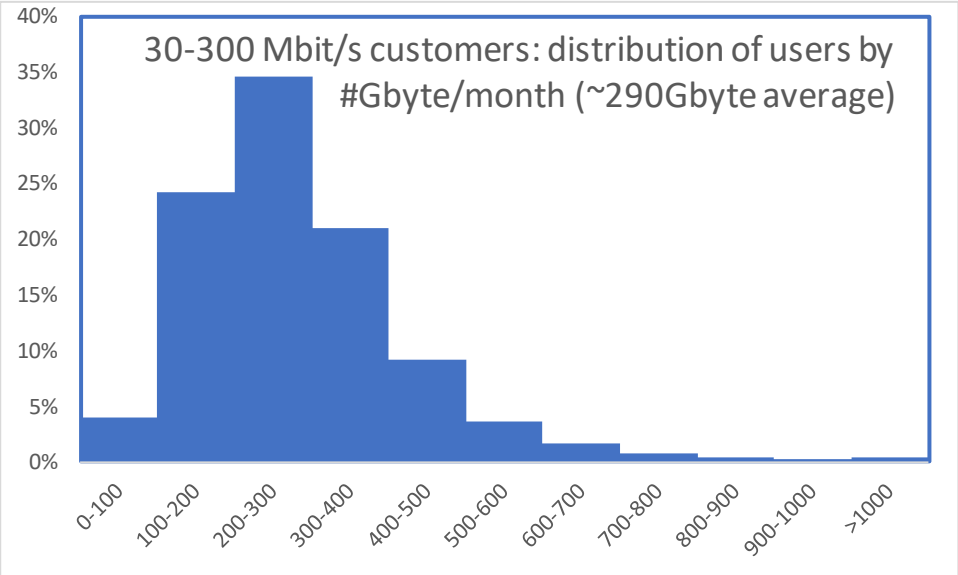
Figure 5. Variation in download



Source: Ofcom Fixed performance data & Telzed

Note how some slow speed users still download large volumes – they will experience slow-downs and video will need to be at a slow rate or may freeze. Only ~20% of customers attempt the average fixed download of 240Gbyte or more.

Figure 6. Higher speed download volumes



Source: Ofcom Fixed Performance Data & Telzed

Note the large variation in usage. Few users download >500Gbyte/month, but they push up the average (240Gbyte) from the median (124Gbyte).

The data implies slow speed users "overload" their broadband, and are held back by the slow speed from doing more on line.

Although many are held back by speed, there is a lack of take up of the faster services[21]:

- Significant numbers of users remain even on <10Mbit/s even if faster services are available
- Few take 300Mbit/s+ services even when available.

This implies:

- Consumers are price sensitive and unwilling to pay more for a faster service. Hence they "overload" slower services – as shown in the download data above
- Many customers are seemingly happy with the lower speed and do not see the need to upgrade. This is a parallel to customers remaining with just PSTN line rental (no broadband) – low income and older customers for example. For many purposes, <10Mbit/s is sufficient, especially if the traffic volume is low, video streaming is not very important, and large file transfers are rarely required. Many households fit this profile. Upgrades also require dealing with the telcos' service supply, changing suppliers and understanding the vague speed specifications - especially in FTTC. Therefore there is an understandable reluctance to change services unless[22] really required
- Delivering FTTP is unlikely to get large take-up unless the price premium is very low – why should a customer pay more for say 500Mbit/s when currently ~50Mbit/s or less is adequate for many users? Also, customers are seemingly quite willing to take a slower service (<10 or 30 Mbit/s) to save money even if it is being heavily used – customers are thrifty and will minimise spends until the pain of a slow service is too much and the pain of upgrading is borne (changing service has a price increase but also incurs the above service-supplier issues)
- It is likely that many users are unwilling to take a faster FTTC service as it is anecdotal – the customer has no idea what speed they will get. Copper based services have almost no ability to define the service before it is enabled – one of several problems with FTTC. Consumers are put off by the uncertainly and lack of specification in advertisements – a sensible requirement to ensure operators do not promise a speed that might well not be achieved. Why upgrade to superfast if the service is not guaranteed and the ISP states it might not actually deliver the superfast speed? Furthermore, consumers are not even able to be sure what speed they really

[21] Connected Nations 2018 and fixed performance data. See also Footnote 4 on fibre take up

[22] Various reasons have been noted for the lack of interest in upgrades in speed. This is worth deeper understandings as customers cannot be simply forced to faster services. Furthermore, those remaining on slower speeds could encourage older technology (xDSL) to remain in use. In the longer term this could increase costs, as lower costs follow from removal of legacy copper and duplicated/parallel fibre/copper networks. See https://www.ispreview.co.uk/index.php/2019/08/the-top-reasons-why-uk-adsl-broadband-users-havent-upgraded.html **The customer attitudes to change and reluctance to upgrade are central to aspirations by the government/regulator to increase superfast penetration and this can lead to a technology choice and roll out that "covers customers" with superfast but does not actually deliver the service to the customers (low take up).** Coverage targets do not deliver actual services. This leads to a wider concern over *coverage* targets

need. Combined with the speed-price premium, they will often avoid over-specifying a service speed

- The lack of higher speed take-up is probably also due to the fact that once a service of c30-50Mbit/s is obtained, it is about "good enough" for most households. It works for most domestic and many SoHo needs – many current video streams will work reliably. A speed that is a reasonable amount more than the video stream rate, fits many premises' needs. This links to the above Figure 2 that shows a slow-down in the speed increase rate over time. Once upgraded to FTTC/FTTP/DOCSIS, but not at the fastest possible speed available, customers are seemingly content and so are not upgrading frequently. This contributes to the sub-Nielsen's law trend. Slower than 50% speed increases[23] are now also seen globally, which suggests similar factors are seen elsewhere.

2.4.3 The data has significant implications for FTTP investments

In the following, additional discussions consider other issues with fibre and related strategic concerns.

The new superfast services will likely need to be sold at similar prices to current copper-based services. If a FTTC service of 30-70Mbit is currently used then many consumers will not take the new FTTP service as the current service is about adequate, at least in the near future. Perhaps the move to FTTP will need to be done with *forced migration* – consumers get the same/similar service *at the same price* but now on fibre. Forced migration at a higher price is unlikely to succeed. Also this means that only very low speed-price premiums will be possible. By this approach high fibre take up is assured (most would surely take faster speed *if* they did not need to pay much/anything for an upgrade to the same service on fibre). This take up of fibre ensures the maximum economies of scale and lowest unit cost and allows legacy network turn-off. This is probably needed to get the FTTP costs down as low as possible.

PSTN-only and slow xDSL customers will probably need to be migrated to equivalent fibre services at almost no cost to the customer. This has additional implications to the business case, though a fibre solution to almost all premises could be lower cost in the long run (a point of debate).

Delivering FTTP (or very close to premise) at the same prices as today, requires that the (debated) cost reductions from removing copper can be achieved. Altnets building FTTP-only do not have this issue – they only have FTTP. They seemingly can deliver FTTP without excessive prices, though they generally do not tackle marginal/high cost areas (B4RN is one exceptional example delivering in rural areas). Migration has major implications for FTTP and especially BT strategies. It impacts Ofcom cost-analysis and price controls. It also links to government plans/aspirations for full fibre:

- Full fibre plans will be distorted by targets aimed simply to "get coverage." A technical deployment that covers an area (but with low take-up), will be chosen to minimise

[23] Ookla based data https://www.speedtest.net/insights/blog/2018-internet-speeds-global/ shows 26% speed increase

investment. This might result in higher costs in the long run if future take up is eventually high

- Fibre take up may remain low as consumers are price-sensitive and remain on a slow service and they "take the pain" even if the speed is clearly restricting use. In this scenario a solution that has low costs for coverage will be better than a choice that delivers minimal costs with high take-up, because many customers will not take the service
- Using fibre to deliver only an existing ~20Mbit/s service because it is cheap and tolerated by customers is a rather bizarre outcome. But can customers be forced to take faster fibre at a higher price? A similar outcome is that PSTN-only customers (there are a significant number of them) will also need the same service, but delivered over fibre. This is already an issue in other countries
- Modelling costs for adding fibre is now often done, and is relatively easy. This *incremental* cost might mask the full picture that includes:
    - Huge shared costs of duct/infrastructure with copper. The common cost needs to be fully considered
    - The avoided costs from radical removal of copper. Savings become most significant when the "last copper wire service in a cable" is discontinued. Dual networks (copper plus fibre) increase costs
    - Using architectures based on existing cabinets and local exchanges ties the costs to the legacy. Altnets are able to break this rule, but can use some BT ducts. Should FTTP be based on a new structure and more radical network design than simply "adding some GPON or other fibre architectures" from the current exchange sites or from existing cabinets?
    - Full fibre and the related economies (claimed low opex in the long run from fibre and multi-service capabilities from fewer central sites) requires a more radical network change[24].
- Ofcom *et al* should move the reporting focus from coverage by FTTx or high-speed services to a take-up measure. Does it matter to users or the national welfare if users have a service that is available but do not take it?
- If take-up is far behind availability this renders some of the investment redundant. This effectively increases costs
- How can users be encouraged to take the faster service to gain the benefits of economies of scale and allow the removal of legacy technology? This implies a bold move to offer speed with a negligible price premium. This *does* reflect the costs of all-fibre, where 500Mbit/s has little cost difference to 100Mbit/s. This needs a change in pricing logic (which is currently: charge more if customers will sometimes pay more, until competition erodes away the premium)

[24] This is the start of a much longer discussion. No one (surely?) building a truly new network based on fibre would be limited by the need to have a local exchange within a few kilometres of the customer. This is ~100 year old design criteria that defines the exchange nodes (and costs) in legacy based migrations. It is not an ideal architecture

- If competition *is* able to lead the FTTP investment, then arguably this must be protected/encouraged. They are mostly unencumbered by the BT legacy[25] of FTTC and copper. Given the issues of: low take up; lack of users; limited real need for very high speed (true today, but the need will increase over time, and some users certainly do already need Gbit/s type speeds), then policies need to be carefully defined. Without this, the BT FTTP strategy will logically focus on the new altnets' FTTP areas as a priority – potentially harming investment and competition in the long run, and therefore discouraging the very FTTP investment that is desired.

The above moves far from the basic CMR facts. However the low FTTP levels and the existing FTTC numbers set the foundation for the problems.

2.5 The fixed line situation and trends create a conundrum

The key points above (low fibre levels today, dependence on copper, government pressures for FTTP, cost and migration issues, speed and download needs etc) are that the strategies for operators, BT and policy makers is more complicated than reaching coverage targets or setting government targets for FTTP. Speed *and* traffic volumes matter to customers. If delivered over cable or fibre/copper, the technology does not matter, if the price and quality is good. It still requires optimal long term technical choices (which is probably not FTTC). The "circle that needs to be squared" covers:

- BT legacy in copper and choice of FTTC. This includes the lack of guaranteed service speed specifications over copper as well as the inherent cost structures. A move to FTTP might be summarised as: "it would be better if not starting from here"
- BT's financial and commercial ability
- Finances/strategies of altnets buying BT on a wholesale basis or if building new networks
- Lack of take up for very high speed, when available
- Price sensitivity of customers. Customers seem to be willing to take the slowest possible speed and minimise payments
- Price premiums when costs do not vary much by speed within a technology class – these may not be sustainable
- Targets for speed, coverage and to deliver full fibre might not align with customer demands
- Large investments needed in fibre
- No significant revenue growth
- Mobile/FWA cannot fill the demand:

[25] They may still use some BT infrastructure such as duct or poles

    - Mobile coverage of land area, roads and in-buildings is an enduring problem. Additional-mast costs are incremental, but the new revenues are elusive. 4G did not alter the underlying business economics from 3G. Will new 5G *telecom* services make the difference, or will it mainly "just:" add more data capacity to 4G?
    - There is no realistic ability for 5G to fill the gap to more than a small percentage of premises, but it could in some localities
    - Fundamental limitations of mobile/5G/FWA to give a guaranteed service speed and even availability of service (is there a building in the way of the mast?).
- A need exists for Gbit/s type symmetric services for a significant minority of customers (should they not get any service just because others do not need it?). UK has many mixed areas – business and residential customers:
    - It may be noted that special services for a few exceptional sites are possible *with the right FTTP technology*, but are not possible with FWA/5G as just one customer that really needs 1Gbit/s with almost no risk of slow-down, is highly unlikely with a shared mast.
    - Fixed lines/fibre can deal with the special needs.
- Need to move to a symmetric service to deliver most of the advanced services and applications.

This paper cannot solve this conundrum. To varying degrees similar problems are faced globally. Those countries already with many masts, or having already made the fibre investment, are naturally better placed. Of course fixed and mobile solutions can converge – with FTTmast close to the premise. However that does not affect the fundamental problems.

2.6 Mobile coverage problems remain

Two CMR coverage figures are of most interest:

- In premises coverage. This is required for any serious use of mobile networks. Users sit down when accessing significant volumes of data or do complex tasks
- Coverage of area and roads. This important when travelling and cover the peripatetic use of mobiles.

Internet data in each of these situations is the key mobile service. Voice level coverage is now much less important than 5+ years ago as data is the primary service that consumers focus on.

Coverage is best defined as coverage by all operators. Any one operator may have better coverage, but users cannot roam to other networks and have limited opportunity to select an operator that has coverage in the desired locations.

2.6.1 The outcomes are not good

4G is now generally available and most data is now carried on 4G. 4G in premises coverage has risen from 42% May 2015 to 78% of premises with good indoor 4G coverage from all four operators by January 2019.

4G coverage reached 57% of A and B roads by January 2019.

This can hardly be considered a very good outcome:

- More than one in 5 premises are likely to not have a useful signal – never mind the anecdotal issues of no useful signal in some rooms (many users have experienced the need to move location in a building to get a decent signal)
- More than 40% of the road locations, when travelling have no signal. This overstates the true situation as busier roads probably will have better signal coverage. It still means that when travelling, users cannot assume any signal will be available when needed
- The key benefit of 3G and 4G, of *mobility*, is not met to a level that allows users to make a reliance on service being available. Therefore mobile data can never be considered as something to be relied upon and user behaviour will use WiFi/fixed when available (say when stationary if travelling) or users simply do not rely on mobile. Mobile cannot be considered as a vital service – this excludes many service applications. **The 5G transformational world of high availability and always in-service applications is enormously different to the real 4G (or 3G) world, even after many years of network build**
- An almost identical situation today with 4G, existed with 3G in 2014/15: in 2014/15 only 71% of the UK premises had indoor 3G.

Related to this is an ongoing discussion on poor rural coverage. These same areas often do not have good fixed line services. 4G could have been used to deliver services. This has not occurred on a widespread basis, but roaming is now being discussed again. Without this take up would be very low as consumers do not know which network can service them and changing contracts is not liked. Perhaps the mobile operators desire to be the only supplier, and Ofcom's view that competition would deliver the coverage, has caused a worse outcome for consumers and operators than if they had supplied *some* service, even if it might be roaming (given or taken).

2.6.2 Issues

This has some serious implications:

- The same lack of coverage with 3G has been repeated with 4G
- Users therefore make an anecdotal choice to use mobile if available and if they are confident of a signal in the location. If uncertain, then they will not rely on it. This makes a decision to substitute or even just to use more mobile, harder – users will not rely on mobile and will plan to use a fixed-network when in a suitable location
- This hugely undermines the prospects of any fixed substitution by mobile. This is one reason for the lack of evidence of any significant substitution in the Ofcom data. It did not happen significantly with 3G (even when it compared well to xDSL speeds) and now has not happened with 4G. The same story is surely likely with 5G for similar

technical/commercial reasons that relate to the fundamental limits of mobile to carry a lot of traffic and the huge disparity between fixed usage versus mobile usage[26].

There are some possibilities of multi-SIM mobile devices to get coverage or for the operators to develop localised roaming between networks. Given the pressures to improve coverage, perhaps these old ideas will become more relevant.

2.6.3 Causes

The reasons behind the above points include:

- The fundamental limits of masts to carry a lot of traffic
- Coverage of area and good signals in-buildings, requires mast investment
- Marginal returns for more masts for coverage or better signals: they are under used and less profitable
- The business case for covering roads and land area is limited and becomes almost hopeless in areas that need broadband USO or other funding to deliver a broadband signal, without the funding assistance
- Mobile operators know there is no point trying to substitute for fixed (other than to low percentage of users) due the huge mast investment needed. See for example Vodafone's fixed *and* mobile approach
- Lack of any telco-chargeable services to pay for more data traffic and better coverage.

The above *is* seemingly recognised and Ofcom and DCMS do not envisage massive broadband change with 5G. It will be a major *addition* to fixed lines and we will need and use both fixed and mobile. However some others think or claim differently (i.e. mobile *is* the primary future).

2.7 Fixed Wireless Access

2.7.1 FWA background

CMR data has some data on FWA services[27]. These have been persistent niche solutions in the UK and many countries. In the UK these have generally failed to make an impact. The reported data is now more relevant as FWA could be viable as a niche solution and for the USO. FWA using 4G or 5G can deliver adequate speed. A primary problem is that, like mobile, the mast is a shared item and *traffic* in busy hour can slow the performance. This

[26] Mobile *can* carry more traffic than fixed, but generally this is seen in developing-economy countries with low total traffic per capita. See Cisco VNI data. Some developed countries like Austria and Finland lead in mobile use, yet fixed traffic is still dominant. Mobile usage even there is still far behind the UK ~300Gbyte/month of a fixed line – even allowing for more mobile devices in a premise (see tefficient data and Telzed papers)

[27] See Annex 1: Performance of EE fixed wireless broadband connections, of: "UK Home Broadband Performance" published May 2019

traffic limits the number of customers per mast. NB this is discussed in other Telzed papers. So a 50Mbit/s capacity mast could have up to ~50 subscribers downloading 100Gbyte per month (USO specification).

To replace fixed lines, a 1Gbit/s mast can cope with up to ~100 premises, assuming it is designed to cope with future average demand of 1000Gbyte/month (likely in not many years' time). Even fewer premises are possible with additional allowances for growth and statistical variances: masts are installed to allow for growth over time and at busy hour, the average traffic of all subscribers should be less than the 1Gbit/s limit.

Note how the download is critical. As this is now ~300Gbyte on average, and rising, the premise numbers per mast will drop. Surely the business case will need to cope with several 1000Gbyte/month in say 5+ years' time. Further, the service is statistical and will be subject to slowdowns depending on local traffic and how heavily the mast is loaded. This is more critical when there are few customers – the traffic variance is greater. So a service can be impacted by local users in the same street, if they are heavy downloaders of traffic.

The rapid rise in the median download (to 124Gbyte) suggests a further problem for FWA (and mobile) to replace fixed lines. It is reasonable to have a FWA business plan that addresses only lower-volume customers, say those who use <60Gbyte/month. This is feasible on mobile/FWA, with good mast capacity and it allows a reasonable number of customers per mast. But this is already a very small percentage of households – **so the FWA business plan has to assume a low penetration of premises –** the mast has then to cover a large area**.** How can a business plan target these lower volume users? If many average users (>300Gbyte/month) take the service, then the masts are probably overloaded.

2.7.2 FWA speeds show problems

The CMR reports significant slowdowns at busy hour. This is relevant as it shows the problems inherent in heavily used mobile or FWA masts. As the service is embryonic the data may not be representative, but it is reasonable to expect an initial service launch to give a good service.

With high speed masts using 4G or 5G technology, FWA is likely to play a greater role. The lessons from history should still be heeded. Similar issues remain such as: the ability to cover every premise in a cell; or the ability to carry large traffic volumes; and to upgrade capacity over time. Implied focus areas include USO; localised developments; and low market penetration over larger areas. The latter is an interesting market play, if spectrum can give in-building coverage of larger areas. This has low initial costs, unless the demand (traffic or customer numbers) rise and mast numbers increase. Can the revenue expand proportionately?

2.7.3 FWA still has a role, but has similar mast-capacity issues as mobile

Ofcom rightly highlights the potential for FWA *and* mobile to have a role in broadband delivery. The busy hour traffic issue (resulting in slower service) rightly highlights the fundamental limitations.

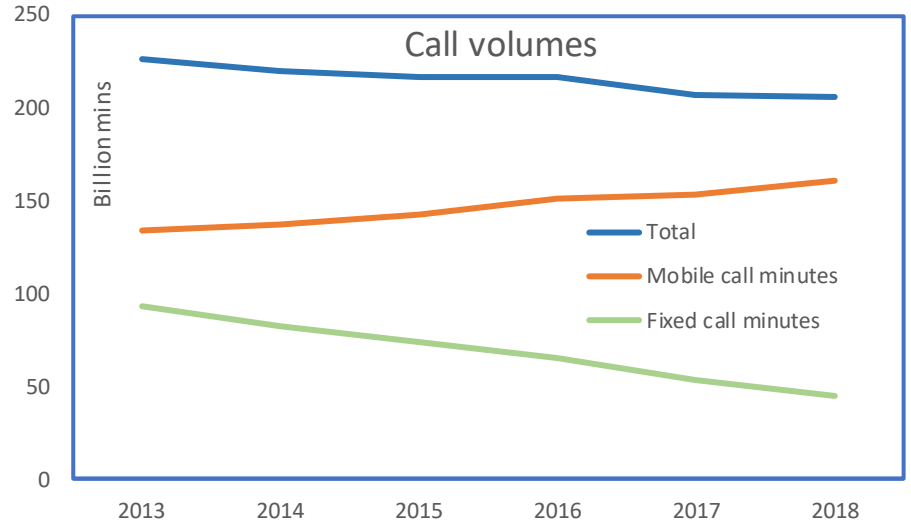
Note that this discussion does not mean that FWA/mobile home broadband cannot succeed. Localised FWA solutions and FWA with low penetration (large cell sizes, few customers/km) and large mast capacity means that it has a possible role. **The basic numbers of traffic and mast numbers means that it cannot be a significant solution for large scale UK fixed**

line substitution. There are a number of other obvious limitations – many of which contributed to past FWA broadband and telephony solutions failing in UK and elsewhere. Contact Telzed if help is required on this subject.

2.8 Voice traffic

This is arguably not hugely important in terms of revenue and many communications are now done by alternative means: messaging, VoIP/OTT, WhatsApp et al, social media et al. The demise of traditional voice telephony (voice calls – PSTN over fixed or mobile) has still not occurred as shown below. The demise was predicted ~20 years ago, but the death has been slow (fixed) or elusive (mobile where volumes are now rising slightly).

Figure 7. Voice traffic volumes



Source: Ofcom CMR 2019

The data shows:

- Fixed voice has lasted much longer than some probably predicted. Alternatives of mobile and OTT voice have only made slow, but significant, impacts. It is likely that OTT is incremental traffic (used in a different way to PSTN), but this is not in the Ofcom data
- Mobile has not fully replaced the lost fixed line traffic. Arguably it is a surprise that mobile traffic actually increased at all, given that OTT now works well over mobile data and over fixed broadband
- For many users mobile and OTT are not obviously full substitutes for fixed calls. Fixed line rental numbers have also held steady (only down from 33.4million to 32million 2013-2018).

The persistence of fixed line rental is probably due to the fact that price bundling means that there is little benefit from terminating a fixed line in the UK. The broadband rental price on its own would rise. This follows from the basic fact that the main costs of the fibre, cable or copper remain in place – avoiding one service does not reduce the costs significantly. Further, a small reduction in PSTN line rental volumes is not accompanied by a reduction of physical fixed lines numbers – as shown above in Figure 3, broadband line numbers have

risen. This implies a small percentage now do not take a PSTN line, but more premises now take fixed broadband as "broadband only," even if the price-benefits are low.

Note that retail prices are not easy to compare and Ofcom now does not report fixed and mobile calls separately from data or line rental. This is sensible as calls, line rental and broadband are mostly bundled in both fixed and mobile.

An area to look at further is the marginal cost of fixed line calls. This matters for low volume users – often low income or older customers who may not have broadband. Retail prices are sometimes far above costs. This was an issue seen by Ofcom several years ago when line rental and fixed line retail prices *rose* despite falling costs and falling wholesale prices in a "competitive" market. This shows that markets need not behave as expected and are far from high street shop levels of competition.

3 Comparison to CMR 2012 and DSR

A selection of the summary/highlight comments from the Telzed review of the 2012 CMR and earlier market data is included below, with additional commentary to link the points to the CMR 2019. Overall the key message is: **many of the fundamental concerns in the UK telecoms markets remain almost the same as in 2012.**

"*Overall consumer spends show no growth.*" This remains equally as relevant.

"*Superfast broadband take up has lagged behind availability… This suggests that the demand for such speed is currently limited. This has major implications for investors and regulators, since the take-up rate and the final take-up penetration of superfast broadband have major effects on the prices that must be charged*." This message remains valid. This is a worrying issue that impacts investment and possible lack of return in FTTP

"*Mobile broadband growth is limited. It is not seen as a viable replacement for fixed line broadband access. "Large screen" use of mobile services is not a threat to fixed lines.*" This remains true – as shown by the relative traffic levels and the lack of substitution. This is perhaps a surprise to many as "mobile is the future" type claims persists and most people make more use of mobile. The facts show that the UK also makes almost equally more use of fixed. As noted above the mobile use is different – many webs sites and Apps are used, but each are not used as intensively as the fewer fixed line services which consume ~100x more traffic.

"*Mobile value is more in small screen devices (smartphones and similar) but this does not require large volume use of the mobile network. As mobiles have some control of the end device and applications they can partly tap into the value end of the value chain.*" This fits with the above point. However mobile operators seem to have been unable to directly benefit from the Apps and OTT services, except in the device market. In part this is due to net neutrality regulations and competition that make it hard for an operator to charge for a service when other OTT suppliers can supply a similar service.

Mobile operators do not show any inclination to take the voice market from fixed operators in a price war. Mobiles *have* now been able to take much of the fixed voice traffic, but arguably there was not really a price war. Voice costs and prices are now low, as investment is dominated by data demands, so voice pricing is frequently bundled and at a low marginal rate. The trend to use less fixed voice is simply continuing the earlier trend. Mobile voice has been successful in maintaining volumes, but whether this gave a significant revenue benefit is less clear. It is likely that mobile voice revenue simply became part of "all mobile revenue" - data+voice - and as this was almost constant, only a relatively low revenue gain was obtained.

Alternatives to traditional voice – messaging, internet-voice in all its IP forms, as well as video are now viable and are taking shares from the traditional fixed line market. Surely, this is still true. Perhaps the surprise is that the decline remained slow/steady in fixed, and mobile volumes remains so constant. Arguably the alternatives are not as liked by consumers as some might have predicted 10+ years ago, to form a substitute, but the alternatives provide *incremental* traffic and are used in different ways (long calls and meetings) that would never have been done on a traditional fixed or mobile call.

For telecoms service providers to increase value they must increase their share of the finite/static revenues of the market and/or else reduce costs. The static revenue issues remain. This is hugely relevant to 5G and FTTP investment.

"*Moving into new markets such as content supply or TV is a very high risk move."* This is not analysed within the CMR 2019. The point is still valid and the many problems and recent changes announced by BT testify to this (see press coverage and BT Accounts[28]). This has deeper implications today as it impacts FTTP investment as the wholesale market and competition are heavily influenced by BT's actions and ability to invest.

"*The fixed to mobile migration of customers and revenues seems to have slowed or stopped."* This is still the case – this may be a surprise given the "future is mobile" claims.

"Fibre (superfast broadband) take up lags well behind availability." No change since 2012 but the line numbers has increased. This is now a major political issue and as the Prime Minister (Boris Johnson) has made recent announcements on more FTTP.

"Fixed voice has a long life ahead, even if the volumes and revenues will decay further… telco income is moving to other services, including general access rentals [bundled lines and broadband]." This remains true, but the fixed traffic levels are now much lower – the steady decline remains, without a sudden fall. Possibly this is partly due to residual business-usage of fixed lines. Price bundling, PSTN-only customers, and concerns on the quality or interworking of alternative voice services (such as OTT) have surely helped to retain traffic.

"*..the basic observations that 3G is not available in many areas."* This situation – lack of 3G coverage and "not spots" [reported on in other studies in ~2012] - is almost identical with today's 4G: coverage is still a concern, but now with 4G. Perhaps Ofcom failed to set proper targets and obligations or else the economics of covering areas with lower traffic remains poor and the mobiles cannot/will not do it. This is a major subject as the debate now moves to 5G.

"*…predictions that the "future is mobile" that were being made in the past, have not happened*." The same conclusions are valid today.

The following relates to the DSR review submission made by Telzed.

"4G coverage (42% May 2015) is a low coverage level." Coverage remains an issue.

"…where even today only 71% of the UK premises have indoor 3G." The same concern remains, but now with 4G.

Overall it is remarkable that 2102 and 2019 views of the market (based each on 2011 and 2018 data) show such similarities.

[28] Contact Telzed for more on this. BT has announced sales of parts of the business. BT Global still remains a problem after many years of value dilution. The TV business probably needs investigating. BT seems unclear if FTTP or FTTC is the best way forward – both have pros and cons

4 Conclusions

4.1.1 Headline points

The main conclusions (extending from Section 1.3) are:

- Little has fundamentally changed from the 2012 CMR with respect to the ability for mobile to deliver voice or broadband data. The trends have continued and mobile remains eclipsed by fixed, in terms of data volumes. The relative amounts of traffic on fixed and mobile have not been changing significantly. Traffic growth of both remains significant - c30% per year
- Less than 4% of traffic is on mobile – there is no sign of a switch to mobile instead of fixed
- Fixed line broadband numbers increase. There is no sign of significant substitution by mobile (termination of fixed services)
- Revenues remain static, or close to. This implies problems for major incremental investments in FTTP or 5G. This implies 5G will fill in and expand 4G capacity but may not rapidly cover the country with superfast broadband. The slow deployments and low coverage over time seen for both 3G and 4G give evidence for the lack of rapid and wide-scale deployment of 5G by the mobiles
- The CMR provides no evidence for future 5G services. *If* they will provide incremental revenues for new masts, then this provides a platform for increased broadband data volumes and addresses the current coverage concerns of 4G
- Mobile devices are used for many applications, but each device, web site or application uses less traffic than fixed line broadband services/applications, on average. Mobile is therefore used in a different way – short updates and small downloads from many sites. This is important to explain why mobile seems to dominate our lives, yet the traffic is so low, relative to fixed. In turn this may explain why some “mobile is the future” claims are made. The perceptions reflect the perceived/real value in the many transactions, not the traffic volume
- Mobile-only customers/households may becoming more common but the traffic volumes imply they must be making use of fixed lines (WiFi/office/friends)
- Coverage of 4G remains a concern, as it was with 3G. This may be a failure by Ofcom to force the deployment or else it reflects the business economics and technical limitations of the UK mobile operators. It may not be possible to cover most premises or roads with an adequate signal. This puts the 5G applications that rely on a signal being always/mostly available in perspective: given the problems with 3/4G will 5G be able to cover the country and premises in just a few years? This seems unlikely
- These trends and numbers give ample thoughts for aspirations to improve FTTP and improve 4G/5G coverage. Both fixed and mobile have problems. The wider issues also relate to the performance of the operators. Lack of revenue, lack of growth, business problems etc. mean that investing huge amounts in 5G and fibre have barriers to overcome. Where are the revenues to pay for it? Perhaps a radical

approach that reduces network costs could work, if low opex of fibre prove true *and* legacy (copper) systems and architectures are terminated. Unless this is done a cost-hump of dual technologies is surely far from optimal

- Ofcom and DCMS seem to concentrate on coverage targets by mobile, superfast and fibre. "Be careful of wishes" - as a solution that gets cheap coverage (e.g. fibre is available if you order it), might be worse long term with better customer take up. Operators know that a small short-term investment may save money now but later upgrades could be more expensive, so the investment decisions are complex
- Take up lags availability of service (coverage). Although inevitable, major lags should raise alarm bells for government and operators' strategies. UK customers seem willing to take as slow a service as possible and have downloads that overload it, rather than pay more. The slow speed is adequate for some, or else they are unwilling to pay more. A large fibre-speed price premium is therefore unlikely to work for many. Moving customers to a faster speed or a new technology may be required at the same price. Operators have to bear the cost to benefit from the long run gains from the new/better technology and deletion of the legacy networks.

4.1.2 Deeper problems exist and additional data could help

The figures and technical reality make UK aspirations for FTTP, subject to a number of problems that do not have a simple solution. More radical solutions are probably needed than "simply" defining a BT wholesale product for new FTTP.

Market data should show clearly the take up of broadband, coverage and physical-delivery of FTTP. The UK data would be better if were consolidated into fewer sources. Mobile coverage data should concentrate on in-building signals. Peripatetic use still needs land-area, roads and population coverage, but most "serious/volume use" of mobile is probably done "sitting down in a building."

Reporting the numbers of base stations and masts would be a useful addition (this shows industry investment) though definitions require finessing.

More analysis is required that looks at the demands and customer needs, to build strategies that take allowance of the current situation and the deeper implications of the markets. This type of analysis and thinking is beneficial in all countries. The headline traffic and customer numbers/trends are important, but these really need a full understanding of why they occur and how they may impact future tends or the ability to meet government or operators' targets. This report gives some insights and ideas of these factors.

An important message from this paper is the need to understand the market numbers in detail and to know the underlying causes. This has to be linked to understanding of the businesses themselves (e.g. huge profits would allow options that are unlikely today in the UK). These link to the operators', regulators' and government strategies and then to the actions needed to obtain the desired outcomes. This report has concentrated more on the wider/strategic insights to emphasise that the market data is more useful in this wider context. Wider insights need much more than just the headline values. These (for example) do not show the significance of the UK growth in alterative builders of fibre to the home – they are currently such a small part of the total. In the UK this fibre deployment is still emerging but surely it is causing BT to alter its plans. Regulatory and government actions need to understand these changes or else such competition will fail, as have many other telco ventures in the past.

Fibre investment is desired for mobile and fixed, so a new approach is surely needed. Should this be protective of the new altnets?

All countries need to fully understand their markets and to learn from other countries. This should improve the actions to move towards the desired goals. Defining these is a more complex task.

Please contact Telzed (R Steele) for discussions and further assistance with these and related issues in any country. National strategies, business plans, regulations, and investment decisions can all benefit from an appreciation of the situations, trends, economic factors and technical capabilities.