

Leased line pricing in the context of “all-IP” transition

A report for BT

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Executive summary

Ofcom's Business Connectivity Market Review (BCMR), published in June 2015, proposes to regulate the price of low speed (up to 8 Mbps) traditional interface (TI) circuits using a CPI-12.25% pa price cap (versus the current price control of RPI+2.25% pa). We assess the impact of this proposal in the context of productivity gains from "all-IP" transition.

The migration from traditional to contemporary business connectivity services

Demand for low speed traditional interface (TI) circuits has declined substantially over the past four years. The main drivers for migration include withdrawal of sub-2 Mbps services from 2020, substitute Ethernet First Mile (EFM), next generation access and wireless products, and contemporary interface (CI) services offering a lower cost alternative above 8 Mbps.

The main barriers to migration are the costs which users face in making the transition to a more modern technology and inertia.

The prospects for continued migration away from TI circuits at historic rates are good, as long as there are no significant reductions in TI circuit prices. (Historically CI prices have fallen relative to TI prices).

The impact of Ofcom's proposals on migration

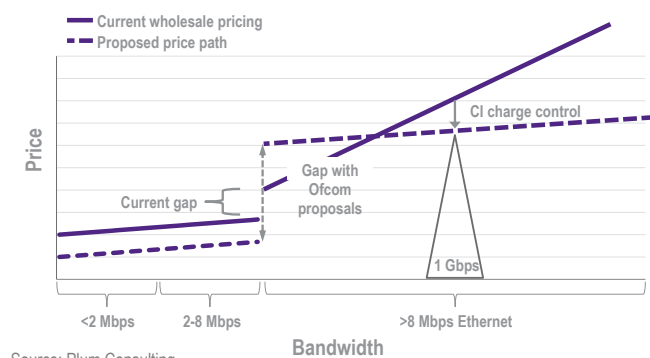
Ofcom's proposals would slow migration away from legacy low-speed TI circuits since the proposal would reduce the price of low speed TI circuits by around 40% over the market review period.

Given that sub-2 Mbps TI circuits will be withdrawn from 2020, the proposed price reduction would both encourage sub-2 Mbps TI users to move to 2-8 Mbps TI services and discourage existing 2-8 Mbps TI users from moving to CI circuits (and other modern technology services).

The BCMR proposal to introduce a dark fibre access remedy would also lead to a flattening of the price-bandwidth gradient for CI products. This would push up the price of low bandwidth CI services, thereby discouraging migration to these services.

The combined effect would be to increase the price gap between low-speed TI circuits and similar speed CI circuits, creating a TI price trap, and perpetuating use of legacy TI circuits. The following figure illustrates.

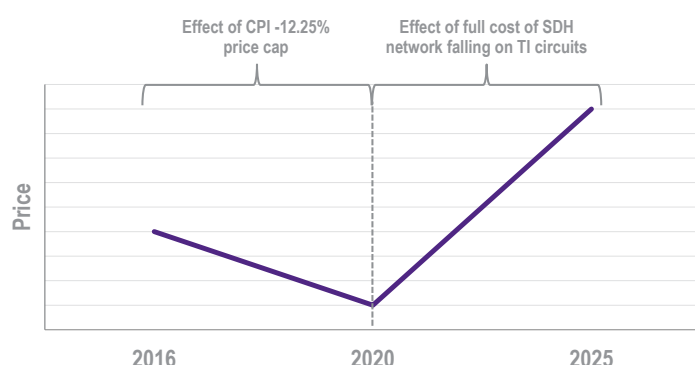
The "Traditional Interface price trap"



The wider consequences in the context of an all-IP transition

BT is planning to migrate its voice services to all-IP, area-by-area, between 2020 and 2025 and to phase out use of IPstream. This would mean that the full costs of BT's Synchronous Digital Hierarchy (SDH) network, currently shared with voice services, would fall almost entirely on TI services. This would introduce a price shock for TI users, as illustrated below. TI users caught by the price trap would pay increasing prices from 2020 onwards until they could migrate to alternatives. These users would also incur the costs of a double migration.

Price path of low bandwidth TI circuits



Source: Plum Consulting

Other operators in Europe are implementing rapid transitions to all-IP which, in a number of cases, involve closing the SDH network as well as migrating voice services to all-IP before 2020.

Given that BT is planning an area-by-area migration to all-IP voice services between 2020 and 2025, a full rationalisation to all-IP and corresponding gains in terms of productivity and innovation, would require a full migration of business services to CI circuits by, or soon after, 2020. (Since business connectivity services are often utilised at multiple sites an area-by-area migration is not feasible).

Ofcom's current proposals, by slowing the transition of business connectivity services to CI interfaces, may therefore constrain the option to bring forward all-IP rationalisation in an efficient and timely way. A more rapid transition represents a larger dynamic prize, with a payoff for productivity for the UK economy, than the potential short-term static gains from fine-tuning TI service prices.

More rapid migration would also encourage further innovation and competition in the market for alternative business connectivity services, since innovation is focussed on the new rather than the legacy market.

Promoting efficient migration

In a previous Plum report "Leaving a legacy" (May 2015) we concluded that allowing pricing flexibility for legacy services would promote efficient transition since suppliers will have an incentive to price efficiently and manage service termination given the costs and benefits of transition. In relation to other transitions, including the copper-fibre access market transition, Ofcom have followed the anchor product approach, which allows increased scope for pricing freedom whilst also constraining scope for exercise of market power via a chain of substitution. The anchor approach would appear well suited to transition underway in the business connectivity market.

Conclusion and proposed way forward

If implemented, the current Ofcom proposal to substantially lower the price of legacy services would discourage migration from TI services. This would:

- Delay and result in double migration for sub-2 Mbps users who migrate to 2-8 Mbps products.
- Introduce a price shock from 2020 as remaining TI users bear the full costs of the SDH platform.
- Delay the productivity gains from comprehensive all-IP transition.

A preferable approach would be to allow greater pricing freedom in relation to legacy services and flexibility in relation to termination of such services, in order to promote efficient and timely transition.

We propose that TI products not be subject to wholesale or retail price controls. Should Ofcom be concerned that the anchor constraint from alternative services may prove insufficient as a constraint on legacy service pricing, an RPI+ safeguard cap could be maintained, consistent with rapid migration.

1 Introduction and context

The UK's business connectivity markets are in transition from traditional interface (TI) circuits, where legacy PDH and SDH networks are used for core transmission, to contemporary interface (CI) circuits, which use IP technology. Under current price regulation this migration away from TI circuits is occurring for TI products at all bandwidths – whether sub-2 Mbps; at 2 to 8 Mbps; or at over 8 Mbps.

Ofcom has recognised the need to allow BT flexibility to manage this transition away from TI legacy products in its latest business connectivity market review (BCMR) proposals¹ in that:

- It has agreed that BT can withdraw sub-2 Mbps TI products by 2020.
- It has lifted retail price controls on sub-2 Mbps TI products.
- It has lifted regulation entirely on medium and high bandwidth TI services.

However, Ofcom proposes stricter wholesale price control on <8 Mbps TI circuits – by tightening the price cap from the current RPI+2.25% per annum to CPI-12.25% per annum.

In this report we assess the likely consequences of this proposed change on the migration away from TI circuits in the context of all-IP transition.

More generally we note that all-IP transition is discussed in the Ofcom Strategic Review of Digital Communications Discussion Document.²

All-IP transition should be assessed holistically as part of the strategic review since consideration of transition on a product-by-product basis is unlikely to reflect the overall prize in terms of productivity and innovation.

Further, the Government's productivity plan includes a section on *"Regulatory frameworks that support disruptive business models, innovation, emerging technologies and the digital economy"*.³ Timely transition to all-IP would contribute to delivering on the aims of the Government's productivity plan.

Finally, transition should be assessed from a dynamic rather than static perspective, which may result in less emphasis on cost orientation in the near term given the prospective payoff in terms of efficiency gains.

¹ Ofcom. May 2015. "Business Connectivity Market Review: Review of competition in the provision of leased lines." http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/summary/BCMR_Sections.pdf

Ofcom June 2015. "Business Connectivity Market Review: Leased lines charge controls and dark fibre pricing." <http://stakeholders.ofcom.org.uk/consultations/lcc-dark-fibre/>

² Ofcom. July 2015. "Strategic Review of Digital Communications – Discussion Document." <http://stakeholders.ofcom.org.uk/consultations/dcr-discussion/>

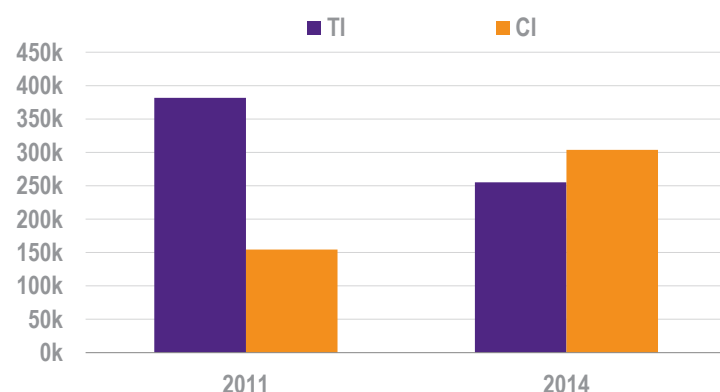
³ HM Treasury. July 2015. "Fixing the foundations: creating a more prosperous nation." <https://www.gov.uk/government/publications/fixing-the-foundations-creating-a-more-prosperous-nation>

2 The migration away from TI circuits

Over the past three years there has been a strong market trend away from legacy TI circuits to use of CI circuits and other modern access technologies for business connectivity. Figure 2-1 compares the installed base of TI and CI circuits in 2011 with that in 2014.

Figure 2-1

The changing balance of TI and CI circuits



Source: Plum Consulting, Ofcom

Note: Radio backhaul services are excluded; 2011 data comes from Table 8 of BCMR October 2014; 2014 data comes from Table A15.10 of BCMR May 2015

98% of TI circuits are low-speed circuits – which we define as offering a bandwidth of 8 Mbps or less. There are two main categories of such low-speed TI circuits;

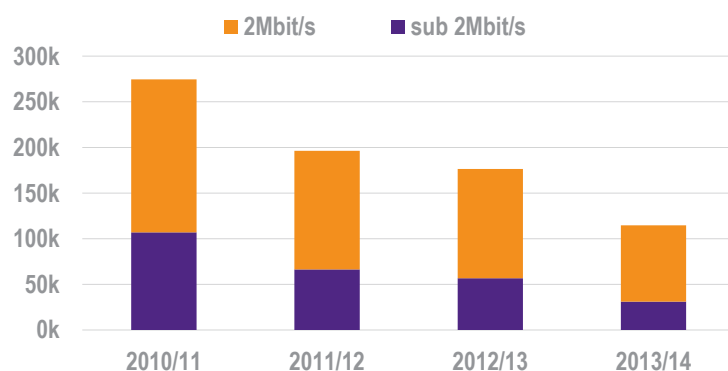
- Partial private circuits (PPCs) where BT has just under a 90% market share (Table A15.10 of BCMR May 2015).
- Radio backhaul services where BT has a 23% market share and where most circuits are self-supplied by mobile operators (Table A15.11 of BCMR May 2015).

If we examine BT data on low speed PPCs we find that the number of circuits fell by 58% over a three-year period – from 275,000 in 2010/11 to 115,000 in 2013/14. Figure 2-2 illustrates.

Figure 2-2

The decline in low-speed TI circuits

Wholesale and retail



Source: Plum Consulting, Ofcom

Note: BT circuits only. BT has a market share close to 90% and we would expect the decline shown to reflect the decline in the market as a whole.

If historic trends were to continue, we might expect a further reduction from 115,000 to 20,000 by the end of the next market review period (excluding radio backhaul services). This reduction in demand for TI circuits might accelerate further as the quality of Ethernet access provision improves.

3 Prospects for continuing migration

In this section we consider the prospects for continuing future migration away from TI circuits.

3.1 Drivers for future migration

3.1.1 Withdrawal of legacy services

Ofcom has approved⁴ BT's proposal to withdraw its PDH-based sub-2 Mbps services by 2020.

There is growing recognition amongst customers that TI circuits are provided using old technology equipment, which will need to be phased out. Ofcom notes that awareness of the withdrawal of very low bandwidth leased lines is good:

"...it appears that the level of awareness is, in general, good among CNI operators in most sectors and that most CNI operators are either formulating or implementing plans to migrate to more modern technologies." Paragraph 3.5, BCMR: VLB leased lines, 15 May 2015

Ofcom also observes that:

"TI services and some of the equipment used to provide them, for example SDH transmission equipment, are relatively old and therefore BT may incur costs in repairing, and in some cases replacing, these assets over this control period." Paragraph 7.67, BCMR Charge Control, 12 June 2015⁵

3.1.2 Availability of substitutes

The European Commission comments on the chain of substitution linking TI and Ethernet services:⁶

"These access products are not necessarily all direct substitutes of each other. However, they may still form part of the same market, provided they are in a so-called "chain of substitution". At one end, there are the terminating segments of traditional interface leased lines, which have been found substitutable to "carrier-grade" Ethernet services for all but the most demanding business applications. At the other end, users that can make some concessions on certain quality-of-services aspects could switch to a high-quality access service, which is not necessarily a terminating segment of a leased line. Nevertheless, as a result, the products we find at both ends of the chain belong to the same market as they are both constrained by the same product(s)."

Ofcom notes that, depending on the load on the network, CI Ethernet services may not exactly match the jitter and latency characteristics of TI services in all circumstances. Adding capacity to the network

⁴ Ofcom. May 2015. "Business Connectivity Market Review: Very Low Bandwidth Leased Lines." (VLBLL) <http://stakeholders.ofcom.org.uk/consultations/very-low-bandwidth/about>

⁵ Ofcom. June 2015. "Business Connectivity Market Review: Leased lines charge controls and dark fibre pricing" (LLCC) <http://stakeholders.ofcom.org.uk/consultations/llcc-dark-fibre/>

⁶ European Commission. 2014. "Explanatory note accompanying the Commission Recommendation on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation". Page 48. http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=4968

will mitigate this problem, but software is also becoming increasingly capable of functioning over a wide range of connection characteristics, for several reasons:

- Users are working from home more frequently, so business applications are expected to work over consumer-grade broadband.
- Users will increasingly bring and use consumer devices into the workplace.
- Businesses will increasingly use mass-market applications.

This “consumerization” of IT means that applications will increasingly have the ability to adapt to different connections.⁷ Thus, while the difference between TI and Ethernet services in terms of jitter and latency are eroding, these characteristics are also likely to become less important in the majority of use cases.

Users, including critical national infrastructure (CNI) users, are migrating or planning to migrate to a variety of connectivity solutions:

- NATS has plans to migrate to an IP-based solution by March 2018.
- TFL is replacing its TI circuits with broadband.
- Network Rail is migrating from TI circuits to its own fibre network.
- Environment agencies in Northern Ireland and Scotland have migrated to wireless technology and to BT’s 21CN respectively.
- The emergency services’ radio communications network provider, Airwave, plans to complete its transition to microwave technology by April 2016.
- Ofcom notes that some users of sub-2 Mbps circuits, including electricity distribution operators, are planning to migrate to higher speed TI products (BCMR, A10.23).

We also observe the availability of EFM and wireless solutions which may meet the needs of these users (See Figure 3-1 for wireless and free space optical examples).

⁷ WhatsApp claim their voice service will have an adaptive codec that adapts to the bandwidth available.
<http://techcrunch.com/2014/02/25/whatsapps-koum-re-iterates-no-facebook-integration-voice-calls-coming/>

Google Chromebox video collaboration is designed to ensure interaction with anyone on any device. Google, February 2014.
<http://googleblog.blogspot.co.uk/2014/02/chromebox-now-for-simpler-and-better.html>

Figure 3-1: Possible future wireless and free space optical access solutions

- Low bandwidth applications which currently rely on fixed connectivity may migrate to 3G and 4G wireless, for example, point of sale terminals and wireless ATMs.⁸ In addition, wireless machine to machine (M2M) connectivity services are likely to play an expanding role and to utilise dedicated networks in addition to cellular and local area Wi-Fi and Bluetooth connectivity.⁹ Arqiva's Internet of Things network is now live across ten UK cities,¹⁰ and Neul has built a network based on Weightless technology.¹¹
- Wireless backhaul for mobile networks. Ericsson trials have demonstrated that high-frequency systems can outperform those using sub-6 GHz bands – even with no direct line of sight.¹² Ericsson modelling of heterogeneous networks has also found similar performance with fibre or wireless small cell backhaul.¹³
- Free space optical systems coupled with microwave links for backhaul, high capacity links and redundancy e.g. AOptix claim to offer a constant data rate of 2Gbps up to 10 kilometres with delivers carrier-grade availability in the harshest weather conditions.¹⁴ Facebook are also testing free space optical links supporting speeds of 10s of Gbps.¹⁵
- The Radio Spectrum Policy Group has identified light licensing of some spectrum bands over 10 GHz as an attractive way of providing additional capacity for wireless backhaul¹⁶

3.1.3 Relative prices

We have seen the recent development and take-up of Ethernet First Mile (EFM)¹⁷ and next generation broadband products which offer cheaper business connections than low-speed TI circuits to a wide range of business customers. Figure 3-4 illustrates by comparing TI PPCs with Ethernet, EFM and FTTC products using information supplied by BT.

⁸ http://www.verizonenterprise.com/resources/factsheets/fs_verizon-managed-wireless-atms_en_xq.pdf

<http://www.cisco.com/c/en/us/products/routers/819-integrated-services-router-isr/index.html>

⁹ Ofcom. January 2015. "Promoting investment and innovation in the Internet of Things."

<http://stakeholders.ofcom.org.uk/binaries/consultations/iot/statement/IoTStatement.pdf>

¹⁰ <http://www.arqiva.com/overviews/internet-of-things/internet-of-things-network>

¹¹ http://www.neul.com/neul/?page_id=3318

¹² Ericsson. February 2013. "Non-line-of-sight microwave backhaul for small cells."

http://www.ericsson.com/res/thecompany/docs/publications/ericsson_review/2013/er-nlos-microwave-backhaul.pdf

¹³ Ericsson. November 2014. "Wireless backhaul in future heterogeneous networks."

http://www.ericsson.com/res/thecompany/docs/publications/ericsson_review/2014/er-wireless-backhaul-hn.pdf

¹⁴ <http://www.aoptix.com/products/high-capacity-wireless-transport/>

¹⁵ Facebook. 30 July 2015. "New Milestones in Connectivity Lab's Aircraft and Laser Programs."

<http://newsroom.fb.com/news/2015/07/new-milestones-in-connectivity-labs-aircraft-and-laser-programs/>

¹⁶ Radio Spectrum Policy Group. 11 June 2015. "RSPG Report on Spectrum issues on Wireless Backhaul" RSPG15-607 European Commission. https://circabc.europa.eu/d/a/workspace/SpacesStore/cdd664eb-3007-4463-8dc9-e7940bd36d8f/RSPG15-607-Final_Report-Wireless_backhaul.pdf

¹⁷ EFM allows connectivity providers to run Ethernet over multiple bonded copper pairs to connect the "first mile" from the consumer to the exchange. EFM can offer up to 35 Mbps uncontended symmetric capacity. The capacity EFM is capable of will depend on the distance from the customer to the exchange. However we note that 98% of businesses are within 4km of a BT local exchange.

Figure 3-2: Low speed TI circuits vs EFM vs FTTC

Service	TI PPC	CI Ethernet fibre access	EFM	FTTC
Contended?	No	No	No	Yes
Latency	Low	Low	Low	Variable
Distance limitations	Not limited	Not limited	Not limited	Not limited
Service availability	99.85%	99.93%	99.93%	N/A
Coverage	99%	99%	82% ¹⁸	73%
Symmetry?	Yes	Yes	Yes	No, but at least 2 Mbps each way
Price per annum ¹⁹	£3490	£3711	£1875	£574

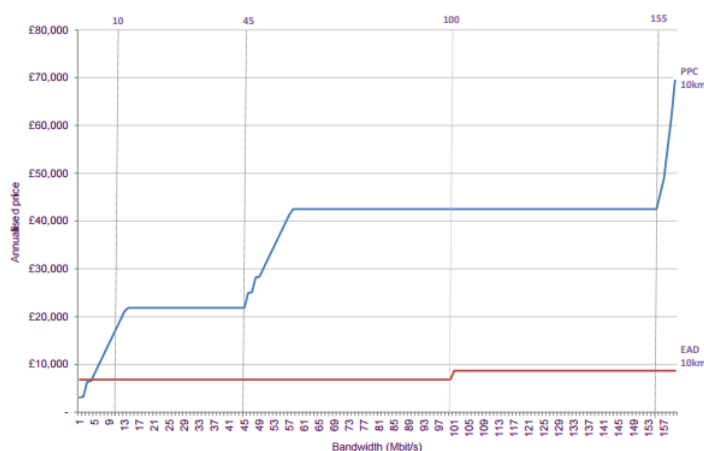
Note: BT believes that EFM offers a significantly smaller cost saving to customers when compared with TI circuits than that indicated by Ofcom in Table A10.2 of the BCMR document of May 2015.

Ofcom (BCMR, Leased Line Charge Control, June 2015) also note that business demand for bandwidth is growing:

“As we note in the May 2015 BCMR Consultation, the capacity demanded of leased lines has been increasing in recent years and seems set to continue to increase. Businesses’ need for bandwidth is being driven by a number of factors, including increased adoption of remotely hosted ICT applications (often referred to as ‘cloud computing’), greater consumption of bandwidth hungry applications and video content, and increased reliance on the internet as a means of communicating and transacting with employees, customers and suppliers.”

For those customers demanding higher bandwidth, Ethernet and alternatives offer attractive price points, as illustrated in Figure 3-3 for 10 km links.

Figure 3-3: Ethernet and TI wholesale charges at higher bandwidths



Source: Ofcom. BCMR, May 2015. Figure A10.2.

¹⁸ 90% by end 2015 and continuing to grow.

¹⁹ Based on a 3 year contract for a 2 Mbps 10 km circuit.

3.2 User cost and inertia barriers to migration

We have identified two main barriers to migration away from TI circuits:

- Users face costs in migrating from one business connectivity product to another. The main costs are the replacement of CPE; connection charges for the new services; the costs and staff time in making the change; and possible disruption costs and/or costs from parallel running.
- There is inertia to change. Users often proceed on the basis that “*if it ain’t broke don’t fix it*”. Changes to communications services are typically part of a general technology refresh of a business’s ICT systems. This might occur once every five to 10 years.

Ofcom raise the possibility of another barrier to migration, namely that some end users may need the characteristics offered by TI circuits in terms of latency, jitter and (perhaps) coverage. For example:

“...some legacy and some specialist applications will continue to require SDH/PDH leased lines as reflected in the EC Recommendation that identifies “demanding business applications” that may require TI services.” Paragraph 5.19 BCMR 15 May 2015

However, Ofcom do not provide evidence that this is a genuine problem or the scale of the problem:

“We do not know how many users place a high value on TI services. However, we note that around 40 percent of BT’s customers for very low bandwidth TI circuits could be designated as operators of Critical National Infrastructure (CNI), some of which rely on features of TI circuits for telemetry applications.” Paragraph A10.25, BCMR, 15 May 2015

As discussed earlier, CNI users are substituting a range of services for TI services. In addition Ofcom note that:

“Ethernet services cannot exactly match all of the characteristics of SDH/PDH services such as latency and jitter to the very high specification across all network load scenarios. But as discussed above, these differences are becoming progressively less important as mainstream enterprise applications migrate to Ethernet/IP technologies and are therefore able to use Ethernet leased lines.” Paragraph A10.17, BCMR, 15 May 2015

We conclude that service characteristics are unlikely to be an enduring barrier, and that user costs of migration and inertia are the key barriers.

3.3 Conclusion

The prospects for the migration away from TI circuits continuing at observed historic rates are good, as long as there are no significant reductions in TI circuit prices. As users make periodic reviews of their systems (so overcoming inertia) they are likely to choose lower-priced alternatives to TI circuits based on modern technology to meet growing bandwidth requirements.

4 The consequences for migration of implementing the BCMR proposals

In this section we consider the likely consequences for the migration from TI circuits over the next market review period if Ofcom's BCMR proposals for charge controls and dark fibre access are implemented as they stand.

4.1 Lowering the price of sub-8 Mbps services would discourage migration

After allowing for initial adjustments and the annual price cap, implementing the proposed charge control would lead to a reduction in the prices of 2-8 Mbps TI circuits of around 40%. This would encourage customer migration from sub-2 Mbps services to 2-8 Mbps services, rather than to Ethernet and other services provided by BT and others. Ofcom note that this is likely:

"...with BT announcing plans to shut the PDH platform, some of these users are still planning to migrate to TI technologies (i.e. SDH circuits (at 2Mbps)). Continued demand for TDM-based services could be related to the barriers to switching associated with having to change end-user equipment in order to use alternative technologies." Paragraph A10.39, BCMR 15 May 2015

This would tend to perpetuate rather than phase-out TI services. It would also involve a double migration for customers – first from sub-2 Mbps TI services to 2-8 Mbps TI services, and then to other services as 2-8 Mbps TI services are phased out. This would involve additional costs for these users, including financial costs and costs associated with service disruption. Ofcom notes that some end users of very low bandwidth TI leased lines are already planning to migrate to 2-8 Mbps TI services at current prices (Ofcom, May 2015. BCMR, A10.23).

4.2 Collapsing the Ethernet price gradient would discourage migration

Ofcom also proposes to introduce a dark fibre remedy in relation to Ethernet services. The reference service for pricing dark fibre is at 1 Gbps. Not only will dark fibre access tend to collapse the price of higher bandwidth services, it will also tend to raise the price of lower bandwidth services in order that BT can recover its fixed and common costs in an efficient manner. Ofcom acknowledge these points:

"...in our view, it would be impractical to vary the price of a passive access product according to the bandwidth of the service for which it is used" Paragraph 7.50, May 2015 BCMR

"...some active circuits (expected to be low bandwidth) will likely have higher prices if passives are introduced compared to a world where they are not." Paragraph A24.159, Ofcom BCMR May 2015

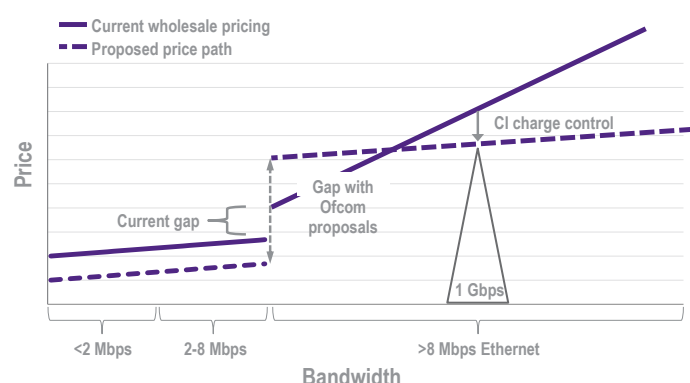
The impact of the proposed lowering of 2-8 Mbps TI services should therefore be considered alongside the potential increase in lower bandwidth Ethernet services as a result of dark fibre access. This combination would further discourage transition from sub-2 Mbps TI or 2-8 Mbps service TI services to Ethernet services.

4.3 Combined effect of Ofcom proposals

The combined effect of allowing prices for sub-2 Mbps services to rise, lowering the price of 2-8 Mbps services, rebalancing Ethernet prices due to dark fibre access, and imposing the price control on CI circuits, is illustrated in Figure 4-1.

Figure 4-1: Overall impact of Ofcom proposals on incentives to migrate²⁰

The "Traditional Interface price trap"



Source: Plum Consulting

This figure shows that the current modest price gap between TI and CI services at 8 Mbps would widen significantly. This would:

- Encourage sub-2 Mbps TI customers to make an interim transition to 2-8 Mbps TI products rather than moving directly to CI products
- Discourage 2-8 Mbps customers from migrating to CI services.

The combined effect would be to slow the migration from TI to CI services, as described in Sections 2 and 3 above.

²⁰ Figure 4-1 shows the effect of BCMR proposals for the next market review period on wholesale prices for business connectivity products. But if, as seems reasonable, we assume a constant mark-up to cover retail costs, then it also gives a good indication of the price effects which retail business connectivity customers would face.

5 The implications of all-IP transition

In this section we consider the likely impact of BT's transition to all-IP services on TI product prices in the years following the next market review period.

5.1 BT is planning to move to all-IP for voice services

BT's future network vision consists of a common access platform and a single, IP-core network.²¹ The SDH network is currently used by voice, data services and TI business connectivity services.

BT is planning to migrate its voice services (including PSTN, ISDN, and WLR) from using local circuit switches and its SDH transmission network to a solution based on soft switches and IP transmission. BT believes that this migration would lead to substantially lower costs, given falling volumes of fixed voice traffic and announcements by vendors that they are discontinuing support for circuit switched equipment.

BT's is currently planning to start this process in 2020, to make the migration on an area-by-area basis, and to complete the process by 2025 at the latest.²² This migration is largely confined to moving voice services to all-IP. It does not include any migration of business connectivity services. For example under these plans TI services would continue to use the SDH transmission network.

To achieve a full migration IPstream services would also need to be replaced (IPstream is currently being phased out by BT). BT intends to deploy Wholesale Broadband Connect to 94% of exchanges.

5.2 Implications for the price of TI circuits

Migrating voice services to all-IP will have significant consequences for the unit costs of supplying TI circuits:

- TI circuits and the PSTN are the two main users of BT's SDH network. Data services such as IPstream are a third user, but these services are in the process of being phased out
- As PSTN use of SDH falls, the full cost of the SDH will need to be recovered from TI services and unit costs will rise substantially
- BT tells us that it is very difficult to reduce the costs of the SDH network by scaling down capacity without introducing faults. In addition there is little residual value for any equipment which is released by this process.

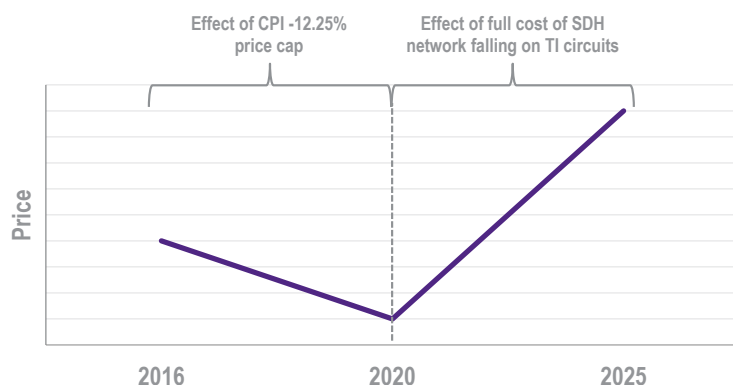
Assuming that Ofcom allows BT to recover these rising costs of TI circuits through its wholesale and retail prices, end users would then face a price shock after 2020, as shown in Figure 5-1.

²¹ BT Group, January 2015 <http://www.btplc.com/Sharesandperformance/downloads/PDFdownloads/g315-slides.pdf> Slide 19

²² The Telegraph. 24 June 2015. "BT aims to shut down traditional phone network to help it battle US tech giants." <http://www.telegraph.co.uk/finance/newsbysector/mediatechnologyandtelecoms/telecoms/11696314/BT-aims-to-shut-down-traditional-phone-network-to-help-it-battle-US-tech-giants.html>

Figure 5-1

Price 'shock' on low bandwidth TI circuits



Source: Plum Consulting

This figure suggests that users would face a major discontinuity in the evolution of TI prices over time around 2020. This discontinuity could be significantly greater if BT decided to bring forward its all-IP migration plans for voice services.

5.3 The all-IP plans of other operators

A survey of eight European operators conducted in 2013 found that all had plans or were conducting studies into PSTN/ISDN network transformation. Of those with firm plans the target date for transformation was before 2020, the earliest planning to complete the transformation by 2017 and with one operator planning transition between 2022 and 2025.²³ The EC working paper in relation to the review of relevant markets also refers to the transition to “All-IP”:²⁴

“...investment in all-IP networks will allow the network operator to increase its efficiency and also provide more cost-efficient services to its end users.” Page 21

In the US “All-IP” transition is actively under consideration by industry and the FCC. The FCC focussed attention on the issue beginning in November 2013²⁵, and is engaged in a consultation process regarding the detailed rules.²⁶ Whilst it is not without controversy,²⁷ given the closure of copper line service where fibre to the premise is available (or proposed closure where wireline service is considered uneconomic), network and service rationalisation is proceeding in the US.

²³ Plum. June 2013. “Relevant Markets in the Telecoms Sector: The Times They are aChangin.” Page 21. http://www.plumconsulting.co.uk/pdfs/Plum_June2013_Relevant_Markets_in_the_Telecoms_Sector_-_The_Times_They_are_a-Changin.pdf

²⁴ European Commission. October 2014. “Commission Staff Working Document accompanying the document Commission Recommendation on relevant product and service markets within the electronic communications sector susceptible to *ex ante* regulation.” http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=7056

²⁵ Tom Wheeler, FCC Chairman. November 2013. “The IP Transition: Starting Now.” <https://www.fcc.gov/blog/ip-transition-starting-now>

²⁶ FCC. November 2014. https://apps.fcc.gov/edocs_public/attachmatch/FCC-14-185A1.pdf

²⁷ Ars Technica. “Verizon: Let us install fibre—or we’ll shut off your phone service”. July 2015. <http://arstechnica.co.uk/business/2015/07/verizon-let-us-install-fiber-or-we'll-shut-off-your-phone-service/>

Specific examples of operators in Europe who have ambitious plans for all-IP transition include:²⁸

- The main telecommunications operators in Macedonia and Slovakia (both owned by Deutsche Telekom) have already transitioned to all-IP. So too has Telekom Austria in Austria.
- The main telco in Croatia (again owned by Deutsche Telekom) plans to complete its all-IP transition by the end of 2015 while the current dates for Swisscom in Switzerland, TDC in Denmark and Orange in France are 2017, 2018 to 2020, and 2020 respectively.
- Deutsche Telekom, having learned how best to make an all-IP transition in its subsidiaries in Croatia, Macedonia and Slovakia, plans to migrate to all-IP in Germany by the end of 2018.

It is not always clear what an operator means by all-IP. In some cases it might mean, as BT currently does, migration of voice services only, or it might mean a full migration of all the main services to IP and closure of the SDH network. In at least one of these cases, that of Slovak Telekom, it is clear that the term is used to mean a full migration. Figure 5-2 illustrates.

Figure 5-2: Slovak Telekom's all-IP transition²⁹

Slovak Telekom has successfully moved its entire customer base to the IP (Internet Protocol) based network. All 678,000 Slovak Telekom business and residential customers have been switched to the IP network.

The company is the second Deutsche Telekom subsidiary to switch to all-IP this year, following Makedonski Telekom in Macedonia in February 2014. More than 35% of the DT customer base in Europe is now using the IP network.

"By moving geographically and switching one entire exchange area at a time we realized the maximum benefits of migrating to the IP network, due to the corresponding effect on energy and maintenance cost savings," says Branimir Maric, Chief Technology and Innovation Officer at Slovak Telekom.

During the migration to all-IP more than 800 tons of obsolete technology material were removed from Slovak Telekom sites, 51 PSTN local hosts were shut down, complete SDH and ATM networks switched off and in total more than 6,500 network elements were removed from the Slovak Telekom network.

Slovak Telekom is already seeing notable savings on energy, support and maintenance and warehouse costs for spare parts they no longer need to store. The hardware that is now in use is also more stable than it was on the old standard.

5.4 The impact of the BCMR proposals on all-IP transition UK

In the light of these developments elsewhere in Europe, maintaining the option for BT to pursue a rapid and comprehensive all-IP migration may have considerable value.

Implementing the BCMR proposals for price control on low-speed TI circuits over the next market review period would, by discouraging transition away from TI products in the business market, reduce the scope for timely all-IP transition and consequent gains in terms of productivity and innovation.

Without the freedom to withdraw TI circuits from the market at an early date, BT's ability to maximise cost savings from an early and more ambitious all-IP transition would be substantially reduced.

²⁸ LightReading. June 2015. "Does BT Lag European Peers on All-IP?" <http://www.lightreading.com/ethernet-ip/does-bt-lag-european-peers-on-all-ip/a/d-id/716849>

²⁹ Slovak Telekom. December 2014. "Slovakia second market to go all-IP." <http://www.telekom.com/innovation/261242>

Whilst it is intended to migrate to all-IP voice during the period 2020 to 2025, this is on an area-by-area basis. In the business market migration needs to occur on a national basis at the same time given that customers may utilise business connectivity services at multiple sites. Delaying full migration of legacy services beyond 2020 would therefore constrain transition to all-IP in those areas where voice has been migrated.

Delaying the productivity benefits of all-IP transition would be inconsistent with the interests of users of communication services and Government objectives in relation to the wider economy. With economic recovery underway, raising the rate of productivity growth so that GDP growth is sustained is a Government priority.³⁰

³⁰ HM Treasury. July 2015. "Fixing the foundations: Creating a more prosperous nation."
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/443897/Productivity_Plan_print.pdf

6 Efficient migration from legacy TI circuits

It is clear that users are currently migrating in substantial numbers from legacy low-speed TI services to modern technology CI products and other modern technology solutions including wireless, as discussed in Sections 2 and 3 above. In this section we consider whether implementing the current BCMR proposals would help or hinder an efficient migration away from legacy TI circuits.

6.1 Ofcom's previous policy on efficient migration

In the past Ofcom has made a number of statements on efficient migration from legacy products. For example:

"Where the customer takes the decision to migrate, it can be efficient to set relatively higher prices for services supplied using the legacy technology. We would expect this to encourage migration away from the legacy technology, thereby allowing the operator to benefit from the economies of scale associated with running one, rather than two, technologies." Paragraph 4.47, BCMR, 12 June 2015

"Given this [BT management of transition] in a market with rapidly declining volumes, it is appropriate to rely on ex post competition law rather than imposing ex ante regulation." Paragraph 5.20, BCMR, VLBB, 15 May 2015

In relation to pricing during transition from legacy to modern technologies, Ofcom has previously adopted an approach where BT is regulated on either the legacy product or the new product but not both. Plum has set out a full analysis in a previous report for BT.³¹ Examples where Ofcom follow this rule include:

- The copper to fibre transition for consumer broadband. Here Ofcom sets cost oriented prices for legacy copper loops but gives BT considerable freedom over how it sets wholesale prices for its fibre products
- Price regulation of wholesale broadband access in areas where there is not effective competition. BT offers a range of broadband products in these areas and Ofcom chose, in 2011, to price regulate only one of them – IPstream.³²

These two examples apply the principle of anchor product pricing – in which legacy and new products act as substitutes to the extent that the regulator can price regulate just one in the knowledge that chain of substitution effects will constrain the price which can be charged for the other. Ofcom sees a number of advantages to this approach which are listed in Figure 6-1 below.

³¹ Plum. May 2015. "Leaving a legacy – enabling efficient network transitions."
http://www.plumconsulting.co.uk/pdfs/Plum_February_2015_Leaving_a_legacy.pdf

³² Ofcom. July 2011. "WBA Charge Control – Statement."
<http://stakeholders.ofcom.org.uk/binaries/consultations/823069/statement/statement.pdf>

Figure 6-1: The advantages of anchor product pricing³³

It allows efficient technology choice by both suppliers and downstream users:

"Where there is a set of services we propose to control, it is generally efficient to reflect differences in demand (especially the responsiveness of demand to prices) or costs in relative prices. BT is generally better placed than Ofcom to do this." Paragraph 7.74

"...controlling all the different products separately would reduce BT's ability to respond, for example, to unanticipated changes in relative costs or in the demand for services." Paragraph 7.76

It encourages innovation in alternative solutions:

"Anchor pricing has good incentive properties. It allows the dominant provider the flexibility to charge more to reflect any enhanced functionality of the new service. In turn, this creates the incentive for the investment required to advance service characteristics which are directly related to customers' willingness to pay for improvements in quality." Paragraph 7.112

It minimises the information informational burden:

"If we were going to apply separate controls, we would have to decide an efficient allocation of common costs. This would require extensive analysis based on detailed information on the costs and demand for individual services. This is not likely to be a practical or desirable proposition." Paragraph 7.75

The BCMR proposals would involve tight price caps on both legacy TI products (at CPI-12.25% pa) and on replacement CI products (at CPI-13.75% pa). We consider that an anchor pricing approach, as discussed above, would promote an efficient migration and lead to better outcomes.

6.2 Enabling efficient migration

Promoting efficient transition involves sending the appropriate signals to users of the legacy product. There are a number of ways in which Ofcom might promote efficient migration away from legacy products such as TI circuits:

- Given information asymmetries regarding customer switching costs, it might promote efficient migration by allowing the network provider flexibility regarding pricing and notice for closure of legacy services. The network operator would then seek to promote efficient transition via relative pricing of legacy versus new services having regard to the relative costs of provision of legacy and new services. The approach leaves open the possibility of bargaining by customers who may face high near-term migration costs. This would ensure efficient closure of the legacy platform (i.e. when the costs of operation exceed user willingness to pay).
- It might allow a short notice period, ideally corresponding to contractual commitments. This is consistent with efficient migration in that it allows private bargains between users and their supplier to deal with transition problems. For example the supplier might extend the life of legacy services for customers who have private information regarding their transition costs. This approach is common in commercial markets, for example, the US Navy's Space and Naval

³³ Ofcom. July 2013. "Review of the Wholesale Broadband Access Markets - Consultation." <http://stakeholders.ofcom.org.uk/consultations/review-wba-markets/>.

Warfare Systems Command are paying for extended support for Microsoft Windows XP.³⁴ In the case of the transition from TI circuits it might prompt customers to seek a modified EFM product which included capability for synchronisation.

- It might make it clear to the residual set of customers who are slow to migrate, either because migration is not an immediate focus for them (“inertia”) or because it involves costs in terms of new user equipment, that this should not be a brake on market transition. It is unlikely to be efficient for a residual set of customers to be protected from transition when the consequence of such protection is harm to the majority of customers via higher overall network costs.

Overall arguments on efficient migration suggest that, given information asymmetries, it is better to allow the SMP operator pricing (and non-price) flexibility for either the legacy or new products set. This is the view taken by Ofcom in other cases.

Pricing flexibility for TI services does not necessarily imply greater returns, since higher prices promote faster migration from TI services, thereby reducing legacy revenues. Further, a more rapid all-IP transition will reduce overall costs, ultimately benefiting customers and the economy.

6.3 Would the BCMR proposals promote efficient migration?

We note that, in the case of the migration from TI circuits:

- Implementing the BCMR proposals could encourage users to make an inefficient input technology choice. In the long term this could lead to double migration costs for sub-2 Mbps users who migrate to 2-8 Mbps TI circuits. Users of 2-8 Mbps services may also continue to use those services when another technology could better serve their needs. Under a counterfactual in which current price regulation is maintained this problem would largely be avoided.
- Implementing the BCMR proposal would leave large numbers of TI users, (perhaps up to 100,000) paying rapidly increasing prices from 2020 until such time as they could migrate. Under the counterfactual this number would be much smaller (perhaps 20,000).
- If Ofcom were consistent with its previous decisions on regulating for efficient migration it would focus regulation on CI products and give BT price flexibility on TI products to manage the migration efficiently.

We conclude that implementing the current BCMR proposals is unlikely to lead to efficient migration.

6.4 Wider implications of the BCMR proposals

Ofcom is currently engaged in a Strategic Review of the Digital Communications Market. Questions of competition and last mile fibre access were previously addressed in 2005 and 2009 respectively, and the approaches developed then appear to be working well. Arguably this leaves “All-IP” as one, amongst a small set, of strategic issues facing Ofcom and the industry over the coming decade.

Rethinking regulation around “All-IP” offers an opportunity to promote efficient and timely investment in the core network and to reduce the overall costs of service provision. Seen in this context, the focus

³⁴ Ars Technica, June 2015. “Navy re-ups with Microsoft for more Windows XP support.” <http://arstechnica.com/information-technology/2015/06/navy-re-ups-with-microsoft-for-more-windows-xp-support/>

of the BCMR appears overly narrow, and may be counterproductive. In particular there is a danger that implementing the current BCMR proposals would foreclose options that Ofcom would otherwise wish to consider for an efficient transition to all-IP in the UK during the Strategic Review.

More rapid migration would also encourage further innovation and competition in the market for alternative business connectivity services, since innovation is focussed on the new rather than the legacy market.

7 Conclusions and way forward

If implemented the Ofcom proposal to substantially lower the price of legacy services would discourage migration from T1 services. This would have the following consequences:

- 'Double migration' for sub-2 Mbps users who initially migrate to 2-8 Mbps T1 services rather than alternatives, because of the price reduction in T1 services. This would delay migration to alternatives.
- T1 users would face a price shock from 2020, as they would bear the full costs of the SDH platform as voice migrates to IP.
- The option to pursue the full benefits in terms of productivity and innovation from all-IP would not be available if legacy business services continue beyond 2020 in areas where voice has migrated to IP.

We conclude that a preferable way forward would be to allow greater pricing freedom in relation to legacy services and flexibility in relation to notice of termination of such services. This would facilitate an efficient migration having regard to the potential overall productivity benefits from comprehensive all-IP transition.