OPTUS

Submission in response to

Digital Platform Services Inquiry Discussion Paper for Interim Report No. 5: Updating competition and consumer law for digital platform services

Public Version

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Executive Summary

1. Optus welcomes the opportunity to provide a submission in response to the ACCC's "Digital Platform Services Inquiry Discussion Paper for Interim Report No. 5: Updating competition and consumer law for digital platform services" (the Discussion Paper). The Discussion Paper raises a number of important issues that affect competition and consumers across the broader communications sector, including telecommunications.

2. The market power of Digital Platforms raises issues with regards to consumer protection and also to the effectiveness of Australian competition law regime – including industry specific regimes like that which applies to the communications sector.

3. The nature of communications services and the internet in particular has rapidly evolved over the last decade. By contrast, the regulatory framework that applies to telecommunications has largely remained stable.

4. Optus submits that the ACCC should enquire whether the existing laws contained within the Competition and Consumer Act – including Parts XIB and XIC – are fit for purpose to address the market failures arising from the market power of the global Digital Platforms.

5. Telecommunications providers are investing heavily in the infrastructure and technology required to lay the foundations of Australia's digital economy. Optus alone typically invests $1.5 billion each year in its network and services. A significant proportion of this annual investment it to keep pace with the growth in data demand. Yet this data growth is being driven by large content providers who are building hyper-profitable businesses off the back of investments by telecommunications providers.

6. There is a growing chasm between those who invest in infrastructure and those who profit from that investment.

7. Telecommunications is a classic two-sided market. The services supplied by Internet Service Providers (ISPs) benefit both sides of the network, the party that delivers the content and the party that receives the content.

8. Currently ISPs are only able to charge one group of users for broadband services – retail customers. The other side – content creators – do not contribute to the network costs of the ISP platforms which deliver their products. This charging arrangement is uncommon among platform economies. Platforms in many other markets charge both sides of their platforms for connecting customers (e.g., newspapers, subscription television, credit card networks).

9. While the current situation reflects a classic "two-sided market dilemma", the market power of the large digital platforms limits the potential for meaningful negotiation over charging or co-investment. This is a challenge facing the communications industry globally. Yet despite some Digital Platforms providers contributing to broadband investment in the United States, Japan, France and South Korea, Digital Platforms do not accept the need to invest in the infrastructure that supports their profit growth here in Australia.

10. The current misalignment between the beneficiaries of investment in communication networks and those who actually have to invest places strain on the whole digital ecosystem and threatens the achievement of Australia's digital economy vision. It also

creates a fairness issue, since users of high bandwidth servces, such as gaming, are being subsidised by other users of broadband networks. In effect, all consumers are paying for inefficiently delivered traffic even if they do not generate that traffic.

11. The challenge is how to facilitate discussions between ISPs and Digital Platforms where there is such an imbalance of market power. Optus submits this is where targeted proportionate regulatory powers or intervention could be beneficial. We welcome the ACCC considering whether the CCA contains sufficient powers to enable it to address the market power imbalance, should it be required.

Market power of digital platforms limit investment in Australia

12. In addition to the harms outlined in the Discussion Paper, Optus takes the opportunity of this consultation process to highlight concerns about the impact that large Digital Platforms are having on telecommunications investment and ultimately the sustainability of the sector. The exponential growth of streaming traffic and high bandwidth over the top (OTT) services provided by Digital Platforms has required Internet Service Providers (ISPs) to invest heavily in network capacity, particularly to accommodate surges in demand during peak usage periods. Up to 80% of Optus peak traffic is OTT content and meeting this demand is a significant driver of Optus capital investment and NBN related operational expenditure.

13. However, the ability of Optus and other ISPs to recoup these investments is increasingly limited as margins in the retail broadband market are squeezed through intense competition. Meanwhile the growth plans of OTTs are based on consumers paying more for higher quality services, requiring more bandwidth and ultimately more investment from ISPs to enable supply. While OTT providers profit from the provision of high bandwidth services, ISPs continue to incur additional costs and receive no additional revenue from consumers or OTT companies to deliver these services. In effect, the OTT industry is receiving a massive cross-subsidy from the Australian communications sector and internet users. Such inequality is not sustainable and is inconsistent with Government's vision of a digital economy enabled by digital infrastructure.[1]

14. Optus supplies more than 11 million services through our fixed, mobile and satellite networks nationally and other sectors rely on our infrastructure to deliver their services. Optus and the broader telecommunications sector is and will remain a crucial component to realising Australia's digital economy goals. However, the investment required to underpin this economic success is not guaranteed. ISPs are now experiencing declining returns on invested capital (ROIC) that in turn challenge the sustainability of the whole digital ecosystem.

15. This is a global trend, with the largest international OTT providers growing profit and market capitalisation at the expense of telecommunications operators. Reflecting the disconnect between this growth and the capital burden, we can see the disparity between the ROIC of the main OTT providers and the leading Australian telecommunications providers. For example, leading gaming providers Take-Two Interactive and Activision Blizzard had ROICs of 20% and 17% respectively for FY21. Similarly, Meta and Alphabet had ROIC in excess of 35% and 25% respectively. This

[1] Australian Government [Digital Economy Strategy (pmc.gov.au)]

can be compared to the low single digit ROICs that the leading Australian communications networks report.[2]

16. The benefits of the digital economy will only be realised if the infrastructure needed to support it is delivered – both mobile and fixed and this will require billions of dollars of capital investment. The communications industry is facing unprecedented financial challenges and the OTT industry reaping large profit margins. This value transfer has not been accompanied by a corresponding willingness from OTTs to invest in the infrastructure that has enabled and will continue to enable their success. The absence of an adequate mechanism to charge OTT providers for traffic, particularly during peak periods has led to a situation where OTTs are "free riding" on ISP networks.

17. Optus has asked expert consultancy Competition Economists Group (CEG) to examine the current arrangement and evaluate its effect on future investment needs. CEG has determined that there is a need for a price signal to internalise the benefits that OTTs gain from being able to offer higher bandwidth services. CEG concluded that the ability to recover costs efficiently from both consumer and content creators will result in lower retail broadband prices for the majority of Australian consumers and higher investment across mobile and fixed broadband networks. CEG also observe that enabling ISPs to levy a charge on OTTs for heavy use during peak periods would have a number of positive flow-on effects, including that:

    (a) ISPs would be able to rebalance their retail charges is favour of lower retail broadband subscriptions charges

    (b) OTT applications would face a charge that is more cost reflective, providing incentives to make more efficient decisions, including investment in compression and other technologies that optimise the bandwidth-demand of their content; and

    (c) The ability to better match costs with the benefits of increasing network capacity means that ISPs will have better incentives to invest in that capacity in both mobile network investment and in acquiring sufficient capacity for the provision of NBN services.

    (d) Benefit NBN Co by enabling it to better recover the capital costs of building the national network

18. CEG conclude that a charging model that delivers efficient and sustained investment in the broadband infrastructure would be in the long-term interests of all market participants who rely on it, including mobile and fixed operators, content creators, including providers of business streaming, OTT video and social media and gaming services, and ultimately end consumers. The full CEG report is provided as an attachment to this submission.

19. While the current situation reflects a classic "two-sided market dilemma", the market power of the large digital platforms limits the potential for meaningful negotiation over charging or co-investment. This is a challenge facing the communications industry globally. Yet despite some OTT providers contributing to broadband investment in the United States, Japan, France and South Korea, these providers do not accept the need to invest in the infrastructure that supports their profit growth here in Australia.

20. Australia's policy makers and regulators play a critical role in helping to safeguard industry sustainability.

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[2] ROIC source; https://www.gurufocus.com.

21. The challenge facing industry and government is how to bring the OTT providers to the table and ensure they are willing to engage in bona fide commercial discussions with the ISP industry to support ongoing efficient investment in digital infrastructure. There appears to be relevant domestic and global precedent, including the recently implemented News Media Bargaining Code, for targeted regulatory intervention to address the power imbalance and help facilitate an equitable and efficient commercial bargain between ISPs and OTT providers ultimately for the benefit of all Australians.

22. Optus is now calling on the ACCC to investigate whether it has sufficient powers under legislation to require digital platforms to agree payment terms with ISPs for use of their networks, particularly during peak periods, if they refuse to engage in bona fide commercial negotiations. Optus urges the ACCC to raise this concern as a matter of priority in its advice to Government on any reform to competition and consumer laws arising from the Digital Platform Services inquiry.

23. Further detail on Optus' concerns as well as answers to the specific questions in the Discussion Paper are sets out below.

Responses to specific questions

1) What competition and consumer harms, as well as key benefits, arise from digital platform services in Australia?

24. Optus agrees with the ACCC's analysis of the factors that contribute to digital platform providers having a substantial degree of market power in relevant online and adjacent markets. Digital platforms benefit from significant economies of scale and (same side and cross side) network effects that enable incumbents to build and protect their market positions, whether through exclusionary conduct or targeted acquisitions of nascent competitors.

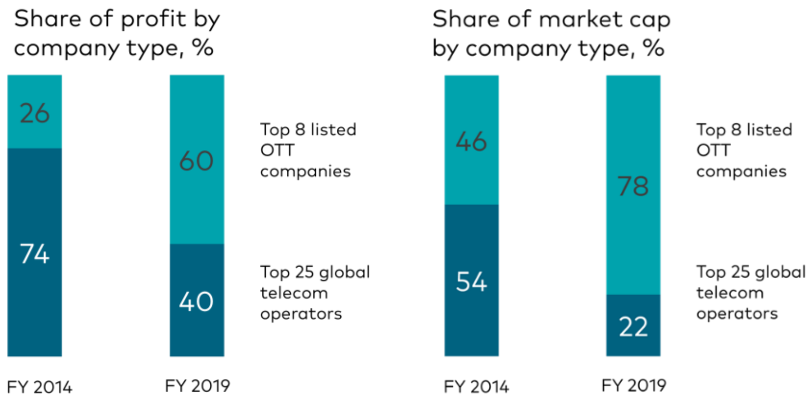
25. It is well established that many OTT services, particularly for messaging and voice communications, are functionally equivalent to if not direct substitutes for telecommunications services. As such, these services are in direct competition with traditional SMS and voice services and have directly led to the erosion of many traditional sources of telecommunications operators' revenue. Yet many of these services are not subject to the same level of regulation that telecommunications services are, including in relation to consumer protection, emergency call functionality and quality of service to mention a few.

26. Optus agrees that the significant capital investment along with the established market power of large platforms represents a significant barrier to entry in digital and adjacent markets. The massive data sets of online platforms provide a huge competitive advantage with respect to data analytics and customer engagement while the sheer financial strength of Big Tech relative to telecommunications operators places them in an unassailable position in the race to collaborate with or acquire new innovative start-ups.

27. In addition to the competition and consumer harms set out in the Discussion Paper, the market power of digital platforms means that digital platforms can often dictate commercial negotiations, which may lead to unfair and potentially market distorting agreements, if any agreement can be reached at all. As noted above, Optus is particularly concerned about the impact of some OTT service providers being unwilling to engage on fair and reasonable charging terms for use of telecommunications networks is having on the ongoing sustainability of investment in communications infrastructure.

28. Large digital platforms such as Google (Youtube) and Meta account for the majority of traffic over telecommunications networks. It is noteworthy that, when streaming service providers agreed to lower their bitrates during the COVID pandemic, peak traffic was reduced by 20 per cent almost overnight, without end-user experiencing a degradation in their OTT subscription service.[3]

29. Yet, the growth plans of these platforms are based on consumers paying more to access higher quality services, which require more bandwidth and ultimately more investment from network operators to enable the delivery of these services. While OTTs generate significant profits from the Australian market, they have shown little appetite to invest in or support the network infrastructure that has enabled this success. The transfer of value from ISPs to OTTs over the last 5 to 7 years is starkly illustrated by the following diagrams:[4]



30. In addition to the commercial challenges to unilateral action to address free riding, ISPs are likely to face technical challenges to engage in unilateral action against the streaming traffic of OTT providers. Any effective unilateral action, whether to impose a charge for the bandwidth consumed or to develop an OTT-specific streaming product, requires ISPs to be able to identify OTT traffic and treat it under a commercial model different from generic internet traffic.

31. Typically, under existing internet HTTP protocols ISPs could have used deep packet inspection (DPI) in order to identify the OTT-specific packets in order to charge OTT providers or to allocate differing levels of quality of service. However, two changes to the design of the internet make this approach no longer viable.

32. The first change is the extensive use of Content Distribution Nodes (CDNs) and content caching. Without the help of OTT providers, ISPs would need to know the exact CDN from which the OTT traffic originates. OTT provides, however, can use multiple CDNs and often change CDN or caching sources. In such situations, ISPs would find it difficult to effectively use DPI to identify and manage specific OTT traffic.

33. The second change has a much larger impact on the ability of ISPs to identify, monitor and control the nature of packets over their networks. This change relates to nature in which packets are moved over the internet as new technology moves away from the existing HTTP delivery of packets. This new technology (called QUIC) allows for privacy, latency and better loss recovery than HTTP – providing a more efficient internet. Privacy implemented into the QUIC protocol means the entire network stream is encrypted and ISPs can no longer rely on DPI as network traffic classification using connection metadata to establish the content publisher or the content type is no longer supported.

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[3] "Optus takes on the gaming giants"; Ticky Fullerton, The Australian, 2 April 2022
[4] *Source*: McKinsey, A blueprint for telecom's critical reinvention

34. The commercial and technical barriers to ISPs acting unilaterally means that it is highly unlikely that effective and efficient charging regime could be adopted without the express participation of the main OTT providers. The challenge remains how to engage with these global OTT providers to deliver mutual beneficial commercial outcomes when they are unwilling to engage with Australian ISPs.

35. Optus notes that similar concerns have been raised by network providers in other jurisdictions, including most recently in response to Ofcom's consultation on net neutrality rules where Vodafone observed:

> "There is no incentive on these eco-systems to use network capacity efficiently, being entirely disconnected from the costs associated with providing access. This imbalance in regulatory approach is not only unjust and unsustainable, it is delivering inferior outcomes for UK consumers. Our firm preference is for a level playing field, one where the rules on network providers are relaxed to align with those of internet platforms and content networks. The current rules act as a barrier to investment in networks by constraining network owners from making a legitimate return on future investment. If the industry is to deliver full 5G and bring wider benefits to the economy and society at large, then it needs to invest at scale."[5]

36. Lower returns on invested capital have implications for the financial sustainability and ultimately competition in the Australian telecommunications sector. The free rider status that OTTs currently enjoy jeopardises investment in digital infrastructure and is inconsistent with the long-term interests of end-users of communications services in Australia. Optus urges the ACCC to address the harms to the communications market and end-users through new regulatory measures that would require OTTs to contribute a fair share to ISP investment costs.

2) Do you consider that the CCA and ACL are sufficient to address competition and consumer harms arising from digital platform services in Australia, or do you consider regulatory reform is required?

37. The ACCC must have regard to "encouraging efficient use of and investment in infrastructure" in applying the "LTIE" test under Part XIC of the Competition and Consumer Act.[6] The ACCC will also have regard to the extent of (allegedly anti-competitive) conduct when considering whether to issue a competition notice under Part XIB, which may involve consideration of whether the conduct may "dampen incentives for investment that otherwise may given rise to infrastructure based competition, and associated benefits from consumers".[7]

38. Therefore, existing provisions of the CCA provide a mandate for the ACCC to consider investment in infrastructure as a key part of its regulatory decision-making relating to the telecommunications sector. Yet these powers are not sufficient to address the free rider problem raised by Optus. Notwithstanding the fact that OTTs are not currently carriage services providers for the purposes of the Telecommunications Act, there are reasonable arguments that the different characteristics of digital markets do not lend themselves to be subject to the sector specific regulatory regime governing the telecommunications sector.[8] More generally, the CCA does not appear to provide a clear

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5 Vodafone Response to Ofcom Call for Evidence: Net Neutrality Review; November 2021; p.2

6 Subsection 152AB(2)(e) of the Competition and Consumer Act and A guideline to the declaration provisions for telecommunications services under Part XIC of the Competition and Consumer Act 2010

7 Telecommunications Competition Notice Guidelines, August 2018, p.17

8 Policy makers focus on big tech | Frontier Economics (frontier-economics.com)

legal basis for the ACCC to intervene to address the power imbalance between OTTs and ISPs.

39. Optus points to the recent amendments to the Competition and Consumer Act to implement the "News Media Bargaining Code".[9] As described by the ACCC, the Code is a mandatory code of conduct governing commercial dealings between Australian news media and "designated" digital platforms who "benefit from a significant bargaining power imbalance" and is designed to "support the sustainability of the Australian news sector, which is essential to a well-functioning democracy". The passage of the Code appears to have encouraged Google and Meta to each volunteer commercial deals with a significant number of new media organisations.[10]

40. Optus supports the view that "competition can best be fostered through an economically efficient level of investment in new and existing infrastructure, complemented by regulation, where necessary to achieve effective competition in retail services. An efficient level of infrastructure-based competition is the extent of infrastructure duplication at which investors can reasonably be expected to make a fair return based on reasonable expectations about the evolution of market shares".[11]

41. Optus urges the ACCC and the Government to help promote infrastructure investment by considering whether similar legislation to that which gave effect to the News Media Bargaining Code – helping to address the power imbalance flowing from digital platforms market power and helping to ensure the long-term sustainability of Australia's telecommunications sector – is required to achieve to Australia's digital future.

3) Should law reform be staged to address specific harms sequentially as they are identified and assessed, or should a broader framework be adopted to address multiple potential harms across different digital platform services?

42. Optus supports amendments to the regulatory framework that enable the ACCC to address specific harms as they are identified and assessed. Optus submits that any new measures should be designed to afford the regulator sufficient flexibility to respond to harms as they arise.

43. As highlighted in the Discussion Paper, the existing regulatory framework may not be fit for the purpose of responding to harms arising from the conduct of large digital platforms. In particular, Optus supports the enactment of legislation that would address the power imbalance between ISPs and OTTs and require OTTs to agree to a fair and reasonable charge for use of ISPs networks to deliver their services.

44. Optus foresees that one of the challenges is to ensure that charging can differentiate between 'normal' traffic and unfair capacity-inducing traffic – in a non-discriminatory fashion. The problem being addressed is not access to standard broadband services; but rather high-bandwidth entertainment services dominating communications access network and threatening the viability of other important digital services.

45. While the precise nature of any charging would be subject to commercial discussions, it may still be beneficial to consider – at a high level – the type of charging that could be adopted to promote more equitable and efficient outcomes. Such charging would adopt cost-causation principles while minimising the risk of discriminatory or anti-competitive structures. Cost causation implies charges are targeted to the traffic types that drives, or is likely to drive, network congestion; while minimising the risk of anti-competitive

[9] Treasury Laws Amendment (News Media and Digital Platforms Mandatory Bargaining Code) Act 2021; [Final legislation as passed by both houses.pdf (accc.gov.au)]

[10] [News media bargaining code | ACCC]

[11] recital 27, European Electronic Communications Code (EECC)

outcomes would target charges at the underlying characteristics of bandwidth demand rather than the broad type or brand of traffic.

46. **[CiC]**

47. All of these charging types require ISPs to identify and manage OTT traffic, and to negotiate with the major OTT providers. Therefore, law reform to implement a bargaining code is necessary to bring OTTs to the negotiating table. Alternatively, Optus supports the approach taken by enabling Ofcom's Digital Markets Unit to undertake specific targeted regulatory responses to entities that have been found to have "strategic market status". Such a measure should enable the ACCC to address the competitive harms identified above.

4) What are the benefits, risks, costs and other considerations (such as proportionality, flexibility, adaptability, certainty, procedural fairness, and potential impact on incentives for investment and innovation) relevant to the application of each of the following regulatory tools to competition and consumer harms from digital platform services in Australia?

48. Optus supports the use of lighter touch regulatory measures, including Codes of practice, backed up by the introduction of "pro-competitive or pro-consumer" measures such as the "pro-competitive interventions" contemplated for Ofcom's Digital Markets Unit.

49. Optus agrees that Codes of practice should theoretically offer important benefits in terms of adaptability and flexibility in development – and notes the potential benefits of industry engagement and consultation to developing real and workable technical solutions to identified harms. However, lighter touch regulatory measures can also lead to a lack of clarity as to compliance and enforceability. Furthermore, the proliferation of Industry Codes means that there is a high probability of duplication leading to regulatory uncertainty and avoidable compliance costs for industry.

50. Alternatively, Optus considers that new rule making powers such as the "pro-competitive interventions" that may be made by Ofcom's Digital Markets Unit (DMU) would appear to enable Ofcom to respond to harms in markets where a firm has been determined to have "strategic market status" which accords with Optus' view that regulation should be targeted and substantiated to addressed identified harms in a timely and effective manner.

51. Optus notes that the exercise of any new regulatory powers should be conditional on meeting accepted standards of regulatory and administrative decision making. This includes ensuring that the regulatory response is proportionate to the harm to be addressed

5. To what extent should a new framework in Australia align with those in overseas jurisdictions to promote regulatory alignment for global digital platforms and their users (both business users and consumers)? What are the key elements that should be aligned?

52. Optus considers that any new framework must first be designed to reflect the local circumstances of Australia's communications market while incorporating measures to ensure sufficient consistency with best practice overseas. The global reach of digital platforms means that regulatory alignment is necessary though the alignment should extend to the general power for regulators to intervene in digital markets, rather than in relation to the specific mechanisms used or markets chosen in which to intervene. This is because while the markets for many digital services may be global in reach, the harms occasioned by abuses of market power by digital platforms may be more local.

53. Optus points to useful precedent in South Korea where new legislation permits ISPs to levy a bandwidth charge on large OTT providers that drive traffic and costs into the networks. For several years there was dispute between major communications networks and OTT providers over the network usage charges for the bandwidth they require to deliver content. Negotiations between SK Broadband (SKB) and Netflix broke down in 2019, with SKB applying to the regulator that OTT providers should bear part of the network costs caused by their services.

54. As a result of the failure to reach commercial agreement, the Korean Communications Commission (KCC) developed regulatory guidance on agreements between networks and OTT providers. The KCC noted that it prefers such disputes to be determined through market mechanisms, but in circumstances where the market does not operate there is a role for government intervention.[6] The guidelines set out principles to prevent unfair discrimination between large and small companies (whether ISPs or OTTs). The guidelines state "Each party must not unfairly restrict the other party's legitimate benefits by using its superior position and on a non-discriminatory basis with other agreements with companies of similar size."

55. Unfair conduct includes a party using its superior market position to coerce the other party to accept terms without justification; if a party unreasonable delays or refuses to execute an agreement; if a party demand the other party conclude or not conclude or to discriminate against a third party. In addition, OTT providers are also expected to inform ISPs of any change in traffic, or surge in traffic, that is expected to have a considerable negative impact on the ISP.[12]

7. Which platforms should such regulation apply to?

56. Optus submits that new measures should apply to specified large digital platforms that provide high bandwidth services.

Addressing data advantages

57. Optus agrees with the ACCC's general observations that data is central to the digital economy and confers and entrenches the market power of those entities able to collect and use data sets at scale, such as large online platforms. Optus welcomes the ACCC's consideration of potential measures that may be used to enable access to the data of digital platforms that may be considered essential to entry into digital markets.

58. In our submission to the Attorney-General's Department consultation on the Review of the Privacy Act, Optus highlighted concerns that measures designed to address harms identified in the Digital Platforms Inquiry were being used to justify economy wide reforms of the Privacy Act. In Optus' view, it remains unclear why reforms intended to improve consumer control over the personal information provided to digital platforms should be applied economy wide. It is the stated intention of the Privacy Legislation (Enhancing Online Privacy and Other Measures) Bill 2021 (OP Bill) to improve the privacy of consumers online – and the policy rationale in support of these changes are evident in the form of the ACCC's Digital Platforms Inquiry.

59. Optus submits that the Review should not only involve consideration of the adequacy of Australia's privacy protections against benchmark privacy protections, but within the context of enabling and promoting competition. Optus submits that many of the reform proposals, while well intentioned, may have unintended adverse consequences, including limiting the provision of existing services, as well as undermining competition

[12] https://chambers.com/articles/korea-communications-commission-announces-guidelines-on-fair-internet-network-use-agreement

or the potential for new entry into digital markets that the Government and the ACCC has stated it is most concerned about.

60. Conversely, Optus queries why, particularly in light of the ACCC's observations about the potential competition enhancing effects of data interoperability and, to a lesser extent, portability, digital platforms are not subject to the Consumer Data Right (CDR) while telecommunications service providers are. Optus notes that the ACCC indicates support for the "Data Transfer Project" – while this is a laudable initiative that ostensibly encourages a wide membership of customer facing organisations, it is important that any arrangements concluded between the members not limit interoperability and thereby create a barrier to entry.

Improved consumer protection

61. As noted above, Optus provides in principle support for the extension of consumer protection regulations to digital platforms, particularly in relation to any circumstances in which these platforms provide services directly to consumers.

Adequate scrutiny of acquisitions

62. Optus notes the ACCC's economy wide merger reform proposals, however, in line with our comments above, Optus supports the introduction of a more tailored scheme that will apply where an undertaking satisfies pre-defined criteria. Optus considers that the financial resources and scale of large digital platforms means that it is increasingly impossible to compete for acquisitions that may enable new entry into digital markets. Further, large platforms are often well placed to identify targets for so called "killer acquisitions" thereby eliminating nascent competition.

63. Optus also supports proposals to amend the merger factors under section 50(3) to focus on the structural impacts of a proposed transaction and to incorporate factors relating to the potential loss of competitive rivalry and/or increased access to/control of data, technology or other significant assets. Furthermore, Optus agrees with the general proposal to incorporate a "balance of harms" test or alternatively the introduction of a rebuttable presumption that an acquisition by a designated digital platform will raise competition concerns.

ISP economics streaming services

Report for Optus

COMPETITION ECONOMISTS GROUP

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1 Overview

1. We have been asked by Optus to consider the growth in streaming, video and gaming applications[1] on the economics of fixed and mobile network infrastructure. We have been asked to consider the potential economic effects of non-discriminatory commercial arrangements in which providers of these applications incur a cost for delivering their content to end-users.[2]

1.1 Background

2. The majority of traffic on the internet is generated through streaming, video and gaming applications.[3] In Australia, there has been enormous growth in the number of subscribers to such applications; it is estimated that there are around 37 million such subscriptions, as of June 2019.[4]

3. The growth in subscriptions to streaming, video and gaming applications has seen commensurate growth in data downloads across both fixed and wireless broadband networks. The ACCC report a compound annual growth in data downloads over fixed and mobile networks of over 40% over the last 5 years.[5] This data usage is increasingly concentrated in peak evening periods.[6] The desire for greater bandwidth has seen increased take up of higher bandwidth fixed line broadband services[7] and demand for mobile services with greater data allowances.[8]

4. The internet, in its most simple terms, connects consumers of content with the creators of content (be it websites or streaming videos). In between the content creators and consumers lie an array of physical communications networks that connect the two sides. These internet services providers (ISPs) act as platforms connecting the suppliers and consumers of internet content – ISPs are two-sided platforms where the decisions of ISPs benefit both the creators and consumers of

1 The providers of these applications are sometimes referred to as providers of over-the-top (OTT) services and include the likes of content streaming services (e.g., Netflix, YouTube), digital platforms (e.g. Facebook, Instagram), and gaming platforms (e.g. Xbox, PlayStation, Twitch, Epic Games).

2 In considering the effect of *non-discriminatory* arrangements we abstract from the issues related to network neutrality.

3 Greenstein, S. (2020), "The Basic Economics of Internet Infrastructure", *Journal of Economic Perspectives*, Volume 34 (2), Spring, pages 192–214.

4 Telsyte, Subscription home entertainment soars in Australia, 17 August 2020, https://www.telsyte.com.au/announcements/2020/08/17/subscription-home-entertainment-soars-in-australia

5 https://www.accc.gov.au/system/files/20-47RPT_Communications_Market_Report_FA.pdf

6 We understand from Optus that 96% of its weekly peak traffic on our NBN services is driven by customers accessing content delivery networks (CDNs) providing access to streaming, video and gaming applications. On its mobile network, CDN traffic at peak is 86%.

7 ACCC, *Communications Market Report 2019-20*, December 2020.

8 Ibid.

internet content, and decisions made by creators and consumers of content impact ISP platforms.

5. In order to deliver these services, ISPs must provide sufficient bandwidth to carry data between the providers of content and the final customer. While consumers drive the demand for content, content creators determine the bandwidth of streams delivering the content to consumers. The investment in this capacity benefits the creators of content – who profit by selling access direct to consumers – and the consumers of content – who enjoy streaming content at peak times without congestion.

6. However, the incentive and ability for ISP platforms to invest in the infrastructure needed to supply the capacity to support the delivery of content between creators and consumers is uncertain. The costs are largely fixed and incurred upfront, whilst revenues are received over the long term. Under existing arrangements, while content creators determine the bandwidth of their streamed content, the cost of creating the capacity to deliver that content lies primarily with the ISPs who typically rely on charging retail consumers for services (who may or may not also consume streaming content).

7. It is in the long-term interests of all market participants – including mobile and fixed operators; content creators, including providers of streaming, video and gaming services; and ultimately end consumers – that a sustainable charging model be developed that delivers efficient investment in the broadband infrastructure these content services rely on.

1.2 Summary of opinion

8. In this report we evaluate the economic issues that currently exist due to the growing demand for streaming content within the current charging arrangements for broadband services which are predominantly charge consumers for access to data services. We consider the:

- implications of alternative charging constructs in which providers of streaming content contribute to the cost of providing the broadband network capacity to deliver that content;
- primary economic issues relating to the incentive to invest in improved broadband services and to minimise the efficiency cost of recovering historic upfront investments in network capacity; and
- the benefits of an alternative charging scheme to promote the efficient pricing of content services to consumers and the effect on an equitable distribution of cost recovery.

9. We conclude that there are material benefits from adopting a charging model that better enables all market participants to make more informed and efficient usage and

investment decisions. We consider a model in which ISPs can levy a charge on content creators for the delivery of data to consumers would create the following benefits:

- ISPs, as the platform that connects content creators and consumers, would have an incentive to adopt a charging structure that maximises participation from both content creators and consumers. ISPs would have an incentive to rebalance charges in favour of lower retail broadband subscription charges;[9]
- Digital Platforms would face a charge that is more cost reflective allowing them to make more efficient decisions, including investment in compression and other technologies that minimise the bandwidth-demand of their content;
- Consumers would also face more cost reflective charges, including any pass through from streaming applications that reflect their higher demand on the network, allowing them to make more informed choices. This will address existing cross-subsidies between low and heavy users of streaming services from uniform charges; and
- The ability to better reflect in prices the benefits of increasing network capacity means that ISPs will have better incentives to invest in that capacity in both mobile network investment and in acquiring sufficient capacity for the provision of NBN services.

10. Finally, we note that opening up an additional revenue stream for NBN services may reduce some of the uncertainty in the cost recovery of the NBN infrastructure; and place less upward pressure on retail fixed broadband prices.

1.3 Effects of current charging construct

11. The public benefits from improved broadband services are well understood to materially outweigh the private benefits, leaving an important gap in the incentives to upgrade and improve broadband network infrastructure.[10] The provision of higher quality fixed and mobile broadband services benefits more than just the retail provider of internet services (i.e., the ISP). In addition to ISPs potentially gaining greater revenues from providing higher quality services, retail customers gain utility from the applications that can be delivered on the improved services, and content providers benefit through the potential to deliver, and earn revenue from, an expansive range of content rich services.

9 Rochet, J-C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Econ Assoc* 1(4), 990-1209

10 See for example, Nevo, Aviv, John L. Turner, and Jonathan W. Williams. 2016. "Usage Based Pricing and Demand for Residential Broadband." *Econometrica* 84 (2), pages 411–43; Marlies Van der Wee, Sofie Verbrugge, Bert Sadowski, Menno Driesse, Mario Pickavet, (2015) "Identifying and quantifying the indirect benefits of broadband networks for e-government and e-business: A bottom-up approach", *Telecommunications Policy*, Volume 39, Issues 3–4, 2015, pages 176-191.

12. Despite the breadth of beneficiaries, the current commercial arrangements concentrate the private costs and commercial risks of providing improved broadband services on the ISP. ISPs incur the costs of providing a network and compensate the cost by charging their customers a fee. The absence of a charge by ISPs for the origination of data delivered to their customers diminishes the incentive to improve services even when it would be of net benefit to all market participants.

13. The current commercial arrangements are such that ISPs, acting as an intermediary platform between content providers and retail customers, only charge one group of users for its service – its retail customers. This contrasts with intermediaries in many other markets that charge both sides of their platforms for connecting customers (e.g., newspapers, subscription television, dating applications, credit card networks).

14. The absence of a charge on providers of digital content creates economic distortions including free riding[11] and externalities[12] in the provision of broadband services. These distortions mute the incentive to invest in capacity to provide higher quality broadband. Providers of streaming, video and gaming content currently free ride on the benefits of high-speed internet during peak hours. With network operators providing additional bandwidth during peak hours, it allows more high-quality streaming content which in turn allows providers of this content to extract additional profits from final customers.

15. ISPs, in providing faster internet services allowing for higher quality streaming[13], generate a positive externality (benefits in the form of higher profits) for providers of streaming, video and gaming applications. These providers are able to charge higher prices to customers accessing higher quality services, such as 4K content. ISPs do not, however, take these benefits into consideration when making investment choices because they do not gain from these benefits through higher profit. Therefore, they may invest less in network capacity.

11 Free riding occurs when an entity is able to enjoy the benefit of a product and the owner of the product cannot recover compensation from that entity or prevent that entity from enjoying the benefit. As a result, the owner of the product will have less incentive to provide the product.

12 Externality occurs when an activity results in costs or benefits to a third party and such costs or benefits does not affect the decision-making process of the entity conducting the activity. The entity fails to take into consideration the additional costs or benefits to the thirty party because the entity's objective, for example profit, is not impacted.

13 The quality of broadband services has a number of dimensions that influence the experience of streaming services. There are internet services providers that tailor their offering to be attractive to particular applications, e.g., gaming. https://www.lightningbroadband.com.au/

1.4 Implications of alternative charging constructs

16. Since the development of the internet in the 1990s, ISPs have not typically charged for accepting data delivered to their customers from public interconnection points.[14] However, today it is not uncommon for owners of streaming applications to be charged by ISPs for the data delivered over the provider's network.[15]

17. The economic effects of a charging arrangement for delivering data to customers can be assessed based on whether it would enable all market participants to make more informed and efficient usage and investment decisions. This consideration would be central to determining whether the introduction of such an arrangement would pass a cost-benefit assessment, as it captures all aspects of efficiency (static, productive and dynamic efficiency).

18. The economic effects for owners of streaming applications, consumers and ISPs are as follows.

19. First, for streaming applications, a charge for delivering data to their final customers would internalise the cost the delivery of their service imposes on ISPs. This would create incentives for streaming applications to make more efficient decisions with respect to the services they offer. This would include decisions such as the locations for hosting content (either on their own or a third party CDN) or the compression technology that is adopted for streaming. Any charge levied for the delivery of content would be expected to be passed through to the consumers in the prices charged for streaming applications. The financial effect on the owners of streaming services will depend on the level of pass through, which can be shown to be affected by the degree of competition in the market for such services.[16]

20. Second, for consumers, a charge on owners of applications for delivering data to them would mean that prices they pay are likely to be more cost reflective, and hence more informed and efficient consumption decisions would be made. The prices that consumers would be expected to pay for broadband services would be lower due to a 'waterbed effect' in the charges levied by ISPs.[17] In addition, as owners of streaming

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14 We understand that there have historically been charges for data content delivery in circumstances where content was transiting the ISP's network or in circumstances where content was delivered via a content delivery network (CDN) that is hosted or collocated on the ISP's network.

15 Greenstein, Shane, and Michael Norris. 2015. "Streaming Over Broadband: Why Doesn't My Netflix Work?" *Harvard Business School Case 616-007*. We note some of these charges appears to be discriminatory in the sense that they are charges for prioritisation of network traffic. This is not the nature of the charges being considered in this report.

16 Technically, the level of pass through will depends on the curvature of the demand curve for streaming services. Weyl, E., & Fabinger, M. (2013). Pass-Through as an Economic Tool: Principles of Incidence under Imperfect Competition. *Journal of Political Economy*, 121(3), 528-583

17 An ISP's overall profit would be held to a level based on the competitive process. See Greenstein, S. Peitz, M. and Valletti, T. (2016) Net Neutrality: A Fast Lane to Understanding the Trade-offs, *Journal of Economic Perspectives*, Volume 30, Number 2, pages 127–150.

applications will pass through the data delivery charge to their customers, this will mean that:

a. Consumers that *do* subscribe to streaming, video and gaming applications will likely pay a higher price reflecting the cost they place on the network due to increased data delivery;[18] and

b. Consumers that *do not* subscribe to such applications will likely pay a lower price, and hence no longer cross-subsidise customers that do subscribe to such applications.

21. This would resolve an inherent inequity in the current charging arrangements. In effect, this will allow a form of price discrimination that could not as easily be arranged by the ISP alone (as they do not identify high-use and high willingness to pay customers).[19] The effect of this charge would be expected to further lower average prices for consumers in the longer term as consumers respond to the price signals.[20]

22. Third, for ISPs the ability to charge for data delivered by streaming applications creates incentives for ISPs to adopt more efficient pricing structures. As intermediaries between customers and content provider, ISPs have an incentive to adopt a charging structure that will attract as many customers on each side of the market as possible.[21] That is, users who highly value high bandwidth streaming applications usage would only be modestly moderated, whilst consumer who do not currently subscribe would be attracted by the lower price for broadband services.

23. The ability to better reflect in prices the benefits to increasing network capacity means that ISPs will have better incentives to invest in that capacity. Efficient investment in additional network capacity cannot simply be assumed. ISPs will invest if in expectation they consider that expected future cashflows will be positive (accounting for the opportunity cost of funds).

24. In the case of mobile networks, infrastructure cost has been increasing with every generation of mobile technology. In the case of 5G, these additional infrastructure costs are driven by the requirement to deploy many additional small cells in order to

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18 The price that customers pay may be differentiated by the bandwidth they acquire for their service (and hence the level of data delivery the application provider would be charged). For example, the charge may differ depending on whether the streams are of standard or high definition. We note that Netflix already differentiates its charges based on the quality of its streams even though it current faces no difference in cost for delivering these services over the ISPs network.

19 ISPs, naturally, are able to identify these customers after these customers have already signed up by looking at their usage patterns. However, ISPs are not able to identify these customers prior to the customer signing up and price discriminate on that basis.

20 The price elasticity of demand for broadband is such that additional take up of broadband would be expected with lower prices. Nevo, Aviv, John L. Turner, and Jonathan W. Williams. 2016. "Usage Based Pricing and Demand for Residential Broadband." *Econometrica* 84 (2), pages 411–43.

21 Rochet, J-C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Econ Assoc* 1(4), 990-1209

make use of high-frequency spectrum.[22] The profitability of investment will depend on expectations of cost recovery in a post-investment competitive environment. The ability to gain incremental revenue from streaming applications for the delivery of data would result in a more beneficial business case for deploying 5G networks. In the absence of this market expansion effect, investment in new technologies may be delayed. Put another way, investment in new technology may be delayed if operators cannot capture the higher willingness to pay for the higher quality services delivered by the latest generation of mobile technology.

25. Ongoing nation-wide investment in 5G capable networks by each of the three mobile operators is far from certain. In this report we use oligopolistic models of investment to explore these effects.[23] We show that there is a trade-off for policy makers in either providing mobile operators with flexibility to implement charging models that allow them to capture the increased demand for services or risk delayed investment in 5G. An alternative trigger for additional investment may be a change in the post-investment competitive, such as further concentration between mobile operators (e.g., through merger or infrastructure sharing). This may be undesirable from the perspective of consumers.

26. In the case of fixed line services, these are largely delivered over the NBN in Australia. The wholesale charges for using services on the NBN is predominantly user charges in the form of per customer charges for different last mile bandwidths[24] and backhaul charges (in the form of CVC). As a state-owned enterprise, investment in the NBN is driven by the Government's stated expectation of the network capability which are periodically updated.[25] Once investments in network capacity are made, the marginal cost of utilising that capacity is low.[26] The charges for the use of the NBN are passed though by retail services providers to end users, even though they are not the sole beneficiaries of this investment.

27. Charging streaming applications for data delivery on the NBN, either via ISPs or via NBN Co itself would better reflect the benefit that the NBN provides to streaming businesses and consumers of streaming content.

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22 https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost

23 Bresnahan, T.F. and Reiss P.C., "Entry and Competition in Concentrated Markets", Journal of Political Economy, Vol 99 No 5, 1991, pp 977-1009.

24 This is known as the access virtual circuit (AVC) charge.

25 https://www.communications.gov.au/publications/nbnstatementofexpectations

26 The marginal cost of using a fixed line networks is the saving from delaying future network investment (i.e., the opportunity cost of using the network is additional investment that would need to be made earlier should the network reach capacity). The marginal cost of using a network made up of predominantly lumpy sunk costs follows a saw tooth pattern; with very low marginal costs after investments are made, which rise as the network becomes fully utilised. If further investments are made, the marginal cost falls again.

1.5 Direct charging should be considered

28. We find that there are material benefits from adopting a charging model that enables ISPs to charge content creators for delivering streaming services. Allowing a pricing structure that between reflects the benefits and costs of delivering services will encourage more efficient investment in mobile infrastructure, such as 5G, and lower the uncertainty in cost recovery for fixed line infrastructure such as the NBN.

29. We consider that given the benefits identified, the adoption of such a charging model warrants further policy consideration and consultation. We note that the precise structure of the charging model, including any regulatory overlay, will have implications for the efficacy of the model. We also recognise that there will be issues to address in implementing an alternative charging model given the nature of the internet. These are outside the scope of this paper. Nevertheless, our conclusions in relation to the economic distortions to efficiency and the identification of inequities with the existing charging model suggest that an alternative charge model could have net benefits to the industry.

1.6 Structure of this report

30. The remainder of this report is structured as follows:

- Section 2 provides contextual background for the substance of the analysis in the remainder of the report;
- Section 3 examines the economic effects of current commercial arrangements in which ISPs do not charge for data delivery from streaming services;
- Section 4 we consider the implications for adopting an alternative commercial model in which ISPs charge content providers for data delivery on their networks; and
- Section 5 is a summary of our conclusions.

2 Background

31. In this section we provide contextual background for the substance of the analysis in the remainder of this report. We begin by discussing the transactions that take place on the internet when consumers use streaming, video and gaming applications. We then discuss the growth in traffic from the use of these applications and the investments that take place to support that traffic growth.

2.1 Transactions involved in streaming data to customers

32. In order to explore the issues, it is helpful to begin by describing the way in which data travels across the internet and the transactions involved. Greenstein (2020) provides an explanation of how data travels on the internet using the example of a single customer viewing a page on Wikipedia. Greenstein (2020) describes the following:[27]

> *The user employs a web browser that has been installed on a computer, smartphone, or other web-enabled device. The user has access to an Internet Service Provider, or ISP. ISPs provide wireline or wireless access by building and operating the physical equipment that carries data from one place to another. The internet service provider takes the user's request to a name server. The name-server associates an internet protocol (IP) address with the requested destination—in this example, Wikipedia.org. Thus informed, the user's browser directs the query to the server with that IP address. Wikipedia's server responds by releasing the requested data in packets, which are formatted to comply with a specific protocol used to interconnect devices on the internet. That data travels to the user's ISP, which delivers it to the user's device, where it is rendered by the device into in a form the user can view.*

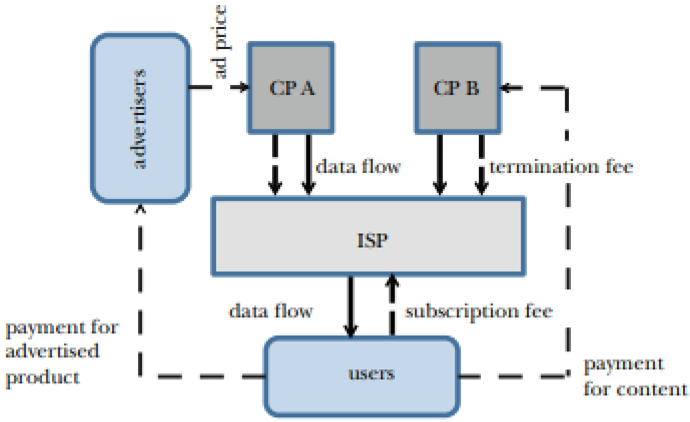
33. The mechanics are largely the same for streaming, video and gaming applications except the user may be employing an application to access content, rather than visiting a website (a web browser can be used in many cases for streaming services). The application transmits a request to the content server to release the data supporting the stream requested by the user. The data travels to the user's ISP which delivers the data to the user's device where the application renders the data into consumable content via the streaming, video or gaming application.

34. The transactions involved in delivering streaming, video and gaming applications depend in part on the commercial model adopted by the application owner. The following figure summarises two commercial models: an advertising funded

27 Greenstein, S. (2020), "The Basic Economics of Internet Infrastructure", *Journal of Economic Perspectives*, Volume 34 (2), Spring, pages 192–214

commercial model offered by content provider (CP) A; and a subscription application offered by CP B. It shows the payment flows in dotted lines and the data flow in solid lines (for simplicity data is shown only to flow from the content provider to the consumer).

Figure 2-1: Transactions for delivering data from streaming applications



Source: Greenstein (2020)

35. The ISP is shown as a platform that sits between users and content providers. Of course, this model is a simplification, in the sense that a more detailed diagram would show the data from the content provider moving to its own ISP, then to the "backbone" of the public internet, then to the end-user's ISP, and then on to the end users (assuming the content provider is not located on the user's ISP's network). The fuller picture could also include the use of content delivery networks (CDNs). This more simplified diagram helps in understanding the first-order effects. In this diagram, the dashed arrows represent the (typical) direction of payment flows; clearly, regulatory intervention may alter such flows. The content providers in this model can have differing business models. In this diagram, for instance, content provider B makes revenues from selling its content to end users, while content provider A does not charge end users, but makes revenues from advertising.

2.2 ISPs operate two-sided platforms

36. ISPs operate a two-sided platform. The services supplied benefit both sides of the network, the party that delivers the content and the party that receives the content.

37. The party that delivers the content benefit from the profit it earns by having access to the users accessing services on that ISP's network. The party that receives the content benefits through its enjoyment of the content that is carried on the network of its ISP.

38. A two-sided platform features the following three elements:[28]

> *The first element is that there are two distinct groups of consumers who need each other in some way and who rely on the platform to intermediate transactions between them. A two-sided platform provides goods or services simultaneously to these two groups.*
>
> *The second element is the existence of indirect externalities across groups of consumers. That means that the value that a customer on one side realizes from the platform increases with the number of customers on the other side.*
>
> *The third element is non-neutrality of the price structure, i.e., the price structure of the platform affects the level of transactions.*

39. ISPs satisfy all three elements of a two-sided platform:

- First element – The ISP serves two groups of consumers, the group that consumes content and the group that provides content. Without the ISP, it is not possible for the content providers to provide online content to consumers.
- Second element – The utility of consumers and the profit of content providers depend on each other's use of ISP's network. The number of customers on a network affects the profitability of the content provider that use that network, thus generating positive externalities.
- Third element – If network providers change the price structure, e.g., decreases the price for consumers and increase the price to content providers (which is currently zero), it will affect the level of transactions on either side.

40. The two-sided nature of broadband network infrastructure has long been accepted in economic literature. According to Rysman (2009):[29]

> *The multi-sided nature of many Internet and high-technology markets, as well as new payment systems and media outlets, suggest that two-sided and multi-sided markets are becoming increasingly important.*
>
> *The Internet service providers can be seen as platforms matching Internet users to content providers and hence, the concept of net neutrality is often evaluated from the perspective of two-sided markets.*

and Economides (2007):[30]

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28 OECD (2009) Two-Sided Markets, Policy Roundtable, DAF/COMP(2009)20 https://www.oecd.org/daf/competition/44445730.pdf

29 Rysman, M., (2009) "The Economics of Two-Sided Markets", *Journal of Economic Perspectives*, Vol 23, No 3,

30 Economides, N., Tag, J, Network Neutrality on the Internet: A Two-sided Market Analysis, *Information Economics and Policy*, January 2007

We explicitly model the Internet broadband market as a two-sided network consisting of broadband users on one side and content and applications providers on the other.

41. In many two-sided markets, the platform operator commonly has the ability to charge both sides of the market. For example, in the case of Apple, Apple provides a platform for app developers to sell products to users of Apple equipment. Apple is able to influence demand on both sides of the market by adjusting the price of the equipment it sells to consumers on one side (i.e., the price of the latest iPhone) and the commission it charges to app developers (Apple charges app developers a commission of 30% for use of its in-app purchasing system).[31]

42. ISPs, however, currently receive compensation from only one side of their platform. ISPs only recover from end-users through monthly charges from retail plans. ISPs are not able to receive compensation from the other side of the platform, being providers of content. Without being able to set a non-zero price, ISPs cannot affect the level of demand (i.e., bandwidth) from providers of content.

2.3 Growth in streaming traffic

43. There has been substantial growth in the use of video streaming applications by end-users in Australia. Research from the Australian Communications and Media Authority shows that over 55% of all Australians have viewed online subscription services over the last week in June 2020.[32] This is an increase from 31% in June 2017. This growth has been most noticeable in the 65-74 age group, with online subscription viewing increasing from 8% in 2017 to 40% in 2020. In fact, the majority of traffic on the internet are streaming, video and gaming applications.[33] In Australia, there has been enormous growth in the number of subscribers to such applications; it is estimated that there are around 37 million such subscriptions, as of June 2019.[34] Netflix alone has grown from less than 1 million subscribers to over 14 million subscribers in the 5 years to September 2020.[35]

44. The growth in subscriptions to streaming, video and gaming applications has seen commensurate growth in data downloads across both fixed and wireless broadband

31 European Commission, Antitrust: Commission sends Statement of Objections to Apple on App Store rules for music streaming providers, Brussels, 30 April 2021, https://ec.europa.eu/commission/presscorner/detail/en/ip_21_2061

32 https://www.acma.gov.au/publications/2021-06/report/communications-and-media-australia-how-we-watch-and-listen-content; Figure 15

33 Greenstein, S. (2020), "The Basic Economics of Internet Infrastructure", *Journal of Economic Perspectives*, Volume 34 (2), Spring, pages 192–214.

34 Telsyte, Subscription home entertainment soars in Australia, 17 August 2020, https://www.telsyte.com.au/announcements/2020/08/17/subscription-home-entertainment-soars-in-australia

35 Roy Morgan – *Various publications*, http://www.roymorgan.com/

networks. The ACCC report a compound annual growth in data downloads over fixed and mobile networks of over 40% over the last 5 years.[36] This data usage is increasingly concentrated in peak evening periods.[37]

Table 1-1: Total data downloaded in Australia from 2015 to 2020 (June quarter)

Year	Data volume (million TB)	Growth
2015	1.46	
2016	2.22	52%
2017	3.17	43%
2018	4.08	29%
2019	5.99	47%
2020	8.23	37%

Source: ACCC. Note: The numbers are for June quarter each year only.

45. The desire for greater bandwidth has seen increased take up of higher bandwidth fixed line broadband services[38] and demand for mobile services with greater data allowances.[39]

46. The impact that streaming content has on overall internet traffic in Australia was observed during the COVID 19 pandemic the government has further intervened to asks streaming applications to reduce the bandwidth of their streams to avoid congestion.[40],[41] These measures were reported to reduced traffic peaks by around 10%:[42]

> *… defaulting videos to SD, removing UHD bitrate, lowering bitrates or implementing CODEC reconfiguration. It was estimated by forum participants that without these measures, traffic peaks may have been up to 10 per cent higher during the analysis period*

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36 https://www.accc.gov.au/system/files/20-47RPT_Communications_Market_Report_FA.pdf

37 We understand from Optus that 96% of its weekly peak traffic on our NBN services is driven by customers accessing content delivery networks (CDNs) providing access to streaming, video and gaming applications. On its mobile network, CDN traffic at peak is 86%.

38 ACCC, *Communications Market Report 2019-20*, December 2020.

39 Ibid.

40 https://www.theguardian.com/media/2020/mar/20/australian-government-asks-netflix-and-stan-to-reduce-data-to-avoid-broadband-overload

41 The Government also instructed NBN to implement a 40% increase in capacity at no additional charge. https://minister.infrastructure.gov.au/fletcher/media-release/nbn-boosts-capacity-australians-working-home

42 nbn, The Impacts of COVID-19 Response Measures on Australian Broadband Traffic on the nbn™ Network, January 2021

2.4 Investment in network capacity

47. In order to deliver these services, ISPs must provide sufficient capacity to meet the bandwidth required from content creators in order to carry content between the providers of content and the final customer. This applies to both fixed and mobile providers. In the fixed market, this means ISPs acquire more capacity through buying more NBN services. In the mobile market, mobile network operators act as ISPs (MNOs) will invest greater capital for infrastructure to support this growth.

2.4.1 Increasing capacity for fixed line services on the NBN

48. In the case of fixed line services in Australia, acquiring additional capacity predominantly means ISPs purchasing addition network capacity over the NBN in the form of CVC which is charged on a megabits per second (Mbps) basis. In order to maintain claimed speeds in peak periods ISPs must acquire additional CVC.[43]

49. In general, ISPs offer NBN broadband services with unlimited data allowances.[44] Retail broadband services are differentiated based on typical evening download speeds for residential customers.[45] The approach largely mirrors the guidance provided by the ACCC that any speed claims made in selling broadband services must be relevant to the period of peak usage.[46] The ACCC periodically monitors the performance of ISPs against the claimed speeds.[47] The ACCC has pursued claims of breaching the misleading and deceptive conduct provisions of the Competition and Consumer Act (CCA) against ISPs for allegedly not meeting speed claims.[48]

50. In order to meet the demand for data in peak periods, ISPs manage their purchases of CVC. The following figure illustrates the balancing of CVC and peak downland demand by a small ISP (Aussie Broadband) in one location.

43 If the bandwidth is exceeded then ISPs will pay an CVC overage which is levied at a premium to standard CVC rates.

44 There are some exceptions to this with some lower priced plans offered by some smaller ISP offering data limited plans.

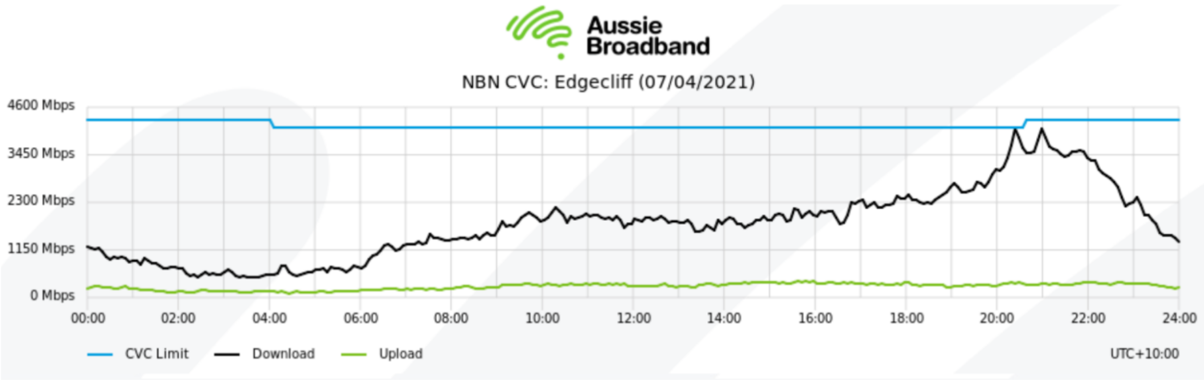
45 For example, at the time of drafting this report Optus presents its speeds based on "typical busy period download speed 7pm-11pm for consumers and 9am-5pm (Mon-Fri) for business".

46 ACCC, *Broadband speed claims: Industry guidance*, October 2020.

47 https://www.accc.gov.au/regulated-infrastructure/communications/monitoring-reporting/measuring-broadband-australia-program

48 https://www.accc.gov.au/media-release/dodo-and-iprimus-in-court-for-alleged-misleading-broadband-speed-claims

Figure 2-2: Example of ISP acquisition of CVC



Source: https://www.aussiebroadband.com.au/cvc-graphs/

51. We understand that ISPs also pay "overage" payments to NBN to maintain customer bandwidth at peak hours if the CVC included within bundles is not sufficient to meet demand.

2.4.2 Increasing capacity for mobile services

52. In the case of mobile services, expanding network capacity mean leasing access to or investing in infrastructure to increase network and backhaul capacity. This investment may be in the form of upgrades to existing facilities, or it may involve the deployment of new generations of mobile technologies (such as the expectant deployment of 5G).

53. Mobile network operators have faced increased infrastructure costs with each new generation of cellular technology. According to McKinsey:[49]

> *While each technology cycle brings greater opportunities to mobile operators, it also requires greater infrastructure investment.*

54. The following diagram shows the depreciation and amortisation costs increasing for Optus over the past 10 years. This is an indicator of the increasing capital expenditures incurred in expanding network capacity, predominantly on its mobile network infrastructure in Australia.

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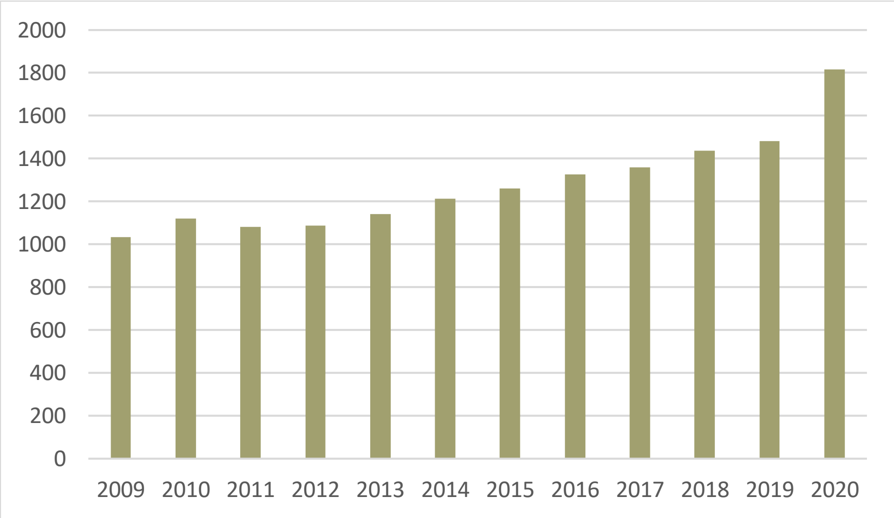
49 https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost

Figure 2-3: Optus depreciation cost ($A million)



Source: SingTel Management Discussion and Analysis[50]

55. One major contributing factor to the increased cost of 5G development is the adoption of spectrum at higher frequency. The higher frequency spectrum decreases the range of cell towers and indoor penetration ability. As a result, telecoms will need to increase the number of radio antennas to make up for the decrease in their range:[51]

> *… mobile operators will need to* ***increase their infrastructure investment significantly to overcome certain limitations. For example, high-frequency spectrum provides extra capacity but comes with much greater propagation limitations [emphasis added].*** *Trials of 3.5 gigahertz spectrum indicate that its range falls to about 400 meters outdoors, compared to the much higher range seen with current spectrum, and has lower indoor penetration. The 26 gigahertz and higher spectrum bands will have even greater propagation limits.*

56. A study by the UK National Infrastructure Commission also finds that the cost of deploying the small cell is high, because the vast majority of the cost (85 per cent) associated with rural areas with lower population density.[52]

> *On average across the scenarios, the cost of delivering 50 Mbps to the urban population of Britain represented only 2% of the overall capex cost, therefore urban rollout is realistic. Delivery of 50 Mbps to the suburban*

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50 https://www.singtel.com/about-us/investor-relations/financial-results

51 https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost

52 Oughton, E. & Frias, Z. (2016) Exploring the Cost, Coverage and Rollout Implications of 5G in Britain, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/577965/Exploring_the_Cost_Coverage_and_Rollout_Implications_of_5G_in_Britain_-_Oughton_and_Frias_report_for_the_NIC.pdf

population of Britain represented 19% of the overall capex cost and is also viable. The most expensive settlement type to deliver 50 Mbps to was rural areas, which on average represented 79% of capex. ***The very high costs of rolling out a ubiquitous 5G network capable of 50 Mbps result from the need to add a very dense ubiquitous layer of small cells [emphasis added].***

3 Effects of the current landscape

57. In this section we evaluate the economic issues that exist due to the demand for streaming data and the current charging arrangements.

58. At a general level, we consider that the current arrangements are unlikely to result in economically efficient outcomes. A sound analysis of economic principles show that the owners of streaming applications are beneficiaries of investments in high-speed broadband networks – put very simply, increased investment expands demand for their services as it allows content creators to deliver higher quality bandwidth-intensive products. Without such investment, these products would not be possible. At present, streaming applications effectively '**free-ride'** on the investments of ISPs.

59. The absence of a charge for the delivery of data by streaming applications for the use of network infrastructure creates what economist describe as an **externality**. In this case, there is a positive externality from investment in network infrastructure enjoyed by the owners of streaming applications. If this externality is not internalised by the investors of network infrastructure, say through a charge for data delivery to final customers, there will be an economic distortion. In this case, there will be underinvestment in or provision of telecommunications infrastructure due to the lack of recognition of the benefit enjoyed by providers of streaming services.

60. In general, we consider that the current arrangements are unlikely to result in economically efficient outcomes.

3.1 Free riding by streaming applications

61. At present, without a charging arrangement, streaming applications effectively 'free-ride' on the investments of ISPs in expanding network capacity.

3.1.1 What is free riding?

62. In economics, free riding occurs when a party can enjoy the use of a good without having to pay for that good and the owner of the good cannot prevent the consumer from using it:[53]

> *Free riding occurs when individuals or organizations enjoy the benefits of a good without contributing to its provision, or when they understate the benefits they derive from a good in order to reduce their contributions to providing the good. The free rider problem is that with fewer contributors,*

53 Rockart S. (2016) Free-Rider Problem, the. In: Augier M., Teece D. (eds) The Palgrave Encyclopedia of Strategic Management. Palgrave Macmillan, London.

> *or underestimated benefits, groups may produce less of a good than is socially optimal.*

63. When a party can free ride, they have no incentive to pay for the good. If the supplier of the good cannot charge all parties that benefit from the provision of the good, it leads to an insufficient supply of good that is socially optimal:[54]

> *The presence of free riders makes it difficult or impossible for markets to provide goods efficiently.*

3.1.2 Streaming application developers benefit from improved broadband services offered by ISPs

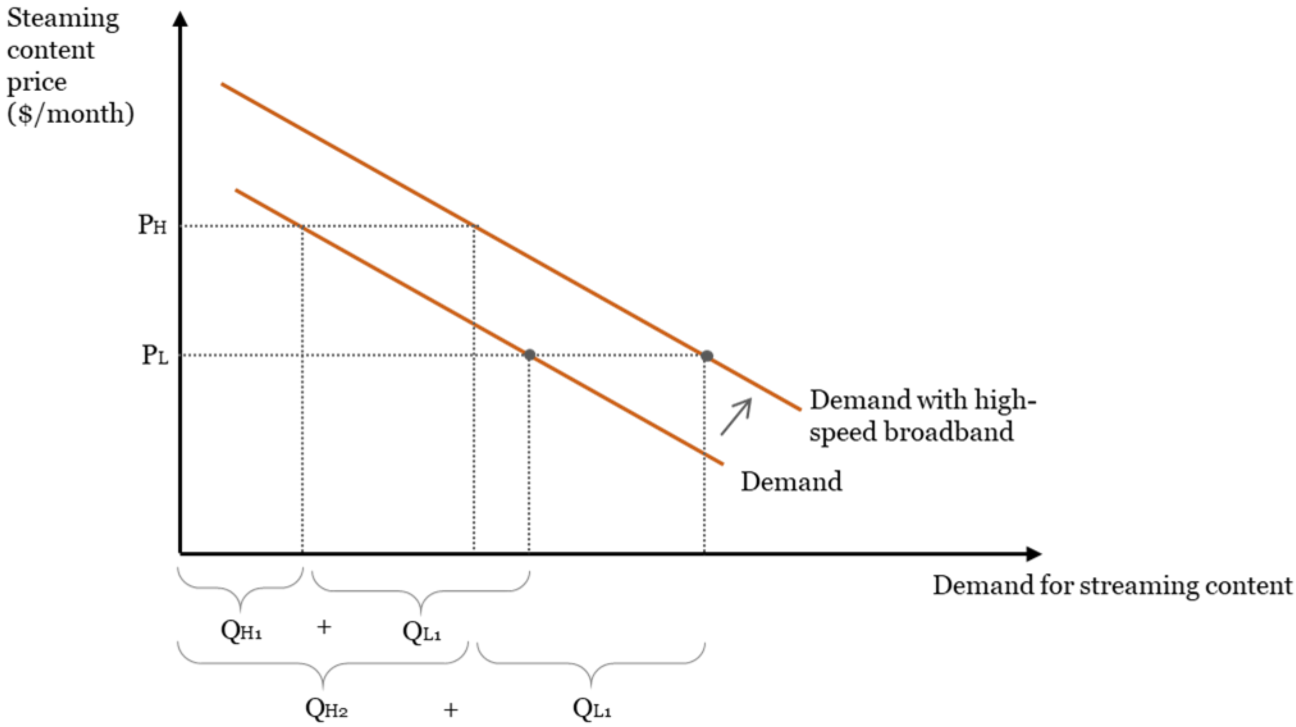
64. The demand for the streaming applications is complementary to the demand for high-speed broadband services delivered by communications network infrastructure. The demand for high-speed broadband can be conceived of as a 'derived demand' from the demand for streaming applications.[55] However, the relationship between the two services goes in both directions, with the demand for streaming service increasing with an expansion in the availability of high-speed broadband and vice versa.

65. The chart below is a stylised example of streaming content price and demand with and without an increase in broadband speed. We assume there are only two streaming content plans (high and low) with subscription fees being P_H and P_L. If there is no high-speed internet available in the market, the demands for streaming content high and low plans are Q_{H1} and Q_{L1}, respectively. When high-speed internet become available, the demand function shifts to the right. More subscribers would consume the high plan, and in the meantime, same level of subscribers would consume low plan, which results in an increase in total demand. The increased demand for streaming content high and low plans are Q_{H2} and Q_{L1}, respectively.

54 Pages 668 in Pindyck, R.S., and Rubinfeld D.L., Microeconomics, 6th edition, 2005

55 Whitaker J.K. (2008) Derived Demand. In: Palgrave Macmillan (eds) The New Palgrave Dictionary of Economics. Palgrave Macmillan, London. https://doi.org/10.1057/978-1-349-95121-5_97-2

Figure 3-1: Demand for streaming content with high-speed broadband are higher



Source: CEG analysis.

66. The above analysis shows that an increase in the availability of higher speed broadband creates greater willingness to pay for streaming content (and other streaming applications).

3.1.3 Implications of free riding for the provision of broadband services

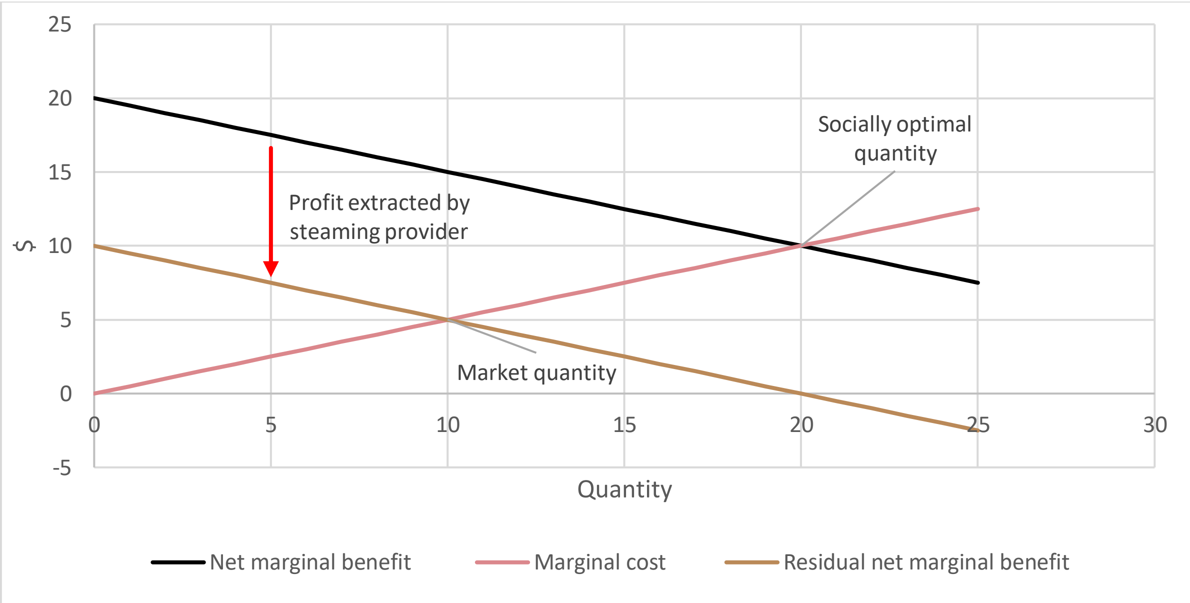
67. In a direct sense, streaming applications can free ride on the investments in broadband network capacity by ISPs leading to under investment and inefficient provision of broadband services.

68. In the provision of broadband services, the additional bandwidth provided to consumers generates surplus for both the consumer and the owners of streaming applications. However, the ISP cannot capture a portion of the marginal benefit enjoyed by the owners of streaming applications. As a result, the bandwidth provided by ISPs for consumers is less than would otherwise be the case.

69. The distortion in quantity is reflected in the following illustrative figure. Suppose customers require high speed broadband to stream an application (e.g., 4K UHD). In the figure the x-axis is the number of customers that are willing to order high speed broadband to watch 4K UHD streaming content. Assume the black line is the marginal net benefit of 4K UHD streaming content (consumer's willingness minus

the cost of providing the content). Suppose the content provider earns a $10 profit from each customer. Then customer's residual net marginal benefit decreases and it falls to the brown line, a decrease of $10.

Figure 3-2: Impact of 4K UHD on market due to free-riding



Source: CEG analysis

70. If the marginal cost of supplying high speed broadband is illustrated by the pink line, then the number of customers purchasing high speed broadband and access 4K UHD content is 10. This is the profit maximizing point for the content provider, however this is not the socially optimal point for access to high speed broadband and 4K UHD content. This is because a proportion of the net benefit derived from high-speed broadband and 4K UHD content is captured by the content provider as its profit instead of providing access to further the number of customers whose net benefit for 4K UHD content is greater than the marginal cost of broadband provisioning.

71. Jeon, Laffont and Tirole (2004)[56] investigated largely the same issue in voice calls. Both the caller and the receiver of a phone call receive a benefit to the call and call charges are typically exacted on the caller rather than the receiver. Jeon, Laffont and Tirole (2004) investigates the impact if the receiver is also charged a price and finds that socially efficient equilibrium can be achieved if both parties, the caller and receiver, are charged regulated prices:[57]

56 Doh-Shin Jeon, Jean-Jacques Laffont and Jean Tirole, "On the "Receiver-Pays" Principle, RAND, Vol 35, No 1, 2004

57 Ibid, page

> *We investigate how receiver charges affect internalization of the call externality. When the receiver charge and the termination charge are both regulated, there exists an efficient equilibrium.*

72. The reason that Jeon, Laffont and Tirole (2004) find that charging receivers would be socially desirable is because it can lower the cost for all callers:[58]

> *... if the access charge is near or above termination cost, charging receivers is socially desirable because it induces firms to lower calling charges.*

73. If the price is set such that the cost is recovered from callers only, it would lead to a sub-optimal level of calls. Therefore, a charge ought to be levied on the receivers who receives a benefit from the size of callers on the network.

74. For broadband services, final customers are typically the only party that is charged, similar to callers. Streaming applications, similar to receivers, do not face that burden. The owner of the streaming application receives a benefit from the size of population that are on faster broadband services, similar to receivers who benefit from having callers in the phone network. Therefore, if a portion of the cost of infrastructure is shifted to streaming applications, the price on end-users can be lowered to encourage more users to switch to faster broadband.

75. Without the presence of receiver charges, Jeon, Laffont and Tirole (2004) finds that the only approach to obtain the social optimum, is for the infrastructure operators to be subsidised through taxation such that the price on callers can be lowered to reach the socially optimum quantity.

3.2 Externalities in the provision of broadband services

76. A direct corollary of the free-riding problem is the presence of an externality. An externality arises when the actions of one party has an effect on others that were not party to those actions and hence did not choose for those actions to be undertaken. Therefore, the choice of action undertaken would not be the same as it would not have taken the benefit or costs of these additional effects into consideration.

3.2.1 What is externality?

77. In economics, actions can have external effects that may be positive or negative. The classic case of an externality is the negative effect on residents of pollution from a nearby factory. In this case, the negative external effect (externality) from the pollution leads to overproduction from the factory. Positive externality occurs when

58 Ibid, page

an action of one party benefits another party. An example of a positive externality is as follows:[59]

> *A positive externality occurs when a home owner repaints her house and plants an attractive garden. All the neighbors benefit from this activity even though the home owner's decision to repaint and landscape probability did not take these benefits into account.*

78. In the above example, a positive externality implies that inefficiency occurs due to an under-supply of such action:[60]

> *The inefficiency arises because the homeowner doesn't receive all the benefits of her investment in repairs and landscaping. As a result, the price … is too high to encourage her to invest in the socially desirable level of house repair. A lower price… is required to encourage the efficient level of supply.*

79. The presence of positive externalities is equally important from a policy perspective, as they can lead to the under provision of goods and services.

80. The absence of a charge on streaming applications for the use of network infrastructure creates what economists describe as an externality. In this case, there is a positive externality from investment in network infrastructure enjoyed by the streaming application. If this externality is not internalised, say through a charging arrangement, there will be an economic distortion. In this case, there will be under investment in, or under provision of, telecommunications infrastructure due to the lack of recognition of the benefit enjoyed by the streaming application.

81. The presence of positive externality generated by communications network operators is well known in economic literature. According to Economides in the Handbook of Telecommunications Economics:[61]

> *Like any network, the Internet exhibits network externalities. Network externalities are present when the value of a good or service to each customer rises as more consumers use it. Everything else being equal…On the Internet, the addition of a user potentially*
>
> - *Adds to the information that all others can reach;*
> - *Adds to the goods available for sale on the Internet;*
> - *Adds one more customer for e-commerce sellers; and*

59 Pages 642 in Pindyck, R.S., and Rubinfeld D.L., Microeconomics, 6th edition, 2005

60 Pages 644 in Pindyck, R.S., and Rubinfeld D.L., Microeconomics, 6th edition, 2005

61 Economides, N., The Economics of the Internet Backbone, Handbook of Telecommunications Economics, Vol 2, Chapter 9, 2005

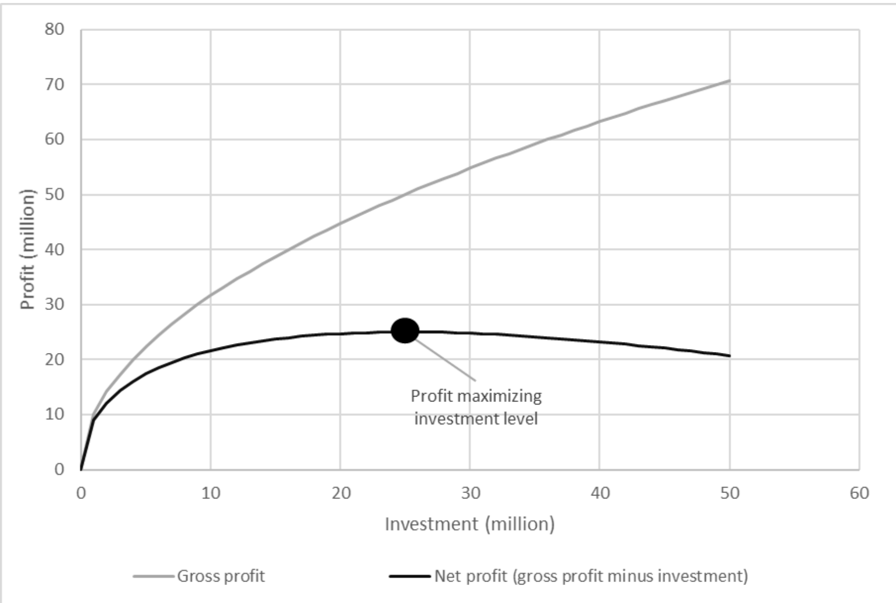
- *Adds to the collection of people who can send and receive e-email, or otherwise interact through the Internet*

3.2.2 Externality from scale of investment

82. In our case, investment in broadband infrastructure is not an action that owners of streaming applications choose to be undertaken. Yet, these actions will effect them. As discussed above, the effect is to increase demand for their services. The example is illustrated using the following figure.

83. The horizontal axis is the dollar amount of investment in the network infrastructure. The grey line is the gross profit that can be earned by the investment. The black line is the net profit (gross profit minus investment cost). The profit maximizing choice for the network operator is to choose the level of investment that maximises the net profit (the point where the black line is at its peak) which is $25 million.

Figure 3-3: Profit maximizing investment level

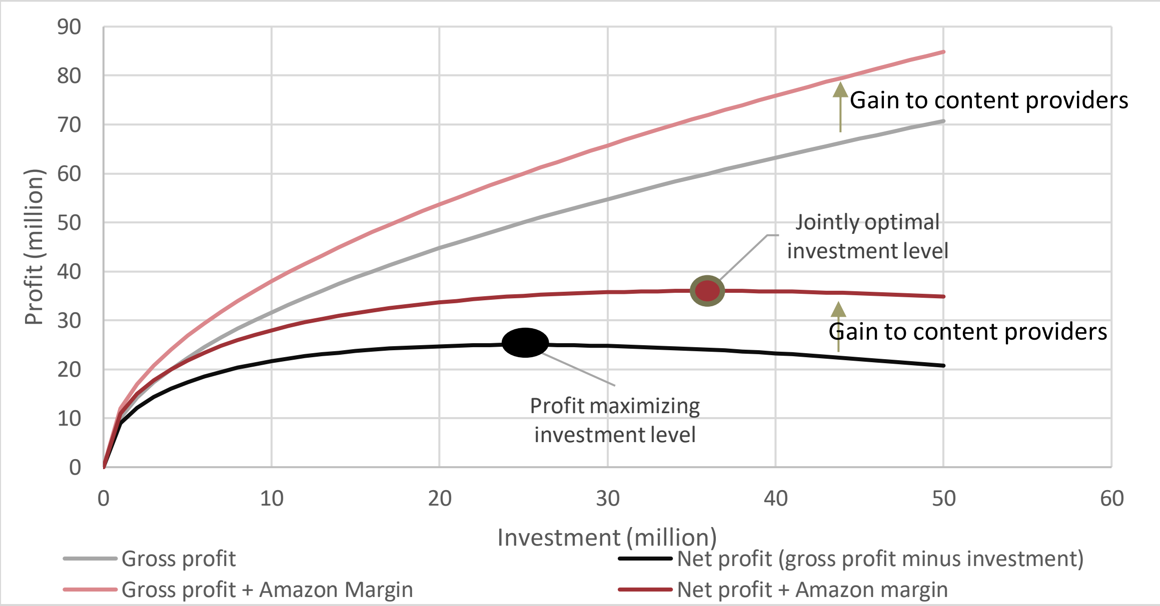


Source: CEG analysis

84. This simple illustration can be applied to the case of a streaming application . Suppose for example that investment in improved broadband allows an increase in the number of subscribers to streaming content providers or allows these consumers to purchase higher quality services (e.g., ultra-high definition services). Absent accounting for any profit gained by content providers in this example, the investment would be $25 million.

85. If additional investment were made beyond this level, content providers will observe an increase in profit due to the ability of the network to carry more data in peak periods. If we are to combine both impacts from investments, increased profit for the ISP and content providers, we observe that the optimal investment is higher at $36 million.

Figure 3-4: Comparison of investment level: profit vs welfare maximising



Source: CEG analysis

4 Implications of a charge for data delivery

86. In this section we consider the implications of a charging arrangement for streaming applications. The framework for our analysis is a cost-benefit assessment that considers the efficiency implications[62] of ISPs charging streaming applications for delivering data to customers.[63]

87. The efficiency analysis considers each aspect of economic efficiency including static distortions to consumption caused by charges above marginal cost (static efficiency), the effects on firms to be more productive and reduce cost (productive efficiency), and the incentive of firms to innovate and invest in a timely fashion (dynamic efficiency). Central to understanding the efficiency effects of ISPs charging streaming applications for delivering data to customers is whether it will enable market participants to make more informed and efficient usage and investment decisions.

88. The framework for our analysis of the effects of ISPs charging streaming applications is that of a two-sided platform, with the ISP acting as an intermediary between consumers of content and the providers of content (streaming applications). The model is formalised in Appendix A where we consider the effects on prices and margins for market participants.

4.1 Overview of model for analysing efficiency effects

89. The model we use to analyse the efficiency effects is an extension of the model developed in Greenstein, Peitz and Valletti (2016).[64] That model is for a single consumer of broadband and a streaming application. We extend this model to show the case for two types of consumers – one that consumes broadband only and the other consumes broadband and a streaming application.

90. Greenstein, Peitz and Valletti (2016) show that in case of a single consumer of broadband and streaming, the effect of a charges from ISPs to streaming applications is neutral with respect to the prices paid by the consumer and the margins earned by

62 "Cost–benefit analysis (CBA) is a method for assessing the economic efficiency of proposed public policies through the systematic prediction of social costs and social benefits. The concepts of 'willingness to pay' and 'opportunity cost' guide the valuation of projected policy effects in terms of a money metric. Comprehensively valuing effects and aggregating across all members of society yields the net social benefits of the policy. A policy with positive net social benefits is economically efficient relative to the status quo.". R.H. Haveman, D.L. Weimer, Cost–Benefit Analysis, Editor(s): Neil J. Smelser, Paul B. Baltes, International Encyclopedia of the Social & Behavioral Sciences, Pergamon, 2001, Pages 2845-2851

63 Where possible we abstract from the precise form of the charge that would be levied on streaming applications. Broadly, we assume it would be structured to reflect the costs that the delivery of

64 Greenstein, S., Peitz, M., and Valletti, T., "Net Neutrality: A Fast Lane to Understanding the Trade-offs", *Journal of Economic Perspectives*. Vol 30, No 2, Spring 2016, pages 127-150

the ISP and the streaming application. In the case of two consumers, we show that the consumer of broadband only will face a lower price and the margin of the ISP will expand.

91. The likely implication of ISPs charging streaming applications for data delivery is lower prices for broadband services to final customers. As noted by Greenstein, Peitz and Valletti (2020), whether or not there is effective competition between ISPs, the effect of a charge on streaming applications (content providers) is to lower the subscription charge paid by broadband customers:[65]

> *This result is obvious if the internet service provider is in a competitive setting, because its overall profits, from every source, are held to a normal level by the competitive process. However, the same result also holds for internet service providers with market power. If content providers are charged more, subscription fees will decrease because of the two-sided nature of the market. This will be to the advantage of end users, an aspect which is sometimes forgotten in the policy debate.*

92. We develop and extend the model in Greenstein, Peitz and Valletti (2020). We show that the prices that consumers would be expected to pay would be lower due to a 'waterbed effect' in the charges levied by ISPs. That is, if ISPs decide to charge streaming applications for the data traffic they generate, the waterbed effect means that the subscription fees paid by the ISPs customers will decrease.[66]

93. In a simple version of the model in which all broadband customers also subscribe to a streaming application, the model is shown to be completely neutral. The charge on data delivery means that ISPs simply lower their charge to their customers by an offsetting amount - an ISP's overall profit would be held to a level based on the competitive process. The charge for data delivery is passed through to the streaming application subscribers leaving the customer and the streaming application indifferent to the charging arrangement.

94. The effect is more interesting when we consider that there are some customers that subscribe to streaming applications and others do not. In this extension the model shows that owners of streaming applications will pass through the data delivery charge to their customers with varying effects for streaming applications, consumers and ISPs.

65 Greenstein, S. Peitz, M and Valletti, T. (2016) Net Neutrality: A Fast Lane to Understanding the Trade-offs, Journal of Economic Perspectives, Volume 30, Number 2, pages 127–150.

66 See Greenstein, S. Peitz, M and Valletti, T. (2016) Net Neutrality: A Fast Lane to Understanding the Trade-offs, Journal of Economic Perspectives, Volume 30, Number 2, pages 127–150.

4.2 Implications of streaming applications

95. In this section we outline the effects of a charging arrangement on the services offered by streaming applications. We consider how a charge for data delivery would affect the decisions of the streaming application and the degree to which the charge would be passed through to customers.

4.2.1 Effect on streaming application's investment decisions

96. Charging streaming applications for delivering data to final customers would internalise the cost of the delivery the data imposes on ISPs. This would create incentives for streaming applications to change the way in which they offer services. A charge that is cost reflective would make for more efficient decisions with respect to the services offered. This would include, for example, the location of content servers, compression technologies used for streaming, and for gaming applications the timing of game updates.

97. In relation to the location of servers, we understand that many streaming applications operate their own content delivery network (CDN) and will locate servers in locations around Australia with cached content that is streamed to customers. Other streaming application will use third party CDNs such as Amazon Web Services, Akamai, Microsoft Azure and Fastly. The CDNs typically have servers located throughout Australia. For example, we understand Amazon serves data to customers using 4 locations in Sydney, 2 locations in Melbourne and 1 location in Perth.[67]

98. A charge by ISPs for data delivery may affect decisions in relation to where to host content and which third party CDN to use as a host for content. A charge for data delivery could increase the incentive to distribute content servers closer to customers. This would be the case if the charged levied by ISPs could be avoided (or reduced) by locating content servers closer to the customer.

99. A charge by ISPs for data delivery may also influence decisions by streaming applications regarding compression technologies. In the absence of a charge for data delivery over the ISPs network, streaming applications have muted incentives to adopt more efficient compression technology. This is because they do not internalise the full cost of carrying data on an ISP's network to the point where consumers are connected. If the data delivery charge could be avoided or reduced by adopting a different compression technology, this will aid more efficient decisions.

100. Alternatively put, investment by applications in compression technologies that reduce the bandwidth required for streaming video is an economic substitute for investment by ISPs in addition network capacity to carry higher bandwidth streams.

67 https://aws.amazon.com/cloudfront/features/

The absence of a charge on streaming applications means there is no price signal in order for ISPs to communicate the cost for streaming applications to respond to.[68]

101. For gaming applications, we understand that current game updates are programmed to occur in off-peak periods in the US. This can coincide with peak periods for network usage in Australia. In the absence of a charge for data delivery, gaming applications have no incentive to account for the impact of this programming on the cost of providing broadband services in Australia.

4.2.2 Effect on streaming application's pricing decisions

102. A charge imposed by ISPs on streaming applications for delivering data to the ISP's users will be an input cost for operating a streaming application. If the charge is incremental to the output of the streaming application, then we would expect an element of the charge to be passed through to the final customer. A charge would be incremental to the output of the streaming application if it were, for example, based on the number of streams or the volume of data that was delivered across the ISPs network.

103. The extent to which the charge would be reflected in prices will depend on the nature of competition between streaming applications and the nature of demand for their services. The extent of pass through can be analysed from the perspective of economic theory and it can be analysed empirically.[69] The degree of pass through will depend on how the charge is set and the degree to which charges are uniform across streaming applications. In general, a uniform charge across streaming applications will be more likely to be passed through the greater the level of competition amongst applications.[70,71]

104. We observe that streaming applications already differentiate their services based on the quality of the streams supplied to customers. The table below sets out selected streaming content plans in the Australian market. Not all streaming platforms differentiate their products based on picture quality. Amazon and Disney, for example, stream content at 4K UHD only. In contrast, Netflix and Stan charge different amounts based on the quality of the streaming content. Netflix and Stan charge between 80-90% more for access to 4K UHD content compared to their basic plans. These premium plans enable more screens within the family, with higher video

68 Choi, J., & Kim, B. (2010). Net neutrality and investment incentives. *The RAND Journal of Economics*, 41(3), 446-471.

69 Technically, the level of pass through will depends on the curvature of the demand curve for streaming services. Weyl, E., & Fabinger, M. (2013). Pass-Through as an Economic Tool: Principles of Incidence under Imperfect Competition. *Journal of Political Economy*, 121(3), 528-583

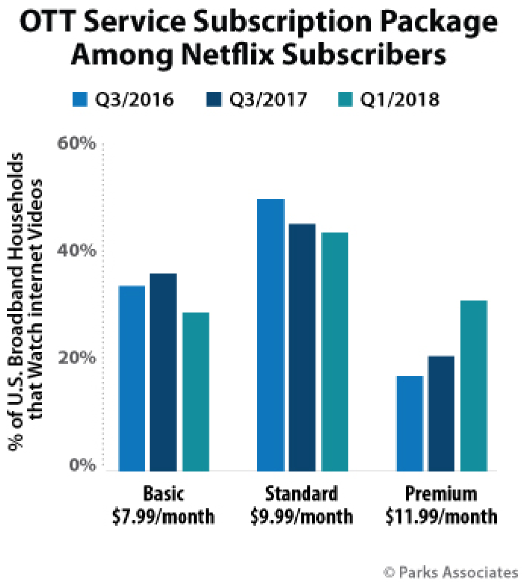
70 For example, Weyl, E. G., and M. Fabinger (2013): 'Pass-Through as an Economic Tool: Principles of Incidence under Imperfect Competition', Journal of Political Economy, Vol. 121, No. 3, pp. 528-583.

71 This is considered to be the case as long as the demand for the services are not too convex. Stennek, J., and F. Verboven (2001): 'Merger Control and Enterprise Competitiveness – Empirical Analysis and Policy Recommendations', *The Research Institute of Industrial Economics Working Paper* No. 556

resolution. High-speed internet enable these companies to provide multiple high-resolution streaming at the same time.

105. We understand that the number of Netflix subscribers on premium packages is in the order of 25% of subscribers. Industry reports indicate that a relatively large proportion of Netflix subscribers purchase a premium service. In 2018, marketing research by Parks Associates indicated that around 30% of Netflix users subscribed to the premium services in the United States.[72]

Figure 4-1: Distribution of Netflix subscribers across tiers



Source: Park Associates

106. It is unclear as to whether the differential in prices charged by streaming companies for each of its plans are cost reflective (i.e., that the difference in price reflects the difference in cost). To the extent they are not, these companies appears to be engaging in a form of price discrimination. That is, its pricing is capturing the higher willingness to pay of final consumers that have higher bandwidth requirements. This occurs despite there being lesser cost differences than are reflected in the price differentials.

107. As we discuss in the following section, the pass through of a charge for data delivery in the pricing of streaming applications could be an efficiency enhancing means to differentiate prices.

72 https://www.parksassociates.com/blog/article/fov2018-pr23 viewed 6 April 2021.

4.3 Implications for final customers

108. In general, charges for broadband services do not reflect the cost of utilising network capacity. The marginal price for using retail fixed line services is generally equal to zero. ISPs offer NBN broadband services with unlimited data allowances.[73] Retail broadband services are differentiated based on typical evening download speeds for residential customers[74] but not on the volume of data downloaded in these peak evening periods.

109. Generally, mobile services are charged based on the monthly download limits. Although fixed wireless unlimited plans are increasingly popular. As noted by the ACCC:[75]

> *'Fixed' mobile services are in some areas becoming increasingly attractive to consumers as an alternative to NBN or other fixed line services. For example, Optus offers two unlimited '5G Home Internet' plans, one for $75 a month with a maximum speed of 100 Mbps, and the other for $90 a month with an uncapped speed.*

110. On these plans, consumers do not face a marginal charge for using network capacity.[76] This creates an inefficiency to the extent the marginal cost of using network is not zero.

111. The marginal cost of using a communications network is not zero at all times. There are savings to network operator from delaying future network investment. This creates a cost in the form of an opportunity cost of using the network due to the potential to delay is additional investment that would be needed as the network reaches capacity. The marginal cost of using a communications network therefore follows a saw tooth pattern; with very low marginal costs after investments are made, which rise as the network becomes fully utilised. If further investments are made, the marginal cost falls again.

112. In the case of the NBN, the CVC charges mean that ISPs face a non-zero charge across all their customers for network usage in peak periods.

113. The absence of these marginal costs being reflected in marginal prices creates an inequity in charges for final consumers between those that contribute more or less to peaks in network usage and therefore drives the need for additional network investment. A charge levied on streaming applications that flow through to users of services in peak periods would go some way to resolving this inequity.

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73 There are some exceptions to this with some lower priced plans offered by some smaller ISP offering data limited plans.

74 For example, at the time of drafting this report Optus presents its speeds based on "typical busy period download speed 7pm-11pm for consumers and 9am-5pm (Mon-Fri) for business".

75 ACCC, Communications Market Report, 2019-20, December 2020.

76 On download limited plans, consumers do face a marginal charge for data consumption.

114. First, as predicted by the model the consumers that do subscribe to streaming, video and gaming applications will likely pay a higher price reflecting the usage they place on the network due to increased data delivery. The price that customers pay may be differentiated by the bandwidth they acquire for their service (and hence the level of data delivery the application provider would be charged). For example, the charge may differ depending on whether the quality of the streams are of standard or high definition. We note that some content providers, already differentiate charges based on the quality of its streams even though they currently face no difference in cost for delivering these services over the ISPs network.

115. Second, the consumers that do not subscribe to such applications will likely pay a lower price due to a rebalancing of charges by the ISP. As a result, these customers will no longer cross-subsidise customers that do subscribe to such applications.

116. In effect, the charge on data delivery will allow a form of price discrimination available to the provider of streaming services.

117. Greenstein, Peitz and Valletti (2020) describe the economic mechanism as follows:[77]

> *Given the opportunity to charge the content provider for termination, the internet service provider is more willing to decrease the subscription fee to end users, precisely because more end users can be attracted to join the platform, resulting in more transactions with content providers that are profitable for the ISP too.*

118. Overall, in many circumstances the effect of this charge would be expected to further lower average prices for consumers in the longer term as consumers respond to the price signals. That is, given the price elasticity of demand for broadband we would expect additional take up of broadband in response to the lower prices.[78]

4.4 Implications for ISPs

119. In this section we discuss how a charge on data delivery can have positive efficiency consequences for ISPs. In particular, we consider how additional revenue streams would promote efficient investment network capacity. This focus is consistent with the economic literature which considers the implications of charges for data delivery on efficiency enhancing investment:[79]

> *Internet service providers face additional incentives to increase capacity and make connections if it enables them to increase revenue from users*

77 Ibid.

78 Nevo, Aviv, John L. Turner, and Jonathan W. Williams. 2016. "Usage Based Pricing and Demand for Residential Broadband." *Econometrica* 84 (2), pages 411–43.

79 Shane Greenstein (2020), "The Basic Economics of Internet Infrastructure", Journal of Economic Perspectives, Vol 34, No 2, Spring 2020, page 198.

and/or avoid operational costs. These incentives appear to be consistent with a desirable long-term outcome— namely, more efficient and better options for routes to send and receive data. An interesting open question concerns the size of the private incentives in relation to the gains to the network. Transit lines [backhaul] are one component in a system, and improvements in one component confers benefits to all the other complementary components. Do most of the gains from better transit lines go to the content providers who use them, to the users who enjoy previously slower content, or to the internet service providers who may gain revenue from users for better services? The answer partly depends on pricing, which we discuss later.

120. The ability to charge for data delivery will have the effect of increasing incentives for ISPs to invest for two reasons:

   a. it will allow ISPs to extract some of the rent that streaming applications enjoy from improved broadband services; and

   b. it will facilitate ISPs implementing a more efficient pricing structure to extract rent from final customers (as discussed in section 4.2).

121. We discuss these reasons further below.

4.4.1 Capture the rents from streaming applications

122. The proposal considered in this report is one in which ISPs are allowed to explore a commercial model that is not presently available to them in the interests of the market achieving more efficient outcomes.[80]

123. The ability to charge for data delivery means the gains to streaming applications can be internalised by the ISP. This would be desirable as it leads to a better allocation of investment resources. This is one of the standard approaches to addressing externalities. For example, in the case of pollution, a firm creates negative externality due to the pollution it creates in a neighbourhood. If the government demands the firm to negotiate with the neighbourhood for the right to pollute, a price will emerge that reflect the cost of the pollution to the neighbourhood which will be internalized by the firm:[81]

Adding a markets to express its demand for pollution – or for a reduction of pollution – will provide a mechanism for efficient allocation.

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80 Of course, there is likely to be a broader social interest in promoting broadband infrastructure. that promoting additional investment in broadband services is likely to be socially beneficial. Numerous academic, private and public studies have supported that that the social benefits from improved broadband exceed the private benefits, indicating a failure in the market to deliver desirable investment.

81 Page 434 in Varian, H.R., "Microeconomic Analysis, 3rd edition, 1992

124. In this case, streaming applications could be required to bargain with the ISP for the right to access the network. As a result, the profit that can be earned by the streaming applications will be internalised by the ISP and leads to higher level of investment in broadband network infrastructure.

4.4.2 Data delivery charge will 'expand the market' promoting efficient investment

125. The classical theory of investment in the economic literature indicates that firms will invest in a project as long as the net cashflows from the project are positive. That is, if the expected future revenues over the lifetime of the project have a higher net present value than the expenditures incurred in delivering the project, the project would proceed. [82]

126. Modern investment theory recognises the uncertainty associated with investment. As such, firms value the option to delay investment. Dixit and Pindyck (1984) state that;[83]

> *... a firm with an opportunity to invest is holding an "option" analogous to a financial call option – it has the right but not the obligation to buy an asset at some future time of its choosing.*

127. The value of this option is lost when firms make investments, as such it is recognised as a cost in assessing investments in new projects.

128. For mobile operators, the cashflows from investing in new technologies (such as 5G) are uncertain. There is considerable uncertainty in demand for applications that rely on new investments. ISPs would have an option value on waiting to determine whether demand for these applications is better known before making lumpy sunk investments in infrastructure. The absence of a charge on streaming applications will likely delay investment in broadband communications infrastructure – investment under uncertainty principle.

129. A sound application of economic theory, in particular the theory of investment under uncertainty in oligopolistic industries (such as mobile), will show that incentives to invest depend on expectations of cost recovery in a post-investment competitive environment. In the post-investment competitive environment costs are sunk, and operators compete with marginal costs close to zero. In the economic literature, mobile competition is commonly described in terms of differentiated Bertrand competition in which operators are far from guaranteed revenues that exceed costs.[84]

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82 Jorgenson, D. (1963). Capital Theory and Investment Behavior. The American Economic Review, 53(2), 247-259. Retrieved February 12, 2021, from http://www.jstor.org/stable/1823868

83 Dixit, A. and Pindyck, R. (1994) "Investment under uncertainty", Princeton University press, page 6.

84 Cave, M.E., Majumdar, S.K. and Vogelsang, I. (2003), "Handbook of Telecommunications Economics", info, Vol. 5 No. 4, pp. 46-46. https://doi.org/10.1108/14636690310495265

130. In such markets, investment in new technologies is based on:

- The cost in investing in the new technology; and
- The expected profits which will be earned. This will depend on:
  - The degree of competition between operators – which will be influenced by the number of operators that invest in the technology (and the degree of differentiation in services offered by operators that do); and
  - Whether the new technology will 'expand the market' – which means adding additional customers or increasing the willingness to pay of existing customers.

131. Bresnahan and Reiss (1991)[85] formulates the relationship between fixed cost, profit drivers and number of competitors. It finds that, with an increase in fixed cost, one of the following must occur such that the number of competitors does not change. It empirically investigates the market size that are needs to ensure competition across several industries in regional United States. To determine the market size needed, it first constructs a model which determines what economic factors drive the entry decision of firms.[86]

132. This well-accepted theoretical model demonstrates that without an increase in market size or margin, firms are unlikely to profitably incur fixed costs. When applied to the mobile market, this indicates that investment in new technologies, which involve substantial fixed costs, may unlikely be profitable without either:

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85 Bresnahan, T.F. and Reiss P.C., "Entry and Competition in Concentrated Markets", Journal of Political Economy, Vol 99 No 5, 1991, pp 977-1009

86 It solves the following equation which determines the long run equilibrium of the market for at least N firms to break-even.

$$\frac{S_N}{N} = \frac{F_N + B_N}{(P_N - \text{AVC}_N - b_N)d_N}$$

S_N is the minimum market size such that N firms break even.

F_N is the fixed cost of entry.

$P_N - AVC_N$ is the margin on each unit of product that can be earned by the firm when there are N firms present. P_N is the price and AVC_N is the average variable cost. Factors that may affect the margin include level of differentiation across products and consumers' willingness to pay.

d_N is the volume that each customer will buy.

B_N and b_N are additional factors that allow variations in fixed cost and variable cost across firms in a market. It can be ignored in this case.

It finds that when fixed cost increases (right hand size gets bigger), the market size or the margin from each customer needs to increase in order for the same number of firms to be sustained in the long-run equilibrium. As seen in the equation, when fixed cost increases, the numerator on the right-hand side increases. Therefore, assuming all else remains equal, the denominator on the left hand side need to decrease, (decrease in the number of firms) or numerator on the left hand side need to increase (increase in the market size), to maintain the equality.

- Consolidation between the number of mobile operators;
- Increase in margin; or
- An expansion of the market.

133. As such, there may be a policy trade-off between encouraging investment whilst ensuring a competitive market. A mechanism to avoid this trade-off would be an ability to 'expand the market'. This expansion could be achieved by providing ISPs the ability to charge streaming applications for use of their network infrastructure.

134. Other things equal, in the absence of this market expansion effect, investment in new technologies will be delayed if ISPs cannot capture the higher willingness to pay for the higher quality services delivered by the latest generation of mobile technology.

4.4.3 Alternative of vertical integration

135. One alternative solution to the one explored in this report would be for ISPs to vertically integrate with content providers. When both firms are integrated, then the single owner would internalise both impacts in its decision-making process:[87]

> *We ask what would happen if the two firms merged so as to internalize the externality. In this case the merged firm would maximize total profits…The output x_e is an efficient amount of output.*

136. A problem with this approach is that there are more than one streaming application and the services provided by network infrastructure is non-exclusive. Even if the streaming application and the ISP merge, it may not necessarily generate a desirable level of investment. This is because if the streaming application and the ISP merge, the merged entity will fail to consider the positive externality of investment on other streaming applications and put increased weight on the negative externality of competition between streaming applications.

137. In addition, integration between ISPs and streamed content may lead to less competition between ISPs or between streaming applications. For example, a theory of harm may be that if an ISP was the only provider to stream 'must have' content, this could conceivably lead to foreclosure of competitors in the market for internet services.[88]

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87 Page 433 in Varian, H.R., "Microeconomic Analysis, 3rd edition, 1992

88 This was essentially the theory of harm adopted by the New Zealand Commerce Commission in blocking the merger of Sky and Vodafone.

Appendix A Waterbed effect model

138. This appendix demonstrates the waterbed effect that would occur when ISPs charge streaming applications for the data traffic they generate using the economic model introduced by Greenstein, Peitz and Valletti (2016) for a single consumer of broadband and a streaming application.[89] We extend this model to show the case for two types of consumers – one that consumes broadband only, while the other consumes both broadband and a streaming application.

139. We show that in case of a single consumer of broadband and streaming, the effect of a charge from ISPs to streaming applications is neutral with respect to the prices paid by the consumer and the margins earned by the ISP and the streaming application.

140. In the case of two consumers, we show that the consumer of broadband only will face a lower price and the margin of the ISP will expand.

A.1.1 Single consumer of broadband and streaming

141. The model shows that if ISPs decide to charge streaming applications for the data traffic they generate, the total charges a consumer would pay for both the high-speed internet and streaming content remains unchanged. This result will hold irrespective of the competitive dynamics between ISPs.

142. We first calculate the price consumers would pay under the current commercial arrangements where retail services providers only charge one group of users for its service – retail customers.

143. Imagine a retail customer pays p to subscribe to highspeed internet and the subscription fee f for streaming content. The profits of the ISP and of the streaming content provider are respectively given by

$$\pi_{ISP} = (p - c_{ISP})q(p + f)$$

$$\pi_{CP} = \left(f - c_{cp}\right)q(p + f)$$

where c_{ISP} and c_{cp} denotes the per subscriber cost to the ISP and content provider. $(p - c_{ISP})$ is therefore the per subscriber margin earned by ISP and $\left(f - c_{cp}\right)$ is the per subscriber margin earned by the content provider. $q(p + f)$ denotes the demand by retail customers whose demand for both depends on the total price they must pay.

144. The profit maximizing condition requires that both the ISP and the content provider set prices such that the following two conditions holds for the two profit functions:

89 Greenstein, S., Peitz, M., and Valletti, T., "Net Neutrality: A Fast Lane to Understanding the Trade-offs", *Journal of Economic Perspectives*. Vol 30, No 2, Spring 2016, pages 127-150

$$(p - c_{ISP})q' + q(p + f) = 0$$

$$(f - c_{ISP})q' + q(p + f) = 0$$

where q' is the first derivative with respect to its argument at the profit maximizing prices.

145. Combining the two equations gives the following total margin earned by the ISP and content provider: $p + f - c_{ISP} - c_{ISP} = \frac{-2q(p+f)}{q'}$.

146. We next calculate the price consumers would pay if ISPs were able to charge streaming content providers for the data traffic. Let t denote the payment that content provider must pay to ISPs for the data traffic. The profits of the ISP and of the streaming content provider would respectively become

$$\pi_{ISP} = (p + t - c_{ISP})q(p + f)$$

$$\pi_{CP} = \left(f - t - c_{cp}\right)q(p + f)$$

147. The ISP's margin would increase by the size of payment that the content provider makes to the ISP. The content provider's margin would decrease by the same amount.

148. The profit maximizing condition requires that both the ISP and the content provider set prices, p and f, such that the following two conditions holds for the two profit functions:

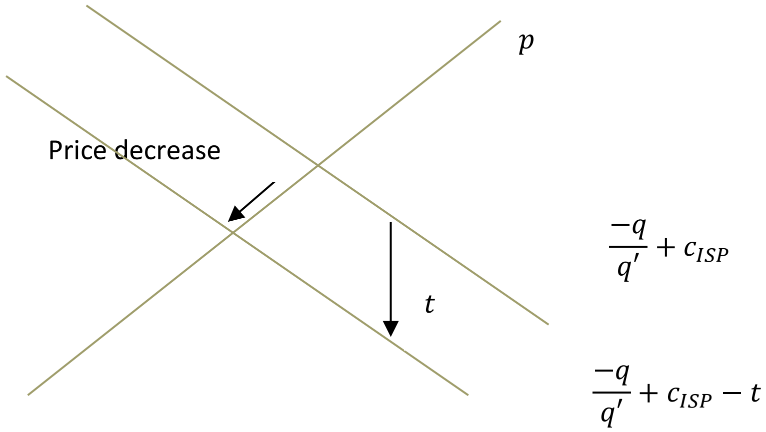
$$(p + t - c_{ISP})q' + q(p + f) = 0$$

$$(f - t - c_{ISP})q' + q(p + f) = 0$$

149. Combining the two equations gives the same total margin earned by the ISP and content provider as the previous case, which is $p + f - c_{ISP} - c_{ISP} = \frac{-2q(p+f)}{q'}$. This result shows that the combined margin earned by the ISP and content provider remains unchanged.

150. The following diagram will show that the ISP's margin will increase. The price reduction is less in magnitude than the increase in transfer payment. This indicates $p + t - c_{ISP}$ will increase. Since the total margin remains the same. This implies the content provider's margin will decrease.

Figure 4-2: Illustration of modelled price reduction (single consumer)



A.1.2 Model with two types of consumers

151. This section demonstrates the waterbed effect that would occur when ISPs charge streaming applications for the data traffic they generate using the economic model introduced by Greenstein, Peitz and Valletti (2016).[90] We expand on the model by including consumers that consumes only high-speed broadband.

152. The model shows that if ISPs decide to charge streaming applications for the data traffic they generate, consumers that only consume high-speed internet would enjoy a reduction in price. While the total charges a consumer would pay for both the high-speed broadband and streaming content would depend on the difference between the two consumer groups.

153. If the majority of consumers consume only high-speed broadband; they are much less price sensitive to consumers that consume both high speed broadband and streaming content; and they become more price sensitive as price decreases, then the amount that consumers consume of both products will increase.

154. This result will hold irrespective of the competitive dynamics between ISPs.

155. We first calculate the equilibrium in which consumers pay under the current commercial arrangements where retail services providers only charge one group of users for its service – retail customers.

156. Imagine a retail customer pays p to subscribe to high speed broadband and the subscription fee f for streaming content. The profits of the ISP and of the streaming content provider are respectively given by:

[90] Greenstein, S., Peitz, M., and Valletti, T., "Net Neutrality: A Fast Lane to Understanding the Trade-offs", *Journal of Economic Perspectives*. Vol 30, No 2, Spring 2016, pages 127-150

$$\pi_{ISP} = (p - c_{ISP})[q_h(p+f) + q_l(p)] \quad (1)$$

$$\pi_{CP} = (f - c_{cp})q_h(p+f) \quad (2)$$

where c_{ISP} and c_{cp} denotes the per subscriber cost to the ISP and content provider. $(p - c_{ISP})$ is, therefore, the per subscriber margin earned by ISP and $(f - c_{cp})$ is the per subscriber margin earned by the content provider. $q_h(p+f)$ denotes the demand by retail customers who consumers both high-speed internet and streaming content. Therefore, it depends on the total price they must pay. $q_l(p)$ denotes the demand by retail customers who only consume high-speed internet.

157. The profit maximizing condition requires that both the ISP and the content provider set prices such that the following two conditions holds for the two profit functions:

$$(p - c_{ISP})(q_h{}' + q_l{}') + q_h + q_l = 0 \quad (3)$$

$$(f - c_{ISP})q_h{}' + q_h = 0 \quad (4)$$

where $q_h{}'$ and $q_l{}'$ are the first derivatives with respect to their arguments at the profit maximizing prices.

158. We next calculate the equilibrium in which consumers would pay if ISPs were able to charge streaming content providers for the data traffic. Let t denote the payment that content provider must pay to ISPs for the data traffic. The profits of the ISP and of the streaming content provider would respectively become:

$$\pi_{ISP} = (p - c_{ISP})[q_h(p+f) + q_l(p)] + tq_h(p+f) \quad (5)$$

$$\pi_{CP} = (f - t - c_{cp})q_h(p+f) \quad (6)$$

159. The ISP's margin would increase by the size of payment that the content provider makes to the ISP. The content provider's margin would decrease by the same amount.

160. The profit maximizing condition requires that both the ISP and the content provider set prices, p and f, such that the following two conditions holds for the two profit functions:

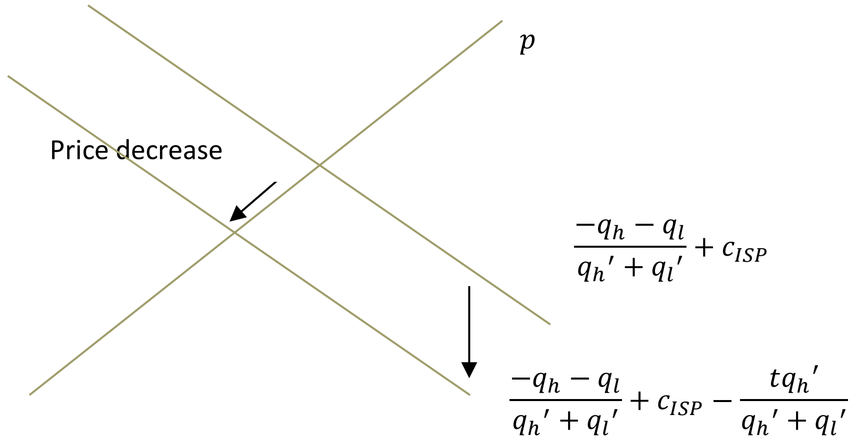
$$(p - c_{ISP})(q_h{}' + q_l{}') + q_h + q_l + tq_h{}' = 0 \quad (7)$$

$$(f - t - c_{cp})q_h{}' + q_h = 0 \quad (8)$$

161. Using the two sets of equilibrium conditions, we first demonstrate the decrease in price that the ISP would charge, leading to an increase in the number of consumers that only consumes high-speed internet. Equation 3 shows that the profit maximizing price the ISP would charge if the ISP does not charge the streaming application is $p = \frac{-q_h - q_l}{q_h{}' + q_l{}'} + c_{ISP} - \frac{tq_h{}'}{q_h{}' + q_l{}'}$. On the other hand, equation 7 shows that the profit maximizing price the ISP would charge if it does charge the streaming application is

$p = \frac{-q_h - q_l}{q_h' + q_l'} + c_{ISP}$. The impact of the payment by content providers is shown in the following figure. It causes the right hand side of the equation to shift lower, leading to a reduction in price.

Figure 4-3: Illustration of modelled price reduction



Source: CEG analysis

162. The reduction in price by the ISP would lead to an increase in the number of consumers that would consume high-speed internet only, q_l. The effect is greater when the size of the payment made by the content provider to the ISP is greater.

163. We next demonstrate the impact on consumers that consume both high-speed internet and streaming content would pay the same amount.

$$(p - c_{ISP} + t)q_h' + (p - c_{ISP})q_l' + q_h + q_l = 0$$

$$(p - c_{ISP} + t) = \frac{-(p - c_{ISP})q_l' - q_h - q_l}{q_h'}$$

$$\left(f - t - c_{cp}\right) = -\frac{q_h}{q_h'}$$

164. Combining the two equations, equation 7 and 8, gives the following total margin earned by the ISP and content provider if ISPs can change streaming applications, $p + f - c_{ISP} - c_{ISP} = \frac{-(p-c_{ISP})q_l' - q_h - q_l}{q_h'} + \frac{-q_h}{q_h'} = \frac{-(p-c_{ISP})q_l' - q_l}{q_h'} + \frac{-2q_h}{q_h'}$. This result is the same as the case where the ISP is not able to charge content providers in equation 3 and 4. This indicates that the combined price set by the ISP and the content provider does not directly depend on the size of the payment made by the content provider to the ISP.

165. However the combined price is affected indirectly through the impact on consumers that only consume high speed internet. If $(p - c_{ISP})q_l' + q_l$ increases, then the margin

increases. When t increases, p will decrease If $(p - c_{ISP})q_l' + q_l$ moves in the same direction as p, then the margin will decrease when t increases. The condition is

$$2q_l' + (p - c_{ISP})q_l'' > 0$$

166. If demand curve is linear, the price will increase. It is satisfied if:

- q_l'' is sufficiently positively large, demand becomes steeper as price decreases.
- q_l' sufficiently near 0, demand curve sufficiently steep
- $(p - c_{ISP})$ is sufficiently large, ISP's margin sufficiently large.

167. The content provider's margin is

$$\left(f - t - c_{cp}\right) = -\frac{q_h}{q_h'}$$

168. If combined margin $p + f - c_{ISP} - c_{ISP}$ increases, this would imply q_h decreases. If q_h' is constant such as linear demand, it implies the margin will decrease. The derivate on the margin is

$$-\frac{q_h'q_h' - q_h q_h''}{q_h'q_h'}$$

169. If it is negative, then it implies the margin will decrease. This would occur when $q_h' q_h' - q_h q_h'' > 0$ or $q_h'' < q_h' q_h'$.

170. If combined margin $p + f - c_{ISP} - c_{ISP}$ decreases. Content provider's margin will decrease if the derivative is positive. This occurs when $q_h'' > q_h' q_h'$.

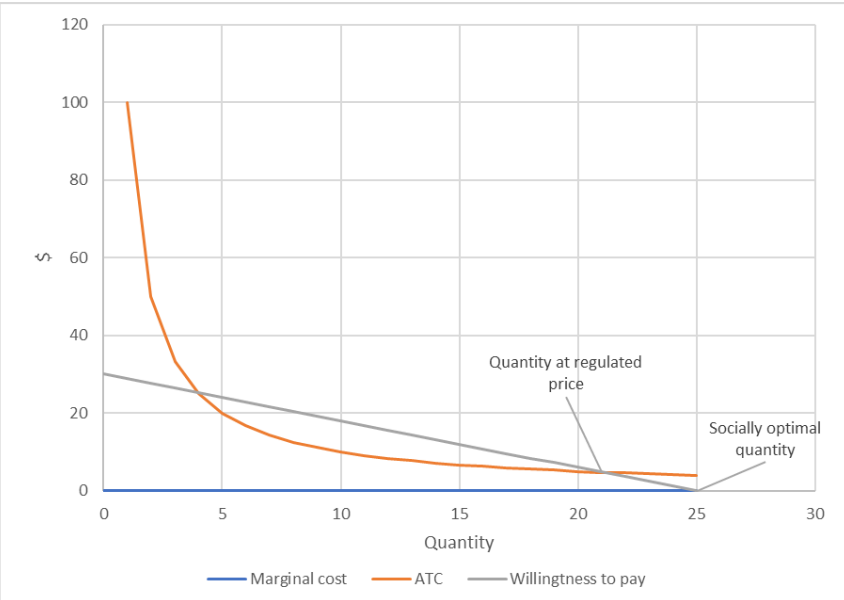
Appendix B Price discrimination and cost recovery

171. In a regulated environment, where there is an overall cap on cost recovery this would cause/allow lower recovery from consumers with lower willingness to pay. Economists refer to this type of tariff restructure as price discrimination. This would expand demand for broadband services overall, which will have consequent welfare benefits. The result is illustrated in the diagram below.

172. The diagram illustrates how a single regulated price set for cost recovery does not necessarily achieve an efficient market outcome. The grey line is consumers' willingness to pay. The marginal cost (incremental cost) is assumed to be zero. This implies the firm incurs no additional cost for every additional unit sold. However, the firm does incur a fixed cost, which is $100 in the diagram below. The orange line is the average total cost.

173. Under an efficient outcome, the optimal quantity is up to the point where the willingness to pay is no longer higher than the marginal cost (incremental cost). Since there is no incremental cost, therefore the socially optimal quantity is at the point where everyone who benefits from the product should have it. In this case it is 25 units. However, if the price is regulated such that the optimal quantity is achieved, the firm cannot recover its fixed cost because the price is zero, below the average total cost.

Figure 4-4: Inefficient allocation due to uniform pricing in natural monopoly



Source: CEG analysis

174. Therefore, traditional economic theory suggests the next best solution, average cost pricing:[91]

> *Ideally, the regulatory agency would like to push the firm's price down to the competitive level. At that level, however, price would not cover average cost and the firm would go out of business. The best alternative is therefore to set the price at… where average cost and average revenue intersect.*

175. Under a regulated environment where the price is set such that the cost of the network is recovered, the price will be set such that it is equal to the average total cost. Therefore, with a single price, the price set is the point where the willingness to pay curve intersects the average total cost curve. In this case, the firm will produce 21 units under the regulated price. However the regulated price does not achieve the most efficient outcome.

176. In fact in a two-sided market such as network infrastructure, the positive externalities generated by the network infrastructure for OTT operators imply that the price the network infrastructure should charge its end users ought to be less than the marginal cost:[92]

> *the result is driven by the positive externality on users on one side of the market, which originates from network participation on the other side of the market. The contribution of this externality to social welfare is larger than the individual market side's price, which leads pricing below marginal cost to be socially optimal.*

177. The efficient outcome can be achieved if price discrimination is adopted. If consumers with higher willingness to pay, pay a higher price, then a lower price can be set for consumers whose willingness to pay is lower than the average total cost but higher than the marginal cost. This result is well known in the economic literature:[93]

> *… where there are substantial economies to be gained by increased production, it would seem proper that experimentation in this kind of price "discrimination" as well as in other aspects of price policy can be encouraged on the ground that it will make for lower costs, i.e., a more efficient use of resources.*

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91 Pages 362 in Pindyck, R.S., and Rubinfeld D.L., Microeconomics, 6th edition, 2005

92 Bolt, W., and Tieman, A., "Social Welfare and Cost Recovery in Two-Sided Markets", *Review of Network Economics*, Vol 5, No 1, March 2006

93 D. A. Worcester, Jr., "Justifiable Price "Discrimination" under Conditions of Natural Monopoly: A Diagrammatic Representation." *The American Economic Review*, Vol 38, No 3 (Jun 1948) pp 382-388