SINGTEL MOBILE SINGAPORE PTE LTD

RESPONSE TO IDA CONSULTATION PAPER – SECOND CONSULTATION ON PROPOSED FRAMEWORK FOR THE REALLOCATION OF SPECTRUM FOR FOURTH GENERATION (4G) TELECOMMUNICATION SYSTEMS AND SERVICES

1. CONTENTS

1.1. This submission is structured as follows:

Section 2 – Executive Summary
Section 3 – Introduction
Section 4 – General Comments
Section 5 – Specific Comments
Annexure A – Expert Report of Prof. Janusz A. Ordover and Dr. Allan L. Shampine
Annexure B – Table of innovations in the Singapore mobile market

2. EXECUTIVE SUMMARY

2.1. Singtel Mobile submits that the IDA's proposition that new entrants will provide scope for greater competition and service innovation in the Singapore mobile market is not supported by evidence and is contrary to the commonly held position that the market is competitive and the actual realities. Further, Singtel Mobile cautions the IDA against adopting an overly optimistic view of the potential changes to the mobile landscape with the entry of a fourth player.

2.2. The subsidisation of a fourth player in the Singapore mobile market and the costs associated with this subsidisation are likely to be substantial. As Professor Ordover and Dr Shampine say in their report:

> *"There is a direct cost to Singapore of receiving less revenue in the auction from such a subsidy, and also of diverting the use of the spectrum away from the firms that would have been willing to pay for it. The latter cost may be particularly high to the extent that an entrant's spectrum is underutilized due to*

a relatively low number of subscribers that would be utilizing the subsidized spectrum holdings.

There can also be substantial indirect costs. It is not clear that the Singapore mobile marketplace can sustain a fourth MNO, whether its entry is subsidized or not.…It is important to consider that if entry occurs in response to a regulatory subsidy, but ultimately does not prove viable, there are real costs associated with that failure. … The losses can exceed the sunk costs of entry and include increased consumer confusion, slower market evolution and additional fixed and variable costs associated with accomplishing any restructuring.…" [1]

2.3. Singtel Mobile is concerned that the IDA's recommendations will disrupt the market and the experience of existing users by allocating scarce resources to a new entrant solely on the grounds that the IDA wishes to see a new entrant in the market. In Singtel Mobile's assessment, this will lead to reduced innovation, economies of scale and investment by the existing three (3) operators. This assessment is supported by the Ordover & Shampine Report, which concludes that:

"the proposed policy of providing substantial subsidies to induce entry raises concerns that such entry will not, on net, be economically efficient, and may in fact be counterproductive, deterring future investment and imposing substantial costs on Singapore's economy."[2]

As such, Singtel Mobile submits that it is critical that the IDA follow international best practice and fully consider the impact that its proposed spectrum allocation exercise will have on the competitiveness and sustainability of the market as a whole.

2.4. Singtel Mobile submits that the IDA should not set aside spectrum for new entrants and that new entrants should join the main auction. Further to this, the same rules, regulations, auction mechanisms and prices should be applied in a non-discriminatory manner to both new entrants and the existing operators. Singtel Mobile emphasises that recommendations detailed in this submission reflect international best practices.

[1] Ordover & Shampine Report, paras 13-14
[2] Ordover & Shampine Report, para 4

2.5. Singtel Mobile submits that the IDA must ensure that the new entrant must sufficiently deploy its spectrum obtained through the auction, so as to ensure that the scarce and valuable spectrum resource is not wasted nor underutilised. This is important to ensure the spectrum is used to deliver services to Singaporeans and not for purposes of reselling or trading for a windfall gain, particularly should the scarce spectrum resource be obtained at a steep subsidy/discount through the support and facilitation of the IDA.

2.6. Singtel Mobile submits that should the IDA maintain the subsidised preferential reserve prices for the new entrant, the IDA should impose a restriction on the new entrant reselling or trading the subsidised spectrum or otherwise selling its mobile business for a period of at least five (5) years from the commencement of the spectrum right. Furthermore, if the new entrant resells or trades spectrum or otherwise sells its mobile business, the IDA should require a "top-up" spectrum payment equivalent to the difference between the IDA subsidised spectrum price and the final bid price in the main auction paid by existing MNOs. This is to ensure that there is no transfer of value from the public sector to the private sector.

2.7. Singtel Mobile submits that the IDA should impose a performance bond on the new entrant, for example 5% of its total budgeted capital investment, to cover the material obligations such as network rollout, service provision and any other relevant commitments so as to ensure that the new entrant meets its commitments. In the event that the new entrant fails to satisfy its network and service commitments, the IDA can then call on the performance bond. This would be consistent with performance bond requirements imposed on other market entrants by the IDA.

2.8. Singtel Mobile submits that the IDA proposal to set-aside frequency spectrum for a new entrant will effectively mean that 2 x 10 MHz in the 900 MHz spectrum band will not be used optimally used for up to five (5) years and will cause the MNOs to face spectrum constraints in meeting the Singapore market's bandwidth needs.

2.9. Singtel Mobile submits that the IDA impose the same requirements on all MNOs who acquire spectrum. Any new entrant whose entry is supported and facilitated by the IDA should not be permitted to avoid its obligations to rollout a full MNO network and should be required to provide both data and non-data services. In particular, if the existing MNOs are required by the IDA (as is currently the case) to provide PCMTS, the new entrant should be similarly so required. In the event that the IDA does not impose a non-discriminatory requirement on the new entrant to provide PCMTS, the

total amount of frequency spectrum available to the new entrant must be reduced and, in particular, the 900 MHz spectrum band should only be available to the existing MNOs so that they may continue to meet their subscriber requirements for both data and non-data services (including PCMTS).

2.10. SingTel Mobile submits that whilst the new entrant may come to a commercial agreement with any of the existing MNOs for purposes of being an MVNO, the IDA's proposed MVNO negotiation principles/guidelines should not apply to the new entrant.

2.11. While Singtel Mobile supports the allocation of the full 700 MHz spectrum band allotment of 2 x 45 MHz for mobile broadband services under the next spectrum exercise, Singtel Mobile submits that it is necessary that appropriate mechanisms should be in place under the spectrum allocation framework to allow for the delay of the commencement of the 700 MHz spectrum right auctioned due to ASO timelines. The expiry date and the spectrum right payment due date should also be delayed correspondingly so as to maintain the same spectrum right duration. Singtel Mobile recommends the harmonisation of the commencement dates and spectrum rights durations of the 700 MHz and 900 MHz spectrum bands, with a spectrum right duration of at least 15 years. The IDA should therefore extend the current 900 MHz Spectrum Right duration (and pro-rate the charges at the winning bid price for the long-term spectrum right in the 900 MHz spectrum band).

2.12. Singtel Mobile submits that the IDA include 2 x 5 MHz of 800 MHz spectrum band (824 MHz – 829 MHz and 869 MHz – 874 MHz) in the auction with a commencement date of 1 April 2017. There is strong justification for its inclusion as this will not impact the IDA's spectrum re-farming plans given the spectrum is free from interference.

2.13. Singtel Mobile submits that the IDA's timeline of three (3) to five (5) years is adequate for the migration of existing users, including trunk radio and SRD equipment, to the GSM centre gap proposed by the IDA.

2.14. The IDA's proposed allocation of the short term spectrum rights for the EGSM band use may not be applicable as the Indonesia government has already implemented 800 / 850 MHz spectrum band re-farming plans, therefore the spectrum can be made available for auction.

2.15. Without prejudice to the above, should the IDA still decide to set-aside spectrum for a new entrant, Singtel Mobile submits that the abovementioned 2 x 5 MHz of 800 MHz

spectrum band be set aside for new entrant allocation instead of the currently utilised 900 MHz spectrum band. Additionally, Singtel Mobile is of the view that if additional set-aside spectrum is deemed absolutely necessary in the lower sub-1 GHz spectrum bands, the IDA should set aside a maximum of 2 x 5 MHz in the 700 MHz spectrum band for a new entrant i.e. a total of 2 x 5 MHz of 800 MHz and 2 x 5 MHz of 700 MHz in the sub-1 GHz spectrum bands.

2.16. Singtel Mobile supports the proposed re-allocation of L-band for wireless broadband in Singapore in the long term, as well as to allow it for trial, temporary and /or commercial use in the interim period.

2.17. The 2.5 GHz TDD spectrum band should be allocated on a full band sharing basis with neighbouring countries.

2.18. A guard band of at least 5 MHz at both ends of the 2.5 GHz spectrum band should be provided for.

2.19. Singtel Mobile submits the imposition of spectrum caps for sub-1 GHz spectrum bands of 2x40 MHz, with no spectrum caps for the 2.3/2.5 GHz spectrum bands.

2.20. The IDA should increase the amount of 2.3 GHz TDD spectrum to be auctioned to at least 1 x 60 MHz.

2.21. With regard to auction pricing, Singtel Mobile submits that the IDA should apply the same reserve prices and standards for all auction participants i.e. non-discriminatory treatment. Singtel Mobile does not support the reserve prices suggested by the IDA for the 2.3/2.5 GHz spectrum bands. Singtel Mobile submits that reserve prices for the 2.3/2.5 GHz spectrum bands should be below S$1 million, in line with international best practices.

2.22. Accordingly, Singtel Mobile submits that, at least for the sub-1 GHz spectrum bands, all bidders including any new entrant should join the main auction. Alternatively, the IDA should align the winning bid of the new entrant auction with the highest bid of the new entrant in the main auction to prevent new entrants from engaging in gaming strategies to increase the cost of spectrum to existing MNOs.

2.23. Singtel Mobile supports the IDA employing auction rules as per the 2013 spectrum auction, with adjustments made in consideration of spectrum bands available for auction. Singtel Mobile submits that the Standing High Bidder rules should be retained for the upcoming auction. With regard to new entrants, Singtel Mobile submits that it is necessary to preclude the new entrant from participating in the general auction with the existing operators if the IDA has already reserved frequency spectrum for the new entrant.[3] Should the IDA allow the new entrant to participate in the main auction, the winning bid in the main auction shall apply to the new entrant's reserved spectrum regardless of whether the new entrant wins additional spectrum. It is important to implement effective safeguards to prevent gaming strategies and price boosting behaviour in any spectrum auction, and these are particularly critical in auctions with set-aside spectrum. This has been demonstrated in international spectrum auctions.[4] Gaming strategies and price-boosting motivations will cause price and market distortions resulting in unrepresentative and uncompetitive pricing of spectrum across new and existing operators, harming the Singapore telecommunications industry with serious implications for operators and consumers alike.

2.24. Singtel Mobile submits that the IDA should postpone its upcoming spectrum allocation to ensure more certainty with regard to spectrum re-farming in neighbouring countries (i.e. Indonesia) pertaining to the 900 MHz EGSM band. A later date beyond Q1 2016 will be optimal and minimise possible market distortions inherent with spectrum allocations via FROR proposed by the IDA. This will also enable the EGSM band to be included in the spectrum allocation exercise.

2.25. Singtel Mobile supports the IDA's proposal to impose a mobile coverage and QoS obligations timeline for any new entrant. Singtel Mobile further submits that is important to treat existing operators and any new entrant equally with regard to QoS obligations, as it is not reasonable for consumers to endure inferior QoS standards for the commercial considerations and benefit of a new entrant.

2.26. The following table summarises Singtel Mobile's spectrum proposals:

[3] UK 3G spectrum rights auction, 2000
[4] Example: Czech Republic 2012/2013 spectrum auction

	700 MHz FDD	800 MHz FDD	900 MHz FDD (including EGSM)	2.3 GHz TDD	2.6 GHz TDD
Frequencies	703-748 MHz/ 758-803 MHz	824-829 MHz/ 869-874 MHz	885-915 MHz/ 930-960 MHz	2300-2360 MHz	2575-2615 MHz
Amount of spectrum	2 x 45 MHz	2 x 5 MHz	2 x 30 MHz	1 x 60 MHz	1 x 40 MHz
Expected start date of spectrum rights	Earliest 2018, flexible commencement date	April 1, 2017	Earliest 2018, flexible commencement date	April 1, 2017	April 1, 2017
Spectrum right duration	At least 15 years	At least 15 years	At least 15 years	At least 15 years	At least 15 years
Reserve price	S$20M per 2x5MHz	S$20M per 2x5MHz	S$20M per 2x5MHz	< S$1M per 5MHz	< S$1M per 5MHz
Spectrum cap	2x40 MHz of sub-1GHz spectrum			No spectrum cap	
Price for spectrum right extension	NA	NA	Pro-rated based on winning price for long-term spectrum right	NA	NA
Set-aside spectrum for new entrant	2 x 5 MHz	2 x 5 MHz	-	1 x 20 MHz	-
Reserve price for set-aside spectrum	S$20M per 2x5MHz	S$20M per 2x5MHz	NA	< S$1M per 5MHz	NA
Cap for set-aside spectrum	2x10 MHz of sub-1GHz spectrum			None	

2.27. Finally, Singtel Mobile submits that the IDA's reasoning for regulating the introduction of "thick" MVNOs is not strong and does not sufficiently consider the costs and benefits of this. The Singapore mobile market is highly competitive and does not require any artificial regulation including easing entry conditions for MVNOs through regulation.

3. INTRODUCTION

3.1. Singtel Mobile Singapore Pte Ltd (**Singtel Mobile**) refers to the Info-communications Development Authority of Singapore's (**IDA**) second consultation paper dated 7 July 2015 on the proposed framework for the reallocation of spectrum for fourth generation (**4G**) telecommunication systems and services (**Consultation Paper**).

3.2. Singtel Mobile is licensed to provide Public Cellular Mobile Telecommunications Services (**PCMTS**) in Singapore and has acquired Spectrum Right(s) to provide 2G, 3G and 4G mobile services. Singtel Mobile has also acquired Wireless Broadband Access (**WBA**) Spectrum Right(s) and is licensed to provide wireless broadband services.

3.3. Singtel Mobile is committed to the provision of state-of-the-art mobile telecommunication services and technologies in Singapore. As a leading provider of mobile telecommunication services over 2G, 3G and 4G networks, high speed data services through General Packet Radio Service (**GPRS**) and High-Speed Packet Access (**HSPA**) technology and wireless services on our Wi-Fi platform, Singtel Mobile has a strong interest in the proposed framework for the reallocation of 4G spectrum in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2.3 GHz and 2.5 GHz spectrum bands.

3.4. Singtel Mobile welcomes the opportunity to make this submission on the Consultation Paper and the various issues identified by the IDA.

3.5. Singtel Mobile has sought the expert opinion of leading economists Professor Janusz A. Ordover and Dr. Allan L. Shampine. Their report and qualifications are annexed to this submission, and parts of it have been cited throughout.

3.6. Singtel Mobile would be pleased to clarify any of the views and comments made in this document, as appropriate.

4. GENERAL COMMENTS

Competitiveness of Singapore's mobile market

4.1. Singtel Mobile submits that Singapore's mobile market is already mature and competitive[5]. The IDA has also made several public statements indicating satisfaction with the state of competition in this market. For instance in 2013 Mr Leong Keng Thai said: "Vendors and the industry see us [Singapore] as a good market to launch their products because we have a base of savvy users, and a vibrant market and sufficient competition to drive innovation and technology adaptation." [6]

4.2. The state of competition is also reflected in the advanced development of the mobile market. The three (3) established Mobile Network Operators (**MNOs**) offer Singaporeans extensive mobile coverage (including in-building and in tunnels) with high quality of service (**QoS**) and varied mobile plan options. IDA statistics demonstrate that there was 148% mobile penetration in 2014 and that total mobile data usage has more than doubled since Q4 2011. [7] The table in Annexure B lists the many innovations in Singapore's mobile market introduced by Singtel Mobile, StarHub and M1 since January 2014.

4.3. The IDA's survey of MNOs' 4G network performance earlier this year provides further insight into the state of competition in the mobile market[8]. The survey found that MNOs had generally achieved significant nationwide street level 4G coverage 18 months in advance of the deadline set by the IDA and that good progress had been made towards completion of the rollout of network coverage in road and train tunnels. Commenting on the survey, Mr Leong Keng Thai said that "Singapore has a high mobile penetration rate, and the 4G subscription rates are increasing every month. Consumers enjoy these higher speed connections, and expect these services to be widely and readily available throughout the country."[9]

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[5] The IDA has been making similar public announcements for several years. See, for example IDA press release 'Singapore's Mobile Market Gets New Impetus for Growth', 3 January 2005.
[6] IDA Press release 23 May 2013, 'Transparent and balanced decision-making'
[7] IDA Telecommunications Statistical Charts. See: http://www.ida.gov.sg/Tech-Scene-News/Facts-and-Figures/Telecommunications
[8] IDA Press release 13 February 2015, 'IDA Survey Shorts 4G Service Coverage Available at Most Outdoor Areas'.
[9] Ibid.

4.4. Singtel Mobile urges the IDA to consider such factual evidence of competition when carrying out its functions. In the Consultation Paper the IDA notes that telecom regulators in other countries are keen to maintain or encourage a 4-MNO market[10]. This is an observation of the number of players present in some competitive markets, not an international best practice standard. To the contrary, several international bodies including the European Commission have stated that there is no "magic number" of mobile network operators.[11]

4.5. The GSMA recently undertook a major empirical study concluding that there is no evidence that prices are systematically lower and investment is higher in a four (4) player, as opposed to a three (3) player market, or vice versa.[12] The GSMA emphasised that "any suggestion that simply counting the number of mobile operators in a market can be a predictor of market performance is misplaced."[13]

4.6. Singtel Mobile submits that the mobile market in Singapore is sufficiently competitive without the introduction of a fourth player. The IDA has not adequately demonstrated the existence of a clear market failure which would justify regulatory intervention[14].

4.7. One of the foundation principles of the Telecom Competition Code is that "to the extent that markets or market segments are competitive, IDA will place primary reliance on private negotiation and industry self-regulation, subject to minimum requirements designed to protect consumers and prevent anti-competitive conduct."[15]

4.8. Mr Leong Keng Thai has also stated that

> *"[w]hen it comes to managing competition amongst industry players, our general approach is to leave it to the market and if the market is working, we do not intervene."*[16]

[10] Consultation Paper, para. 59.
[11] European Commission Competition Merger Brief, Issue 1/2014 – November found at http://ec.europa.eu/competition/publications/cmb/2014/CMB2014-01.pdf
[12] Joint publication of GSMA and Frontier Economics: 'European mobile network operator mergers: A regulatory assessment', December 2014.
[13] GSMA Paper, pg 17.
[14] Singtel Mobile shares the conclusion of the Ordover & Shampine Report at para. 10 that the presence of substantial fixed costs required to enter the market is not in itself a market failure.
[15] Telecom Competition Code 2012, 1.5.1
[16] IDA press release 23 May 2013: 'Transparent and balanced decision-making'

4.9. Singtel Mobile submits that the proposals in the Consultation Paper deviate from the IDA's established policies and submits that the IDA should revisit its proposals to align them with its own stated policies.

Facilitation of new entrant

4.10. The fact that the Singapore mobile market is extremely competitive means that the IDA has to be very sure that, by introducing a fourth entrant, it will not be harming the existing state of competition in Singapore and the incentives for investment. If there is a prospect of such damage, then Singtel Mobile submits that the IDA should not be promoting a fourth entrant.

4.11. In its Consultation Paper, the IDA has indicated increased vibrancy in the mobile market as its rationale for encouraging a new entrant. Singtel Mobile cautions the IDA against adopting an overly optimistic view of the potential changes to the mobile landscape with the entry of a fourth player.

4.12. The IDA needs to be very sure that any so-called potential benefits the IDA has identified from the entry of a fourth entrant would in fact enhance the existing state of vibrant competition in the Singapore mobile sector and outweigh the detriment that will be caused by the artificial introduction of the fourth entrant. Singtel Mobile submits that mobile competition in Singapore has delivered many benefits to consumers in Singapore. Singtel Mobile believes that the market is the most appropriate means of deriving outcomes for consumers. As Professor Ordover and Shampine state:

> "*entry that occurs because of regulatory intervention (e.g. reserved spectrum and subsidies) and not subject to market forces may... be counterproductive and not deliver the expected benefits, especially if it is a result of government handicapping of the entry and investment process*."[17]

4.13. Accordingly, Singtel Mobile submits that the need for a fourth mobile operator in the Singapore mobile market is negligible. There were no bids received when the IDA reserved spectrum for a new entrant in its 2013 auction. The Ordover & Shampine Report concludes that the decision not to bid "is consistent with potential entrants'

[17] Ordover & Shampine Report, para. 8

expectations that prices, post-entry, would be insufficient to earn a normal return on such investments[18]".

4.14. In the Consultation Paper the IDA raised improved QoS and price impact as benefits to introducing a fourth mobile operator. Ordover and Shampine assessed these benefits as marginal, noting that "it is not clear whether the introduction of a fourth MNO would have any beneficial incremental effect" on QoS given existing MNOs are already subject to QoS requirements, and explaining that the magnitude of the price benefit is uncertain.[19]

4.15. Once the benefits of a potential fourth entrant have been assessed, then the costs of a new entrant must be assessed (including the very real costs of subsidising that entry). Singtel Mobile submits that the impact of a new entrant on industry profits and returns is likely to be extremely negative. The Ordover & Shampine Report notes that while it is likely the introduction of a fourth MNO has some price impact, the magnitude of this benefit is uncertain, whereas the direct and indirect costs of subsidising the entrance are known and substantial.[20]

4.16. The direct cost relates to the revenue foregone from the spectrum auction by subsidising a fourth new entrant compared to the revenues that would be derived from the auction if no subsidy existed.

4.17. There are also substantial indirect costs. New entrants typically must compete on price so as to compensate for the poorer quality of their network. Such a situation may be exacerbated if the regulatory framework is such that the regulator places low or no quality standards for the new entrant. The short term result may be lower prices however as industry returns fall, often below the cost of capital, investment is inevitably reduced and consumers will suffer in the long run[21]. The Ordover & Shampine report explains that:

[18] Ordover & Shampine Report, para. 4
[19] Ordover & Shampine Report, para. 12
[20] Ordover & Shampine Report, para. 12
[21] The Ordover & Shampine Report states at para. 17: "While competition can be a potent motivator for investment and technological progress, artificially increasing the number of competitors can have exactly the opposite effect. Prices can be too low to be consistent with adequate incentives to invest in infrastructure and new services, with the result that consumers suffer"

"[t]he economies of competing as a facilities-based provider necessitate incurring substantial fixed and sunk costs that give rise to substantial scale and scope economies, and which limit the number of economically viable carriers that can be sustained in a small market. Overall, while consumers may benefit in the short-run from bargain basement pricing resulting from subsidized entry, prices that fail to provide carriers with an adequate return on invested capital are not sustainable and deter infrastructure investment." [22]

4.18. The indirect cost of a reduced incentive to invest should not be underestimated. As Ordover and Shampine explain, firms invest in purchasing spectrum and constructing a network in the anticipation of earning certain profits. "If the risk-adjusted, expected profits on an investment are insufficient, then the firm will not make the investment or will scale back on its investment plans."[23] The three existing MNOs have already made substantial capital investments. If the IDA artificially alters competitive dynamics by subsidising a market entrant it is essentially expropriating the expected benefit of this investment[24]. This could discourage the three (3) existing MNOs from undertaking future investment.

4.19. The IDA should also consider the indirect cost if the market is unable to sustain the fourth operator and it is forced to exit. Ordover & Shampine view this as a real possibility that should be taken into account, because subjecting an industry accustomed to large fixed and sunk costs to excess competition risks has the effect of reducing overall efficiency and surplus.[25] In such circumstances the normal operation of the market would be exit and consolidation.[26] The costs of exit can exceed the sunk costs of entry and include increased consumer confusion, slower market evolution and costs of restructuring[27].

[22] Ordover & Shampine Report, para. 19
[23] Ordover & Shampine Report, para. 16
[24] The Ordover & Shampine Report notes at para 16 that this fear of 'expropriation' has been well-researched in many countries, particularly in the context of utilities.
[25] Ordover & Shampine Report, para. 17
[26] GSMA paper 'Mobile mergers: enabling consolidation in Europe', 27 February 2015 by Mark Giles states that among all regions with unique subscriber penetration above 50% of the population, Europe is the only region to have witnessed growth in the number of operators over the last three years. The paper demonstrates a clear shift from international acquisitions to in-country consolidations in recent years, and notes that many operators have highlighted the need for consolidation if the industry is to invest in new technologies like 4G.
[27] Ordover & Shampine Report, para. 14

4.20. Due to the limited benefits and substantial costs of subsidising entry by a fourth entrant, Singtel Mobile submits that the IDA should not artificially support the entry of a fourth entrant. We provide further details in the following sections.

(i) Reservation of spectrum

4.21. The IDA has proposed to reserve the following frequency spectrum for allocation in an auction solely for new entrant(s), specifically to facilitate entry of one (1) new MNO:

Package Size	Spectrum Right Duration (Indicative)	Indicative Reserve Price
• 2 x 10 MHz in 700 MHz band; • 2 x 10 MHz in 900 MHz band; • 20 MHz in 2.3 GHz band	12 to 16 years	S$40 million for entire block

4.22. Reservation of spectrum is rarely a good choice where there is no guarantee of it being used to efficiently serve end-users. If applied wrongly, it risks tying scarce resources to inefficient usage for a prolonged period to public detriment. Therefore, to set aside spectrum there must be compelling reasons, and great care must be taken. Otherwise, negative, market distorting outcomes will result as the benefit of the set-aside spectrum is transferred to private shareholders who benefit from the artificially limited prices of set-aside spectrum.

4.23. As Professor Ordover and Dr Shampine say in their report[28]:

> "*Reserving a significant amount of spectrum that can only be bid upon by new entrants means diverting that spectrum from its highest-valued use. That is, the point of an auction is that the firm that can make the best use of the spectrum will be willing to pay the most for it.*"

4.24. From a public interest perspective, the main risks of reserving spectrum include inefficient spectrum use and potentially higher costs of investments, higher retail prices and reduced network investments. The 60 MHz of spectrum that the IDA has set aside is too large, is disproportionate to a new entrant's subscriber base needs and is thus inefficient and detrimental to needs of existing subscribers. This set-aside spectrum

[28] At paragraph 13

results in an artificial spectrum shortage for existing operators which inflates the competition and bidding price for the remaining spectrum and constrains the reserved spectrum from achieving its highest market value use. Finally, the higher costs for spectrum result in cost pressures in retail pricing to the detriment of customers.

4.25. Singtel Mobile notes that in its Consultation Paper the IDA has not offered any specific analyses as to why it feels the amount of spectrum reserved is efficient and /or required for the operations of a new MNO except that:

- it has a combination of low and high frequency for greater service coverage and data capacity respectively;
- there was uncertainty over the availability date of 800 MHz and 700 MHz frequency [and therefore the allocation of 900 MHz to a new entrant];
- allocating 2 x 10 MHz of 900 MHz is unlikely to cause disruption to incumbent MNO operations; and
- incumbent MNOs can still bid for up to 2 x 5 MHz of 900 MHz each.

4.26. Singtel Mobile is concerned that the IDA has based its allocation framework for a new MNO solely on qualitative reasons and/or other non-economically justifiable grounds. Frequency spectrum is a limited resource and any allocation framework must be based on whether it is already efficiently used to serve the market and existing users and whether the intended allocation framework will disrupt the existing users or bring about more benefits to them.

4.27. To allocate a scarce resource to a new entrant solely on the grounds that the IDA wishes to see a new entrant in the market would not fulfil this. Again, as Professor Ordover and Dr Shampine state[29]:

> "*[By reserving spectrum for the new entrant], the IDA's judgment would be substituted for that of the market. The market has already demonstrated that potential entrants do not value available spectrum more highly than the firms already present. There is a direct cost to Singapore of ... diverting the use of the spectrum away from the firms that would have been willing to pay the most for it... [This] cost may be particularly high to the extent that an entrant's spectrum*

[29] At paragraph 13

is underutilized due to a relatively low number of subscribers that would be utilizing the subsidized spectrum holdings."[30]

4.28. In fact, we note that the IDA has unusually made a decision to disrupt the experience of existing end-users by deliberately:

- allocating more 900 MHz spectrum for a new entrant which has not rolled out any network and will not be able to roll out a proper and viable network till some five (5) years after award; and
- removing existing MNOs' current allocations by way of reducing the available spectrum which is being deployed to serve their customers.

4.29. Singtel Mobile submits that all MNOs should have equal opportunity to acquire frequency spectrum in order to efficiently and adequately rollout or continue maintaining their networks. Singtel Mobile is concerned that this form of advance relief to a potential MNO is at the expense of existing end-users.

4.30. By reserving frequency spectrum, especially those in bands where the spectrum is already limited, the IDA reduces or limits the amount of frequency spectrum an existing MNO can use to deploy its services and consequently limits the size and scale of any network rollout, including the quality of the services that can be delivered.

4.31. Limiting the available frequency spectrum may also prevent existing MNOs from expanding their networks in future to meet the capacity requirements in the mobile market. Therefore, it is critical for the IDA to make available as much spectrum as possible in the re-allocation exercise instead of reserving frequency spectrum.

4.32. There are many examples where in developed and mature markets, the regulators encourage new entry but do not set aside spectrum. Internationally, particularly in saturated markets, regulators do allow new entrants to participate in the auction but do not set-aside any spectrum. However, there are only few examples, where regulators set-aside spectrum for new entrants or for regional licenses. The majority of auctions with set-aside spectrum resulted in inefficient outcomes as the examples below indicate.

[30] Ordover & Shampine Report, para. 13

4.33. The 2008 auction of licenses for advanced wireless services (**AWS**) in Canada included a total of 2 x 45 MHz of spectrum of which two (2) 2 x 5 MHz blocks and one (1) 2 x 10 MHz block had been set aside for new entrants. There were five (5) significant new regional license holders (Shaw, Wind, Mobilicity, Videotron and Eastlink) who won spectrum.

4.34. Shaw, an existing fixed operator, had not deployed its network five (5) years after the auction and planned to resell the spectrum at a premium to a large incumbent after the five-year lock-up period. This means the benefit of the set-aside is transferred to private shareholders that benefitted from the artificially limited prices of set-aside spectrum. Mobilicity faced bankruptcy administration and Wind was near insolvency, with shareholders seeking to exit the market. The reduced amount of spectrum in the main auction also resulted in substantially higher and inflated prices paid for AWS licenses. Besides the inefficient outcome of the auction, the example also shows that set-aside spectrum in principle is no safeguard to provide new entrants with the ability to operate in an established mobile market. It also demonstrates that set-aside spectrum is a poor instrument for achieving the IDA's stated purpose of supporting new entrants to the market.

4.35. In its 2015 auction, 2 x 25 MHz of 2100 MHz spectrum was under auction, but Canada had further imposed set-aside spectrum of 2 x 15 MHz, leaving only 2 x 10 MHz spectrum for the main auction. This resulted in severe price distortion as can be seen by the prices paid by the new entrants and the incumbent national license holders.

Licence Winners	Licences Won	Price	Population Covered	Price per MHz per population
Bell Mobility Inc. (incumbent)	13	USD 391,915,504.33	13,489,790	USD 2.32
Bragg Communications Incorporated	4	USD 7,806,890.90	3,101,203	USD 0.08
TELUS Communications Company (incumbent)	15	USD 1,184,774,889.65	30,076,890	USD 2.37
Vidéotron s.e.n.c.	4	USD 24,932,658.28	9,889,843	USD 0.08
WIND Mobile Corp.	3	USD 44,219,687.17	18,140,872	USD 0.08

4.36. During the 2012 multi-band auction in the Netherlands, 2 x 10 MHz at 800 MHz was set aside for the recent entrants. The net effect of this reservation was to artificially increase contention among the three (3) incumbents (KPN, Vodafone and T-Mobile)

for the remaining 2 x 20 MHz, leading to exceptionally high spectrum prices. KPN subsequently suffered cuts to its credit ratings following the auction, which hampered investments. This demonstrates that the high burden of spectrum fees on the industry is almost certain to be felt by the industry and, more importantly, by consumers.

Set-Aside for Sub-1GHz Spectrum in All Benchmarks below or equal to 2 x 10 MHz		
Country	**Spectrum Bands**	**New Entrant Set-Aside Spectrum**
Austria	280 MHz of 800, 900, 1800 MHz	2 x 10 MHz of 800 MHz
UK	140 MHz of 2100 MHz	2 x 10 MHz of 800 MHz
Netherlands	359.6 MHz of 800, 900, 1800, 2000, 2600 MHz	2 x 5 MHz of 800 MHz 2 x 5 MHz of 800 MHz 2 x 5 MHz of 900 MHz Spectrum cap for Set-Aside Spectrum: 2 x 10 MHz for 800 & 900 MHz together
France	29.6 MHz of 2000 MHz	2 x 5 MHz of 2100 MHz
Czech Republic	310 MHz of 800, 1800, 2600 MHz	2 x 10 MHz of 800 MHz 2 x 15.8 MHz of 1800 MHz

4.37. Set-aside spectrum has only been applied by a few regulators worldwide. The table above shows some important examples. If regulators chose to apply set-aside spectrum, then set-aside amount for sub-1 GHz spectrum is usually restricted to less than 2 x 10 MHz due to the considerable negative impact arising from market distortion and inefficient auction outcome. An exception is the Netherlands, which has set-aside 2 x 15 MHz of sub-1 GHz spectrum for new entrants. Furthermore, in the case of the Netherlands, although a slightly higher set aside of 2 x 15 MHz sub-1 GHz spectrum was provided, a spectrum cap for the set-aside spectrum was imposed on the new entrant of a maximum of 2 x 10 MHz of sub-1 GHz spectrum, meaning new entrant operators could effectively bid for only 2 x 10 MHz more of the set-aside spectrum.

4.38. Singtel Mobile therefore does not support the reservation of frequency spectrum for a new entrant. Singtel Mobile submits that all frequency spectrum should be made available to all interested bidders (new or otherwise) in the general auction. All interested bidders should undergo the same bidding process. This ensures that all interested bidders are treated equally and have an equal opportunity to obtain frequency spectrum.

4.39. Without prejudice to the above, in the event that the IDA maintains its proposal to reserve frequency spectrum for a new entrant, the IDA should consider allocating spectrum as proposed in paragraph 2.26 above. This would allow the new entrant to provide coverage and also give them the ability to provide data services while minimising impact to existing networks.

(ii) Subsidised preferential reserve prices for new entrant

4.40. Singtel Mobile also submits that frequency spectrum should not be offered to new entrants at different or subsidised preferential reserve prices.

4.41. The IDA has set the following Indicative Reserve Prices for the general auction:

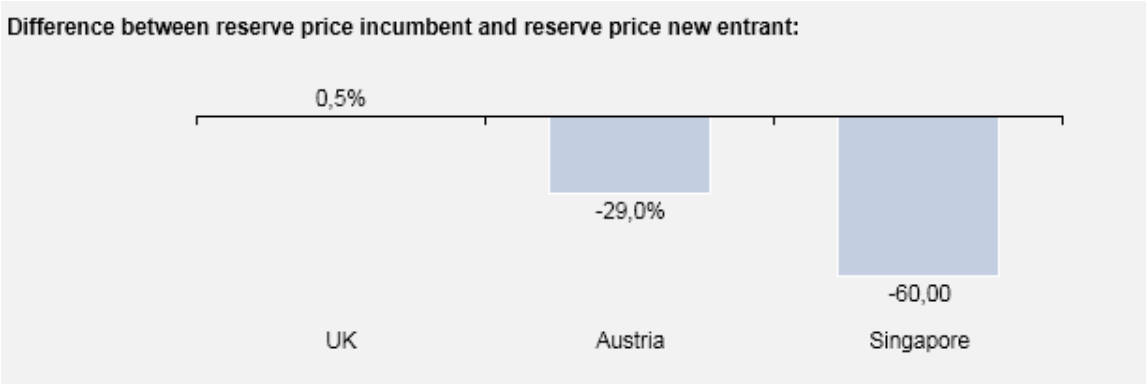
Spectrum Band	Lot Size	Spectrum Right Duration (Indicative)	Indicative Reserve Price
700 MHz	2 x 5 MHz	12 to 16 Years	S$20 million per pair of 5 MHz
900 MHz	2 x 5 MHz	12 to 16 years	S$20 million per pair of 5 MHz
EGSM in 900 MHz (allocated under first-right-of-refusal (**FROR**)	2 x 5 MHz	3 to 5 years	Pro-rated based on reserve price for long term spectrum right for 900 MHz band
2.3 GHz TDD	5 MHz	12 to 16 years	S$5million per 5 MHz
2.5 GHz TDD	5 MHz	12 to 16 years	S$5million per 5 MHz

4.42. Singtel Mobile notes that to arrive at the reserve prices for the allocation of the 700 MHz, 900 MHz, 2.3 GHz and 2.5 GHz bands in the general spectrum auction, the IDA considered the intrinsic value of the relevant spectrum bands and the international benchmarks of reserve and final bid prices for similar bands. IDA also took into account the prices achieved for the spectrum allocated in the 4G spectrum auction in 2013.

4.43. Based on the pricing methodology for the general auction, the actual value of the 900 MHz band (i.e. the amount of 900 MHz band reserved for the new entrant) is S$40 million. By valuing all the spectrum reserved for the new entrant (including the 700 MHz band, 900 MHz band and 2.3 GHz band) at S$40 million, it would appear that the IDA has chosen to not even charge the new entrant for the value of the spectrum in the 700 MHz and 2.3 GHz TDD frequency band.

4.44. According to the above calculations the IDA has proposed to offer a 60% upfront discount on scarce and limited frequency spectrum. Singtel Mobile submits that this is excessive subsidisation of a new entrant with a large discount without corresponding commitments from the new entrant is risky. This dramatically contrasts with the situation for existing MNOs, who are expected to pay the IDA-determined market value for the frequency spectrum that it has allocated and continue to serve the market and end-users at the IDA determined QoS whilst waiting for the new entrant to roll out their network.

4.45. Singtel Mobile notes that the IDA's reserve prices for the new entrant far exceeds discounts offered by any other regulators. The only regulator from the examples provided above that set aside spectrum for new entrants at a lower price level is Austria. All other regulators applied either the same reserve price or even higher reserve prices.



4.46. It is important to set the reserve prices for all parties at levels that reasonably reflect the potential economic value of the spectrum. This is to ensure that the auction mechanism can efficiently achieve its key objective of efficient allocation of scarce spectrum resources, where winning bidders will seek to maximise the use of the spectrum. However, IDA has not applied the same principle for the new entrant operator.

4.47. The Ordover & Shampine Report also raises valid concerns that the subsidy may facilitate market entry by a fourth MNO that is not willing to undertake sufficient investment in the long term. Citing the unwillingness of new MNOs to bid on the allocated spectrum in 2013, the experts explain that:

"[t]he principle of free markets is that if entry was expected to be profitable, a firm should be able to obtain capital to undertake that entry. If investors are unwilling to supply such capital, barring some market failure, it is presumably because they do not expect the investment to be worthwhile."[31].

4.48. If a potential MNO is discouraged by the comparatively small cost of acquiring spectrum rights, this may indicate their unwillingness to spend larger sums on infrastructure and technology investments[32].

4.49. In view of the above, Singtel Mobile submits that the IDA should apply the same standards for all market participants and with this, the same reserve prices for the auction. All interested bidders should be treated in a non-discriminatory manner and new entrants should be subject to the same terms and conditions.

4.50. Again, frequency spectrum is valuable and should be made available on a non-discriminatory basis. To allocate spectrum at a discount for a network rollout that will be fully completed five (5) years from the award date is not reasonable and does not translate into efficient usage of frequency spectrum.

4.51. Singtel Mobile therefore does not support the subsidised preferential reserve prices for the new entrant.

4.52. Without prejudice to the above, should the IDA maintain the subsidised preferential reserve prices, Singtel Mobile submits that the IDA should impose a restriction on the new entrant reselling or trading the subsidised spectrum or selling its mobile business, for a period of at least five (5) years from the commencement of the spectrum right. Furthermore, if the new entrant resells or trades spectrum or otherwise sells its mobile business, the IDA should require a "top-up" spectrum payment equivalent to the difference between the IDA subsidised spectrum price and the final bid price in the main auction paid by existing MNOs. This is to ensure that there is no transfer of value from the public sector to the private sector. In the 2008 AWS Spectrum auction in Canada, rules were specifically attached to the set-aside spectrum to prevent winning bidders from reselling the spectrum for a period of (5) years.

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[31] Ordover & Shampine Report, para. 11

[32] Ordover & Shampine Report para. 12 – "The fact that entrants appear to be conditioning their entry on obtaining subsidies raises questions as to the sustainability of the entrant and, potentially, the whole industry thereafter."

(iii) Insufficient spectrum for network operations by existing MNOs

4.53. In determining the amount of frequency spectrum to make available for existing MNOs, Singtel Mobile is of the view that the amount reserved is excessive for a new entrant and, as aforementioned, this severely limits the available frequency spectrum which prevents the existing MNOs from maintaining and /or expanding their networks to meet capacity requirements.

4.54. Existing MNOs today are required to comply with stringent QoS requirements. The prevailing requirements will mean that they need to maximise the usage of their existing spectrum allocation to meet the service standards set in place by the IDA.

4.55. Currently, existing MNOs make use of 2 x 30 MHz of the 900 MHz frequency spectrum. The IDA has reduced this amount by 33% on the grounds that 900 MHz frequency spectrum will be freed up by the closure of 2G services by 1 April 2017 and the increasing migration of 2G subscribers to 3G/4G services. The fact is that the 900 MHz frequency spectrum is also used to provide 3G/4G services[33] and there are already sunk investments in the 4G networks in Singapore, including for example, the underground MRT coverage that all Singapore end-users are able to enjoy. Underground MRT coverage is now even more in demand as the passenger load on the train system has increased and phone services underground, including for emergency purposes, will become increasingly critical.

4.56. In the current underground MRT tunnels, the existing MNOs have already invested in technical specifications to carry their phone signals; where there is disruption and / or a reduction in the 900 MHz frequency allocation, it would mean a disruption or a reduction in the underground MRT phone coverage, perhaps even impacting emergency services. Further to these, there may be project tenders, including government tenders, underway that will be impacted if the incumbent is unable to obtain sufficient spectrum due to excessive set-aside spectrum and unbalanced reserve pricings.

4.57. For these reasons, Singtel Mobile submits that the IDA proposal to set-aside frequency spectrum for a new entrant will mean that 2 x 10 MHz in the 900 MHz frequency spectrum band will not be used optimally for up to five (5) years while the other MNOs

[33] Consultation Paper, Table 1

will face constraints in meeting the market's bandwidth needs. Singtel Mobile therefore does not support this proposal.

(iv) Provision of data-only services

4.58. The IDA has indicated that MNOs may be able to use the spectrum bands to provide data only mobile services.

4.59. The IDA has specifically required that the existing MNOs provide PCMTS to end-users. Singtel Mobile submits that the IDA impose the same requirements on all MNOs who acquire spectrum. Any new entrant whose entry is supported and facilitated by the IDA should not be permitted to avoid its obligations to rollout a full MNO network and to provide both data and non-data services. In particular, if the existing MNOs are required by the IDA (as is currently the case) to provide Public Cellular Mobile Telecommunications Services (**PCMTS**), the new entrant should be similarly so required. In the event that the IDA does not impose a non-discriminatory requirement on the new entrant to provide PCMTS, the total amount of frequency spectrum available to the new entrant must be reduced and, in particular, the 900 MHz spectrum band should only be available to the existing MNOs so that they may continue to meet their subscriber requirements for both data and non-data services (including PCMTS).

(v) New entrant must be fully-fledged MNO (including PCMTS)

4.60. Similarly, Singtel Mobile seeks clarification from the IDA as to whether the new entrant must be a full-fledged MNO and offer the full suite of data and non-data services or can in fact also operate as an Mobile Virtual Network Operator (**MVNO**). This position is not made clear in the Consultation Paper.

4.61. Singtel Mobile submits that any new entrant whose entry is facilitated by the proposed framework and spectrum allocation should not be permitted to also choose to avoid its obligations to rollout a full MNO network and provide data and non-data services. The new entrant may still come to a commercial agreement with any of the incumbent MNOs for the purpose of being an MVNO. The IDA's proposed MVNO negotiation principles should not apply to the new entrant.

(vi) Efficient utilisation of spectrum by new entrant

4.62. Singtel Mobile submits that the IDA must formally ensure that the new entrant must sufficiently deploy its spectrum obtained through the auction, so as to ensure that valuable spectrum resource is not wasted nor underutilised. The IDA should impose a framework through which utilisation has to be demonstrated by the new entrant, while allowing for retrieval of the spectrum resource by the IDA or reallocation to the market should the resource be underutilised. This is important to ensure the spectrum is used to deliver services and not for purposes of reselling, in particular should the resource be obtained at a steep discount and through the facilitation of the IDA.

4.63. Singtel Mobile submits that the IDA should impose a performance bond on the new entrant, for example 5% of its total budgeted capital investment, to cover the material obligations such as network rollout, service provision and any other relevant commitments so as to ensure that the new entrant meets its commitments. In the event that the new entrant fails to satisfy its network and service commitments, the IDA can call on the performance bond. This would be consistent with performance bond requirements imposed on other market entrants by the IDA.

(vii) Equal treatment across all bidders

4.64. Singtel Mobile reiterates that all interested bidders including the new entrant should be treated in a non-discriminatory manner in terms of prices, terms and conditions for market allocation. This ensures that all interested bidders will have the same considerations when planning their business case.

4.65. Therefore, the IDA should consider:

- that offering a different or preferential reserve price is likely to distort the market and this mechanism should be removed; and
- that all players, potential new entrants and /or existing MNOs should participate in the market allocation on the same terms and conditions (i.e. all should participate in the same general auction at the same prices, terms and conditions).

4.66. Singtel Mobile reiterates that it does not support a new entrant framework where the potential new entrant effectively gets a free ride into the market. Notwithstanding this and without prejudice to our position here, if the IDA still prefers that the proposition

that potential new entrants be facilitated through a separate framework, Singtel Mobile proposes that the IDA considers the following:

- reducing or removing the amount of 900 MHz frequency available and making available more frequency in the other frequency bands (e.g. 800 MHz);
- if additional set-aside spectrum is deemed absolutely necessary, the IDA should set aside a maximum of 5MHz of 700 MHz and 5MHz of 800MHz spectrum for the new entrant;
- reducing the amount of subsidisation given to the new entrant;
- preventing the new entrant from participating in the general auction with existing operators if the IDA has already reserved frequency spectrum for the new entrant, or if the new entrant is allowed to participate in the main auction, the winning bid in the main auction shall apply to the new entrant's reserved spectrum regardless of whether the new entrant wins additional spectrum to ensure that there is no irrational bidding or price boosting by the new entrant to the detriment of the existing MNOs;
- ensuring that the new entrant cannot concurrently be an MVNO.
- requiring that the new entrant furnish a performance rollout framework and a performance bond that can be called upon at various milestones where the new entrant is unable to meet the required rollout requirements; and
- requiring the new entrant to comply with all prevailing QoS, network and service resiliency requirements.

5. SPECIFIC COMMENTS

Question 1

IDA seeks views on its proposed allocation of the 700 MHz band together with other suitable bands for mobile services in the next spectrum allocation exercise; and the mechanism to allow the delay of the commencement date of the 700 MHz spectrum right, and correspondingly, the expiry date as well as the spectrum right payment due date, in the event of a delay in the ASO.

5.1. Singtel Mobile supports the allocation of the full 700 MHz band allotment of 2 x 45 MHz for mobile broadband services under the next spectrum exercise with some qualifications, specifically in the context of the IDA's target timeline of 2018 for the availability of the 700 MHz band.

5.2. Singtel Mobile is concerned that the availability of the 700 MHz spectrum is uncertain as it is dependent on the Analogue Switch Off (**ASO**) timelines. The MNOs require certainty to develop their network rollout plans so as to ensure the full utilisation of their spectrum license upon commencement. As such, rollout-related investments and procurement processes are timed to commence months in advance of the spectrum license commencement date. The rights holder will require that the commencement date be confirmed one (1) year in advance. Any postponement of the 700 MHz spectrum due to unforeseen delays resulting from the ASO will have costly commercial implications for the rights holder.

5.3. In view of the above, Singtel Mobile submits that it is necessary that appropriate mechanisms should be in place under the spectrum allocation framework to allow for the delay of the commencement of the 700 MHz spectrum right auctioned and, correspondingly, the expiry date and the spectrum right payment due date, so as to maintain the same spectrum right duration. Additionally, a compensation mechanism should also be considered to mitigate commercial damages that may arise from delays in the commencement of the 700 MHz spectrum right.

5.4. Singtel Mobile recommends harmonizing the commencement date of the 700 MHz and 900 MHz spectrum rights. With this, and should the IDA maintain its intention to set aside spectrum against international best practice, the IDA could focus on setting aside spectrum for the new entrant within the 700 MHz spectrum band thus minimizing any disruptive impact to existing MNOs and their customers as re-farming of the 900 MHz might not be necessary in this case.

5.5. To harmonize the 700 MHz and 900 MHz spectrum rights commencement date, Singtel Mobile recommends that existing 900 MHz spectrum rights be extended and chargeable at the winning bid price for the long-term spectrum rights in the 900 MHz band, pro-rated to the duration of the extension. If the IDA is unable to provide a one (1) year advanced notice, Singtel Mobile requests that the IDA announce the 700 MHz and 900 MHz commencement date at least six (6) month prior to the commencement date to allow the spectrum rights holder(s) to fully utilise the spectrum rights and support network rollout in accordance with rollout requirements.

Question 2

IDA seeks views on:

a) its proposed 800 MHz band plan based on the 3GPP band 26, or a combination of 3GPP band 27 and band 5 (excluding the EGSM band), including views on the possible phased approach and timeline to migrate existing users of the band; and

b) the impact to existing users (i.e., Trunked radio and SRD) of the 800 MHz band plan based on the 3GPP band 26, or a combination of 3GPP band 27 and band 5 (excluding the EGSM band).

5.6. Singtel Mobile supports the IDA's proposed auction plans for 2 x 5 MHz of the 800 MHz spectrum (824 MHz – 829 MHz and 869 MHz – 874 MHz). Singtel Mobile is of the view that the 3GPP Band 5 has currently developed a mature device eco-system and would allow any MNO to attract roaming traffic from a large number of operators. To date, more than 40 operators are deploying LTE 800 under 3GPP band 5. Malaysia and Indonesia are also deploying LTE in band 5, with operators including Telekom Malaysia, SmartFren and Bakrie Telecom.

5.7. Singtel Mobile further notes that, independent of Band 26, or the combination of Band 27 and Band 5, the upper spectrum of the down link spectrum block 869 MHz to 879 MHz will be impacted by the implementation of HSR/ GSM-R and will require guard bands to be in place and/or filtering. However, the lower 5 MHz of the band 5, 824 MHz – 829 MHz and 869 MHz – 874 MHz, are free from interference.

5.8. In view of the above, Singtel Mobile recommends that the IDA include the lower 5 MHz of Band 5 (824 MHz – 829 MHz and 869 MHz – 874 MHz) in its next spectrum allocation exercise. There is strong justification for its inclusion as this will not impact the IDA's spectrum re-farming plans. In addition, as the band is LTE ready, it can be allocated to the new entrant as opposed to the 900 MHz allocation, so as to avoid unnecessary and costly impact on investments for existing MNOs.

5.9. Singtel Mobile submits that the IDA's timeline of three (3) to five (5) years is adequate for the migration of existing users, including trunk radio and SRD equipment, to the GSM centre gap proposed by the IDA.

Question 3

IDA seeks views on the allocation of the short-term spectrum rights for the EGSM band, including the approach to extend the short-term spectrum right.

5.10. Singtel Mobile submits that the IDA should hold the upcoming spectrum allocation exercise in Q1 2016 at the earliest to ensure more certainty with regard to spectrum re-farming in neighbouring countries (i.e. Indonesia) as the FROR may not be necessary.

5.11. While Singtel Mobile acknowledges the requirement to reserve 2 x 5 MHz of the EGSM (880 MHz to 885MHz paired with 925MHz to 930 MHz) for HSR use for the long-term, Singtel Mobile is of the view that the IDA's scenario of short-term spectrum rights might not be applicable given that the Indonesian Ministry of Communication and Information Technology had already implemented 800/850 MHz spectrum re-farming plans in September 2014. The process is scheduled to be completed by December 2015 with the possibility of extending the migration process by one (1) year. Specifically, Indonesian operator SmartFren has already started its LTE850/2.3 GHz LTE rollout and is expected to launch LTE services by the end of 2015. It is thus highly likely that SmartFren will have completed its spectrum migration process by April 2017.

5.12. In view of the above, Singtel Mobile recommends that the IDA conduct the upcoming spectrum allocation exercise no earlier than Q1 2016. If possible, a later date beyond Q1 2016 will be optimal and minimise possible market distortions inherent with spectrum allocations via FROR. This will also enable the EGSM band to be included in the exercise.

Question 4
IDA seeks views on:
a) its proposed re-allocation of the L-band for wireless broadband in Singapore in the longer term; and
b) the allocation of the L-band for trial, temporary use, and/or commercial services in the interim period.

5.13. Singtel Mobile supports the IDA's proposed re-allocation of the L-band for wireless broadband in Singapore in the longer term. This allocation will provide necessary downlink capacity in the longer term. Increasing downlink to uplink ratios can be expected in the future due to increasing video traffic and the rapid proliferation of smartphones and tablets. The Supplementary Downlink (**SDL**) spectrum provided in the 1.4GHz band will increase the overall spectrum utilisation of conventional FDD allocations and will result in increasing spectrum efficiency. The first spectrum auction also allocating 1.4GHz band was conducted in 2015 in Germany.

5.14. Additionally, Singtel Mobile supports the IDA's proposal to allow L-band spectrum (1452 – 1492 MHz) for trial, temporary use and/or commercial services in an interim period. SDL and carrier aggregation have been enabled in the HSPA+ Release 9 (and beyond) and LTE Release 10 (and beyond), and the IDA's proposal to make spectrum available in the L-band in the interim period for interested parties to conduct trials will enable MNOs to gain first-hand experience once SDL capable handsets are more common.

Question 5

IDA seeks views on:

a) its proposed approach for local operators to coordinate with neighbouring countries' operators to address potential co-channel interference in the use of the 2.5 GHz band;

b) the use of the proposed 5 MHz guard band in the 2.5 GHz band to prevent interference between TDD and FDD systems operating in adjacent bands, versus the imposition of suitable mitigation measures to prevent interference; and

c) the possible adoption and/or suitable restriction levels for Block Edge Mask, synchronisation of TDD networks and any other suitable mitigation measures to prevent co-channel or adjacent channel interference between different TDD systems or between TDD and FDD systems.

5.15. Singtel Mobile supports the IDA's proposal to allocate the 2.5 GHz TDD band on a full-band sharing basis with neighbouring countries and to allow operators to address potential co-channel interference on bilateral basis. Singtel Mobile is of the view that such a concept has proven successful in Europe for two (2) decades. With the implementation of GSM900 services in Europe, national regulatory authorities were concerned with potential co-channel interference from neighbouring counties and developed a preferential frequency assignment model and a methodology to coordinate frequency usage in border areas. However, such coordination procedures depended on a great number of technical, operational and topographical parameters which were both inefficient and unsustainable. Singtel Mobile recognises that it is in the best interests of all concerned parties that potential co-channel interferences are addressed on an operator-to-operator basis through the exchange of site and planning data as well as regular dialogues on potential cross border interferences.

5.16. Singtel Mobile supports imposing a guard band of at least 5 MHz at both ends of the 2.5 GHz band and suggests that the IDA consider revising the proposed auction band from 2570 MHz – 2615 MHz to 2575 – 2615 MHz. This will allow future allocation of LTE FDD Band 7 with the pairing of 2560 – 2570 MHz with 2680 – 2690 MHz.

5.17. With regard to Block Edge Masking (**BEM**), Singtel Mobile regards BEM as a fall-back solution to prevent adjacent channel interference. Singtel Mobile is of the view that first and foremost, there should be a synchronisation of all Singaporean 2.5 GHz TDD operations. The proposed guard band of 5 MHz at both ends of the 2.5 GHz band should be sufficient to enable co-existence between TDD and adjacent FDD systems without the need for additional BEM.

Question 6
IDA seeks views on its proposed allocation of the spectrum bands in the next allocation exercise, including on the proposed uses and spectrum right durations of the spectrum bands, the proposed 'Clock Plus' auction format, as well as the appropriate spectrum caps and regulatory obligations to ensure the optimal use of the spectrum.

5.18. Singtel Mobile generally supports the 'Clock Plus' format which allows bidding on generic multiband frequency spectrum lots. Singtel Mobile recommends that the IDA retain its 'Clock Plus' with Standing High Bidder Rule format which was employed previously in the 2013 4G spectrum auction to reduce irrational bidding behaviour and attempts at price boosting.

5.19. Singtel Mobile further submits that the IDA should implement a spectrum right duration of at least 15 years. Specifically, spectrum rights duration of at least 15 years will allow operators to amortise their network rollout plans. Due to the far-reaching and expansive network rollout activities required for mobile telecommunication services, a production life cycle of less than 15 years is commercially unsuitable and prohibitive. This reflects international best practices illustrated in the benchmark table of recent spectrum allocation proceedings below. The data provided is a sample of numerous examples supporting a 15-year spectrum right duration.

License Duration Benchmark

Country	Year	Auctioned Spectrum	License Duration in Years
Australia	2014	700 MHz	15
Belgium	2013	800 MHz	20
Brazil	2012	900 MHz	15
Croatia	2012	800 MHz	12
Czech Republic	2013	800, 1800, 2.6 GHz	15
Denmark	2012	800 MHz	22
Estonia	2014	800 MHz	15
Finland	2014	800 MHz	20
France	2011	800 MHz	15
Germany	2010	800, 1800, 2100, 2.6 GHz	15
Germany	2015	700, 900, 1400, 1800 MHz	16
Hong Kong	2010	850, 900, 2100 MHz	15
Italy	2011	800, 1800, 2.6 GHz	17
Latvia	2013	800 MHz	18
Lithuania	2013	800 MHz	17
Portugal	2011	450, 800, 900, 1800, 2100, 2.6 GHz	15
South Korea	2011	800 MHz	15
Spain	2011	800, 900, 2.6 GHz	15
Sweden	2009	800 MHz	25

5.20. Singtel Mobile recommends that the IDA introduce a spectrum cap of 2 x 40 MHz or spectrum bands below 1 GHz (**sub-1GHz spectrum**) and that no spectrum caps be imposed for spectrum bands beyond 2 GHz. The following recommendation is in accordance with international best practices.

Total amount of 2.3 GHz spectrum to be auctioned

5.21. Singtel Mobile recommends that the IDA increase the total amount of 2.3 GHz TDD spectrum to be auction to at least 1 x 60 MHz, should the IDA maintain its intention to set aside 1 x 20 MHz for a new entrant. Based on the IDA's existing proposal, only 1 x 10 MHz of 2.3 GHz spectrum would be available for established operators in the main auction. Reflecting the higher handset availability to be expected for 2.3 GHz TDD spectrum, Singtel Mobile recommends increasing the total amount of 2.3 GHz TDD

spectrum to be auctioned to also allow established operators to utilise the additional 2.3 GHz spectrum available.

Spectrum Caps

5.22. The Singtel Mobile spectrum cap proposal was derived from a European spectrum cap benchmark adjusted to the Singaporean environment (i.e. the current market status of three mobile operators, and total amount of auctioned sub-1GHz spectrum in Singapore in accordance with Singtel Mobile's proposal above).

Spectrum cap benchmark sub-1 GHz spectrum[34]

Country	Spectrum cap on sub 1GHz spectrum	Number of Operators	Allocated Spectrum 800 MHz	Allocated Spectrum 900 MHz	Total sub-1GHz Spectrum	Equivalent sub-1GHz spectrum cap for Singapore mobile environment
Austria	2x35 MHz	3	60	70	130	2x45MHz
Belgium	None	3	60	68.4	128.4	None
Switzerland	2x25MHz	3	60	69.6	129.6	2x35MHz
Germany	No cap for 700/ 900 MHz in 2015 auction;	3	60	69.6	129.6	None
Spain	2x25MHz	4	60	69.6	129.6	2x45MHz
Finland	None	3	60	69.6	129.6	None
France	None	4	60	68.8	128.8	None
Ireland	NA as spectrum caps are defined for different time slices.	3	60	70	130	NA
Italy	2x25MHz	4	60	69.6	129.6	2x45MHz
Portugal	2x20 MHz (deferred cap on spectrum holdings)	3	60	57.6	117.6	NA (as deferred)
Sweden	None	2	60	70	130	None
Slovenia	2x30 MHz	3	60	69.6	129.6	2x40 MHz
Slovakia	None	4	60	60.8	120.8	None
United Kingdom	2x27.5MHz	3	60	69.6	129.6	2x35MHz

Spectrum Cap Benchmark

5.23. A considerable number of regulatory authorities do not impose spectrum caps for 2.3 GHz or 2.6 GHz TDD spectrum. Accordingly, Singtel Mobile recommends that for the no spectrum caps be imposed for 2.3 GHz and 2.6 GHz TDD spectrum in the upcoming auction.

[34] Source: Regulator webpages.

2.3/2.6 GHz TDD Spectrum Cap Benchmark

Country	Spectrum	Year	Spectrum Cap
Austria	2.6 GHz TDD	2010	Eligibility conditions, but no direct spectrum caps for 2.6 GHz TDD
Australia	2.3 GHz TDD	2011	Regional auction
Belgium	2.6 GHz TDD	2011	No spectrum cap for 2.6 GHz TDD spectrum
Denmark	2.6 GHz TDD	2009	Eligibility conditions, but no direct spectrum caps for 2.6 GHz TDD
Finland	2.6 GHz TDD	2014	50 MHz jointly for 2.6 GHz FDD and TDD
Germany	2.6 GHz TDD	2010	No spectrum cap for 2.6 GHz TDD spectrum
Hong Kong	2.3 GHz TDD	2008	30 MHz for 2.3 GHz TDD
Hong Kong	2.6 GHz TDD	2009	30 MHz for 2.6 GHz FDD and TDD spectrum
Hungary	2.6 GHz TDD	2014	No spectrum cap for 2.6 GHz TDD spectrum
India	2.3 GHz TDD	2011	Regional auction
Italy	2.6 GHz TDD	2011	55MHz for 2.6 GHz FDD and TDD spectrum
Netherlands	2.6 GHz TDD	2010	Eligibility conditions, but no direct spectrum caps for 2.6 GHz TDD
Netherlands	2.6 GHz TDD	2012	No spectrum cap for 2600 MHz TDD spectrum in 2010 auction;
New Zealand	2.3 GHz TDD	2007	40 MHz jointly for 2.3 GHz TDD and 2500 MHz TDD
New Zealand	2.6 GHz TDD	2007	40 MHz jointly for 2.3 GHz TDD and 2500 MHz TDD
Nigeria	2.3 GHz TDD	2013	NA as only one lot of 1x30 MHz was auctioned
Norway	2.6 GHz TDD	2007	No spectrum cap for 2.6 GHz TDD spectrum
Poland	2.6 GHz TDD	2009	No spectrum cap for 2.6 GHz TDD spectrum
Sweden	2.6 GHz TDD	2008	140 MHz jointly for 2.6 GHz TDD and FDD spectrum
Switzerland	2.6 GHz TDD	2012	No spectrum cap for 2.6 GHz TDD spectrum
UK	2.6 GHz TDD	2013	50 MHz of 2.6 GHz TDD spectrum

Reserve Price

5.24. Singtel Mobile recommends reducing the 2.3/2.6 GHz TDD reserve price to align with international 2.3/2.6 GHz TDD benchmark reserve prices. We provide in this section a benchmark of 2.3/2.6 GHz TDD spectrum reserve prices which clearly illustrates that the IDA's reserve price is significantly above international benchmarks. The only benchmarks which are closer to IDA's 2.3/2.6 GHz TDD reserve price proposal are those of Hong Kong and Switzerland. However, the regulatory authority of Switzerland (**OfCom**) clearly stated in its written responses to the industry that it was driven by revenue maximisation. In abstract 57 of the questions and answers[35], OfCom provides the following statement:

[35] See: http://www.bakom.admin.ch/themen/frequenzen/03569/03901/index.html?lang=en#sprungmarke3_14 ; OFCOM: Tender for blocks of frequencies: Questions – Answers; 30.06.2011

"Annex III Auction Rules – Reserve prices:
16.1 The proposed reserve prices are significantly higher than those used for similar spectrum bands in other European countries. Please explain the rationale for setting reserve prices at these levels?

Answer: According Art. 39 par. 4 LTC the regulator may define a reserve price. Art. 23 par.1 OFMRL settles the minimum level of reserved prices. The determination of reserved prices above this mini-mum level is left to the discretion of the regulator. According to Art. 23 OFMRL adequate revenues have to be achieved.

16.2 Did OFCOM consider the risk that setting reserve prices at these levels could deter potential participants from bidding for some of the available spectrum, potentially resulting in a less competitive auction and frequencies going unsold unnecessarily?

Answer: The determination of reserved prices above this minimum level is left to the discretion of the regulator."

5.25. Reserve prices for 2.6 GHz TDD spectrum in Hong Kong were mainly determined on the basis of high demand and to avoid arbitration. However, the high reserve price was a failure that deterred bidding for 2.6 GHz TDD spectrum which went unsold.[36]

5.26. The provided benchmarks of recent 2.3/2.6 GHz TDD spectrum auctions below show that clearly, reserve prices for 5MHz of 2.3/2.6 GHz TDD spectrums below S$1M would be far more appropriate for the upcoming auction and in line with international best practices. Accordingly, Singtel Mobile recommends setting the 2.3/2.6 GHz TDD spectrum reserve prices on the appropriate level of below $S1M.

5.27. The same reserve prices should apply for both existing operators and for new entrants, particularly for auctions where it is deemed absolutely necessary for set-aside spectrum for a new entrant.

Reserve Price Benchmark 2.3 GHz and 2.6 GHz TDD[37]

Country	Spectrum Band	Year	Population	Reserve price Per lot (local currency)	Reserve price per MHz per	Factor 2.3/2.6 GHz TDD Reserve Price
Austria	2.6 GHz TDD	2010	8.602m	€200,000 per 5MHz	SGD 0.0070	26.1
Australia	2.3 GHz TDD	2011	Regional and not national license			
Belgium	2.6 GHz TDD	2011	11.246m	€500,000 per MHz	SGD 0.0669	2.7

[36] See: http://tel_archives.ofca.gov.hk/en/press_rel/2009/Jan_2009_r1.html
[37] Source: Regulator webpages.

Country	Spectrum Band	Year	Population	Reserve price Per lot (local currency)	Reserve price per MHz per	Factor 2.3/2.6 GHz TDD Reserve Price
Denmark	2.6 GHz TDD	2009	5.52m	DKK 500,000 per	SGD 0.0037	50.1
Finland	2.6 GHz TDD	2014	5.25m	€750,000 per 50 MHz	SGD 0.0041	44.7
Germany	2.6 GHz TDD	2010	82.28m	€1,250,000 per 5MHz	SGD 0.0046	40.0
Hong Kong	2.3 GHz TDD	2008	6.86m	HK$ 150,000,000 per 30 MHz	SGD 0.1290	1.4
Hong Kong	2.6 GHz TDD	2009	6.86m	HK$ 25,000,000 per	SGD 0.1290	1.4
Hungary	2.6 GHz TDD	2014	9.9m	€2.8m for 15MHz	SGD 0.0284	6.4
India	2.3 GHz TDD	2011	Regional and not national license			
Italy	2.6 GHz TDD	2011	61.08m	€36.8m pre 15MHz	SGD 0.0604	3.0
Netherlands	2.6 GHz TDD	2010	16.78m	€50,000 per 5MHz	SGD 0.0009	204.0
Netherlands	2.6 GHz TDD	2012	16.78m	€585,000 per 5MHz	SGD 0.0105	17.4
New Zealand	2.3 GHz TDD	2007	4.598m	NZD10,000 per MHz	SGD 0.0020	93.1
New Zealand	2.6 GHz TDD	2007	4.598m	NZD10,000 per MHz	SGD 0.0020	93.1
Nigeria	2.3 GHz TDD	2013	183.523m	USD 23m for 30 MHz	SGD 0.0057	31.9
Norway	2.6 GHz TDD	2007	4.68m	NOK 1,000,000 per 10	SGD 0.0036	51.2
Poland	2.6 GHz TDD	2009	38.54m	€360,000 for 50 MHz	SGD 0.0003	650.6
Sweden	2.6 GHz TDD	2008	9.08m	SEK 13,750,000 for 50	SGD 0.0048	37.8
Switzerland	2.6 GHz TDD	2012	8.256m	CHF 12.45m per 15MHz	SGD 0.1435	1.3
UK	2.6 GHz TDD	2013	64.8m	£50,000 per 5MHz	SGD 0.0003	557.2

Singapore	2.3 GHz/2.6 GHz TDD	2016	5.47m	SGD5m per 5MHz	SGD 0.1828

Question 7

IDA seeks views on its proposed facilitation framework for the new MNO, including on the set-aside spectrum, the reserve price for the set-aside spectrum, the auction format, and the regulatory obligations on the new MNO.

5.28. Please refer to our comments in section 4.

5.29. Despite offering favourable terms for prioritised frequency allocation and relaxed QoS and network resilience conditions, international mobile market experiences indicate that allocating spectrum specifically for a new entrant is likely to result in an overall reduction of efficiency of the mobile market.

5.30. Although regulators may also be looking to promote investment in the sector, the impact of a new entrant on industry profits and returns is conversely likely to be extremely negative, as further discussed by Professor Ordover and Dr Shampine in their attached report. New entrants typically must compete on price to compensate for the poorer quality of their networks even supported by IDA with imposing QoS and network resilience code standards on the new entrant later as for established operators. The result is that existing mobile operators eventually have to respond by lowering

prices. Whilst customers may benefit in the short term, as industry returns fall, often below the cost of capital, investment is reduced and consumers will suffer in the long run.

5.31. Singtel Mobile's position is that the substantial direct and indirect costs of subsidised entry in the manner proposed by the IDA in the Consultation Paper vastly outweigh any potential benefits.

Set-Aside Spectrum

5.32. Singtel Mobile strongly recommends following international standards by not applying set-aside spectrum for a new entrant and instead allowing the new entrant to join the main auction. Singtel Mobile also submits that the same rules and regulations are applied to new entrant operators as for the existing operators.

5.33. Setting aside spectrum restrains market forces and is economically inefficient, as Professor Ordover and Dr Shampine's report explains.

5.34. Set-aside spectrum for new entrants is rarely applied by regulatory authorities worldwide in the framework of spectrum auctions. Out of several hundred recent spectrum auctions, there are only few examples (Austria 2010, UK 2011, Netherland 2012, France 2010 and Czech Republic 2013) of spectrum auctions where spectrum was set-aside for new entrants. Several regulatory authorities are reserving spectrum for regional licenses as in USA, Canada, India or Australia. However, this is usually not seen as set-aside spectrum for new entrants, but as regional licensing which, however, can have the same negative impacts as set-aside spectrum as shown below.

Benchmark: Auction with set-aside spectrum for new entrants

Country	Spectrum Bands	New Entrant Set-Aside Spectrum
Austria (2013)	280 MHz of 800, 900, 1800 MHz	2x10 MHz of 800 MHz
UK (2000)	140 MHz of 2100 MHz	2x14.6MHz plus 1x5MHz of 2100 MHz
Netherlands (2012)	359.6MHz of 800, 900, 1800, 2000, 2.6 GHz	2x10 MHz of 800 MHz 2x5MHz of 900 MHz New Entrant Spectrum Cap for Set-Aside Spectrum: 2x10 MHz for 800 & 900 MHz together
France (2010)	29.6MHz of 2100 MHz	2x5MHz of 2100 MHz
Czech Republic (2013)	310 MHz of 800, 1800, 2.6 GHz	2x10 MHz of 800 MHz 2x15.8MHz of 1800 MHz

5.35. While many regulatory authorities permit new entrants to participate in spectrum auctions, new entrants usually participate in the standard spectrum auction process and are subject to exactly the same rules and regulations as existing mobile operators. Spectrum set-asides for new entrants risk tying scarce resources to inefficient users for a prolonged period to the detriment of public good. Spectrum set-asides need to be determined with great care to avoid unduly distorting outcomes. From a public interest perspective, the main risks include inefficient spectrum use and, in the case of spectrum reservations, potentially higher spectrum costs on aggregate, result in higher retail prices and/or reduced network investments. Recent examples of unfavourable spectrum auction results caused by spectrum reservations are illustrated in this submission.

Amount of Set-Aside Spectrum

5.36. Singtel Mobile submits that the IDA should reduce the amount of set-aside sub-1 GHz spectrum to 2 x 10 MHz or less following international examples. New entrant operators do not need more spectrum in the first years, as this reflects the initial market share new entrant operators usually achieve. More importantly, this is detrimental to customers of existing operators, who are still subject to full QoS and network resiliency code requirements. Additionally, international benchmarks on set-aside spectrum clearly indicate that no regulatory authority which applied set-aside spectrum for a new entrant has ever allocated more than 2 x 10 MHz of sub-1GHz spectrum for one new entrant, with the exception of the Netherlands. Although 2 x 15 MHz of sub-1GHz spectrum was set aside for new entrants, a spectrum cap of 2 x 10 MHz for new entrant operators was imposed, essentially equating to a maximum amount of 2 x 10 MHz of sub-1GHz spectrum for new entrants to auction.

5.37. The sub-1GHz spectrum set-aside proposal of IDA is entirely incongruent and will adversely affect the IDA's objectives of setting the stage for Singapore to be the World's First Smart Nation that functions beyond the capabilities of a Smart City[38]. IDA's spectrum set-aside spectrum would not be sufficient for established operators to further fulfil the requirements of IDA's QoS regulations imposed on incumbent operators necessary to cope with the growing demand and usage resulting from the IDA's initiatives.

[38] See: http://www.ida.gov.sg/about-us/

5.38. The remaining amount of sub-1GHz spectrum would not be sufficient for established operators to fulfil QoS obligations as only sub-1GHz spectrum provides the necessary deep-indoor coverage propagation that allows established operators to maintain and grow capacity and to provide the necessary high-quality mobile services with sufficient indoor coverage. There is a sharp imbalance between set-aside spectrum for new entrants versus spectrum available to existing operators. A simple comparison of likely subscriber-per-MHz that reflects the current market environment in Singapore, while also considering benchmarks of new entrant subscriber / market share developments, will show the negative impact on high quality service provisioning for established mobile operators possessing a far larger subscriber base, in the mid-term.

- Established mobile operators subject to QoS regulations with an expected minimum of 8-10 million mid-term subscribers would have to serve with 100 MHz of 700 MHz and 900 MHz spectrum, in accordance with IDA's set-aside spectrum proposal at least 80,000 – 100,000 subscriber per MHz of 700 MHz and 900 MHz spectrum.
- New entrant operators not subject to QoS regulations with an expected mid-term subscriber number of less than one million would serve with 40 MHz of 700 MHz and 900 MHz spectrum in accordance with IDA's set-aside spectrum proposal a maximum of 25,000 subscriber per MHz of 700 MHz and 900 MHz spectrum.

5.39. Accordingly, Singtel Mobile submits that the IDA should reduce the amount of set-aside sub-1GHz spectrum to 2x10 MHz in line with international benchmarks, as provided above. Singtel Mobile requests that if, contrary to this submission, the IDA decides to set-aside spectrum (which would be against international best practice), then the sub-1GHz set-aside spectrum should be defined as 5MHz of 700 MHz spectrum and 5MHz of 800 MHz spectrum (824MHz – 829MHz and 869MHz – 874MHz). This would:

- reduce the negative impact on existing mobile operators (re-farming might not be necessary);
- reduce the risk of price war in the upcoming auction (as for example in Canada or Netherlands as shown above);
- be in line with international experience from the few spectrum auctions with set-aside spectrum;
- be beneficial also for the new entrant operator due to spectrum availability as proposed by Singtel Mobile; and

- increase the likelihood that all mobile operators can fulfil QoS obligations also in the future.

QoS Regulation and Network Resilience Code for New Entrants

5.40. While regulatory authorities offer new entrant operators in selected cases longer timelines to fulfil standard coverage rollout obligations, regulatory authorities do not usually apply different QoS standards for new entrant operators, as the following benchmark shows.

Benchmark: QoS regulation for established operators and new entrants in spectrum auctions

Country	Spectrum Bands	New Entrant Set-Aside Spectrum	Different QoS obligation for New Entrant?
Austria (2013)	280 MHz of 800, 900, 1800 MHz	2x10 MHz of 800 MHz	Same minimum throughput condition for new entrant and established operators with 2x5MHz of 800 MHz spectrum
UK (2000)	140 MHz of 2100 MHz	2x10 MHz plus 1x10 MHz of 2100 MHz	No
Netherland (2012)	359.6MHz of 800, 900, 1800, 2000, 2.6 GHz	2x10 MHz of 800 MHz 2x5MHz of 900 MHz	No
France (2010)	29.6MHz of 2100 MHz	2x5MHz of 2100 MHz	No
Czech Republic (2013)	310 MHz of 800, 1800, 2.6 GHz	2x10 MHz of 800 MHz 2x15.8MHz of 1800 MHz	No

5.41. Accordingly, Singtel Mobile submits that the IDA should treat all mobile operators equally with regard to QoS regulation and network resilience code. Imposing QoS regulation and network resilience code on new entrants at a later point in time provides wrong signals to new entrant operators not to target the highest possible QoS for their end user, but also for the end users of the established operators who might be impacted from insufficient quality of the new entrant operator via necessary interconnection between the networks.

5.42. Critically, customers of established operators will not be able to distinguish whether quality gaps are caused by the established service provider or by the interconnecting new entrant. Lower quality standards might also incentivise new entrant operators to provide wrong price signals with low quality services which might at a later point in time lead to a lack of financial capabilities to improve its networks.

5.43. Furthermore, if a new entrant is not required to offer PCMTS (particularly voice), then the amount of spectrum to be allocated to any new entrant needs to be critically considered. Singtel Mobile does not agree to the proposition that incumbents are required to offer PCMTS (including voice) and comply with the QoS standards but new entrants are not required to do so. There must be a level playing field. But if voice is not to be offered by the new entrant over 4G services, then spectrum allocation should also be adjusted.

Reserve Price

5.44. IDA submits in its Consultation Paper that reserve prices for the allocation of the 700 MHz, 900 MHz, 2.3GHz and 2.5GHz bands for the spectrum allocation shall follow the intrinsic value of the relevant spectrum bands and the international benchmarks of reserve and final bid prices for similar bands. IDA also took into account the prices achieved for the spectrum allocated in the 4G spectrum auction in 2013. While IDA does not seek to maximise auction revenues, it is important to set the reserve prices at levels that reasonably reflect the potential economic value of the spectrum. This is to ensure that the auction mechanism can efficiently achieve its key objective of efficient allocation of scarce spectrum resources, where winning bidders will seek to maximise the use of the spectrum. [39] However, IDA does not follow this principle for reserve prices of potential new entrant operators, as seen in the contradiction shown between its reserve price determination for incumbent operators and for new entrants.

5.45. Singtel Mobile submits that the IDA should apply the same reserve prices and standards for all auction participants. Distorting reserve prices results in distorted investment decisions. As discussed in Professor Ordover and Dr Shampine's report, there are substantial direct and indirect costs associated with subsidising new entry into a market.

5.46. Internationally, reserve prices and other auction / license conditions are usually identical for established operators and new entrant operators in auctions where new entrants are permitted to join.

5.47. The only exceptions to this general principle are the 2013 spectrum auctions in Austria and 2011 spectrum auctions in UK, where spectrum was set-aside. However, in the case of the UK, the regulator in UK proposed even higher reserve prices for the new entrant

[39] See: Consultation Paper; page 21/22

operator. With regard to Austria, the regulator proposed reserve prices for new entrant operators joining the spectrum auction which are approximately 29% below the reserve prices of the established operators.[40] The difference of IDA's reserve prices for new entrants and established operators is however approximately 60%. This indicates that the reserve prices for new entrants defined by IDA are not appropriate and should be adjusted to the same level as for established operators following international benchmarks.

5.48. Without prejudice to the above, should the IDA maintain the subsidised preferential reserve prices, Singtel Mobile submits that the IDA should impose a restriction on the new entrant reselling or trading the subsidised spectrum or selling its mobile business, for a period of at least five (5) years from the commencement of the spectrum right. Furthermore, if the new entrant resells or trades spectrum or otherwise sells its mobile business, the IDA should require a "top-up" spectrum payment equivalent to the difference between the IDA subsidised spectrum price and the final bid price in the main auction paid by existing MNOs. This is to ensure that there is no transfer of value from the public sector to the private sector. In the 2008 AWS Spectrum auction in Canada, rules were specifically attached to the set-aside spectrum to prevent winning bidders from reselling the spectrum for a period of (5) years.

Benchmark: Reserve price differences between established operators and new entrants operators

Country	**Spectrum Bands**	**New Entrant Set-Aside Spectrum**	**Incumbent / New Entrant Reserve Price Difference?**
Austria (2013)	280 MHz of 800, 900, 1800 MHz	2x10 MHz of 800 MHz	Lower reserve price for New Entrant (2x10 MHz of 800 MHz spectrum for 64m EUR in main auction and 45.6mEUR in new entrant pre-auction – equivalent to 3.2mEUR/MHz in main auction and 2.28mEUR/MHz = 28.75% reserve price reduction for new entrant)

[40] See: https://www.rtr.at/en/tk/multibandauktion_AU/27890_2013-03-26_F1_11_Tender_Document_Multiband_Auction_2013.pdf

Country	Spectrum Bands	New Entrant Set-Aside Spectrum	Incumbent / New Entrant Reserve Price Difference?
UK (2000)	140 MHz of 2100 MHz	2x10 MHz plus 1x10 MHz of 2100 MHz	Higher reserve price for new entrant (2x14.6MHz + 1x5MHz of 2100 MHz spectrum reserved for new entrants for a reserve price of 125mGBP equivalent to 3.65mGBP/MHz Either 2x14.8MHz of 2100 MHz spectrum offered to established operators for a reserve price of 107.1mGBP equivalent to 3.62mGBP/MHz or 2x10 MHz of 2100 MHz spectrum offered to established operators for a reserve price of 89.3mGBP equivalent to 4.47mGBP/MHz = minimum of 1% reserve price increase for new entrants)
Netherlands (2012)	359.6MHz of 800, 900, 1800, 2000, 2.6 GHz	2x10 MHz of 800 MHz 2x5MHz of 900 MHz	Same reserve price
Czech Republic (2013)	310 MHz of 800, 1800, 2.6 GHz	2x10 MHz of 800 MHz 2x15.8MHz of 1800 MHz	Same reserve price

New entrants bidding rights in main spectrum auction

5.49. The Czech 2012/2013 auction illustrates the challenges for regulatory authorities with defining the following auction and license parameters appropriately for auctions with set-aside spectrum for new entrants:

- sub-1GHz spectrum caps for new entrants;
- reduced reserve price for new entrants ; and
- conditions for spectrum trading and prevention of spectrum arbitrage potentials

5.50. The Czech regulatory authority CTU planned the allocation of six lots of 2x5MHz of 800 MHz spectrum, one lot of 2x15.8MHz, one lot of 2x0.2MHz and nine lots of 2x1MHz of 1800 MHz spectrum, 14 lots of 2x5MHz and 10 lots of 1x5MHz of 2.6 GHz spectrum with its 4G multi band auction 2012. After adjustments during the public

consultation procedure, CTU published in November 2012 the final auction rules and licensing conditions consisting of:

- simultaneous multiple round auction (SMRA) design of abstract and concrete spectrum blocks for established mobile operators and new entrant operators, followed by a single round sealed bid auction for each category to determine the order in which winners of the first stage will be allowed to choose concrete spectrum blocks;
- auction rules allowing bidders holding the highest bid for one or more blocks to choose to withdraw his bids for one or several of these blocks up to five times and to use the corresponding activity points to bid for other blocks.
- set-aside spectrum for the new entrant and spectrum caps for all operators (and also for new entrants) of 2x22.5MHz for the 800 MHz spectrum, 2x23MHz for the 1800 MHz spectrum and 2x20 MHz for the 2.6 GHz paired spectrum; and
- reduced reserve prices compared to the draft license conditions by around 20%; and permission of spectrum trading after CTU's approval.

5.51. The set-aside spectrum for the new entrant caused a spectrum shortage resulting in increased competition. The resulting competition was aggravated by high spectrum caps, allowing new entrants to bid for spectrum outside of the set-aside spectrum. Reduced reserve prices and the possibility of spectrum trading without big obstacles are invitations for non-serious bidders interested in gaining arbitrage potentials. This is in addition to the negative side effect of distorting competition for both set-aside and the non-set-aside spectrums.

5.52. The option of withdrawing lots where the bidder is holding the highest bid in five cases is severely detrimental and enables bidders to apply gaming strategies where one bidder tries to inflate the price for others. The result of such a design was distorted competition and bidding that the regulator was required halt the ongoing auction in view of the total outstanding bid in the auction reaching EUR 800million and still progressing, with a bid volume was approximately three times the reserve price. Notably, this was rectified by the following:

- introducing amongst others, spectrum caps for the new entrants of 2x10 MHz for the 800 MHz spectrum;

- the number of times a bidder may withdraw his highest bid on one or more blocks has been reduced from five to two, to reduce gaming strategies where one bidder tries to inflate the price for others; and
- increasing reserve prices by 20% on top of initial values before reduction.

5.53. The Czech multi-band auction of 2012/2013 showed the importance of:

- restricting new entrant bid rights for non-set-aside spectrum to balance competition levels;
- setting standing high bidder rules preventing gaming strategies of bidders to inflate the price for others. Singtel Mobile highlights and supports the 2013 Singapore auction design of not allowing withdrawal of highest bids; and
- maintaining IDA's spectrum trading rules to ensure that trading of spectrum is only possible only upon the new entrant achieving nationwide network rollout;

5.54. Bid rights of new entrant operators for the main auction in spectrum auctions with set-aside spectrum were also restricted in other countries including Austria and the UK.

5.55. Singtel Mobile urges the IDA not to follow this example.

Benchmark: New entrant bidding rights in main spectrum auction[41]

Country	Spectrum Bands	New Entrant Set-Aside Spectrum	Bidding rights of new entrants in main spectrum auction
Austria (2013)	280 MHz of 800, 900, 1800 MHz	2x10 MHz of 800 MHz	Pre-auction of the set-aside spectrum only for new entrants conducted before the main auction. In case of no new entrants auctioning of the set-aside spectrum in main auction to equal conditions Adjustment of the eligibility points of the winning bidder of the new entrant pre-auction in the main auction by deducting four eligibility point reducing the spectrum cap for new entrants for 800 MHz spectrum to 2x10 MHz instead of 2x20 MHz applicable for established operators.
UK (2000)	140 MHz of 2100 MHz	2x10 MHz plus 1x10 MHz of 2100 MHz	Set-aside spectrum was auctioned in main auction with full bidding rights for new entrants and restricted bidding rights for established 2G operators for the set-aside spectrum. New entrants were entitled to either bid for set-aside spectrum or for other 3G spectrum licenses but not for both. This restricted new entrants bidding for the set-aside spectrum to also bid for other 3G spectrum licenses.

[41] Source: Regulator webpages.

Country	Spectrum Bands	New Entrant Set-Aside Spectrum	Bidding rights of new entrants in main spectrum auction
Netherland (2012)	359.6MHz of 800, 900, 1800, 2000, 2.6 GHz	2x10 MHz of 800 MHz 2x5MHz of 900 MHz	Set-aside spectrum is reserved for new entrants. Other auction participants can only bid on these licences if there is no new entrant in the auction. New entrants are subject to general spectrum caps for all auction participants. Additionally, new entrants are subject to a specific set-aside spectrum cap preventing new entrants to auction more than 2x10 MHz of sub-1GHz spectrum.
France (2010)	29.6MHz of 2100 MHz	2x5MHz of 2100 MHz	Stand-alone spectrum auction for 2x5MHz of 2100 MHz spectrum (fourth 3G license) only for new entrants. ARCEP conducted at a later point in time in 2010 also a second auction for allocation of 2x9.8MHz of 2100 MHz spectrum also open for winner of the new entrant auction / new forth 3G license holder (Free) which was seen after license award as established mobile operator
Czech Republic (2013)	310 MHz of 800, 1800, 2.6 GHz	2x10 MHz of 800 MHz 2x15.8MHz of 1800 MHz	Spectrum cap for the new entrant of 2x10 MHz of 800 MHz was established preventing new entrants from simultaneous bidding for set-aside spectrum and non-set-aside 800 MHz spectrum, i.e. new entrants bidding for set-aside spectrum are not permitted to also bid for other 800 MHz spectrum lots. Spectrum reserved for new entrants in the 800 MHz spectrum band becomes available for all auction participants to bid on if no new entrant starts bidding on it in the first round or when a new entrant withdrew his bid and no new entrant steps in within three rounds.

5.56. Accordingly, Singtel Mobile strongly recommends that the IDA restrict bid rights for new entrants in the main auction, applicable at least for the sub-1GHz spectrum bands. Alternatively, the IDA might consider aligning the winning bid of the new entrant auction with the highest bid of the new entrant in the main auction, to prevent new entrants from gaming strategy by inflating the spectrum prices.

5.57. Singtel Mobile reiterates that the IDA must formally ensure that the new entrant must sufficiently deploy its spectrum obtained through the auction, so as to ensure that valuable spectrum resource is not wasted nor underutilised. The IDA should impose a framework through which utilisation has to be demonstrated by the new entrant, while allowing for retrieval of the spectrum resource by the IDA or reallocation to the market should the resource be underutilised. This is important to ensure the spectrum is used to deliver services and not for purposes of reselling, in particular should the resource be obtained at a steep discount and through the facilitation of the IDA.

5.58. Singtel Mobile submits that the IDA should impose a performance bond on the new entrant, for example 5% of its total budgeted capital investment, to cover the material obligations such as network rollout, service provision and any other relevant commitments so as to ensure that the new entrant meets its commitments. In the event

that the new entrant fails to satisfy its network and service commitments, the IDA can then call on the performance bond. This would be consistent with performance bond requirements imposed on other market entrants by the IDA.

Question 8
IDA seeks views on its proposed negotiation principles to facilitate wholesale access negotiations between "thick" MVNOs and MNOs.

5.59. Singtel Mobile submits that the IDA's reasoning to regulate the introduction of "thick" MVNOs is not strong. The presumption must be that the market delivers the most appropriate outcomes. This is a basic principle of economics, also enshrined in the Telecom Competition Code.

5.60. It follows that if this is the presumption, then there must be good reason to regulate. Regard must be had to the costs and benefits of regulating. Cost of regulation are likely to include reduced incentives to invest in infrastructure which arises where MNOs are required to support a regulated outcome that does not provide a reasonable rate of return to them or where other opportunities exist where the return is greater.

5.61. Professor Ordover and Dr Shampine's report concludes that it is not clear whether there is market failure present, or whether the perceived lack of MVNOs is simply the outcome of normal market operations.[42]

5.62. The experts advise that:[43]:

> *"to the extent the IDA is considering changing the regulatory regime to induce additional entry above and beyond what the market is producing, that could raise the concerns discussed above – reduced incentives for investment, potential deadweight losses from subsequent exit or restructuring, and inefficient use of scarce resources."*[44]

5.63. Singtel Mobile strongly submits that the Singapore mobile market is highly competitive and there should be no artificial regulation in this market, including so-called easing entry conditions for MVNOs through regulation.

[42] Ordover & Shampine Report, paras 20 and 21
[43] Ordover & Shampine Report, para 20
[44] Ordover & Shampine Report, para 14

COMMENTS OF

PROF. JANUSZ A. ORDOVER & DR. ALLAN L. SHAMPINE

BEFORE THE

INFO-COMMUNICATIONS DEVELOPMENT AUTHORITY OF SINGAPORE

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CONTENTS

I. QUALIFICATIONS AND QUESTIONS TO BE ADDRESSED 3

A. JANUSZ A. ORDOVER 3

B. ALLAN L. SHAMPINE 3

C. STATEMENT OF INTEREST AND SUMMARY OF CONCLUSIONS 4

II. SUBSIDIZING NEW ENTRY CAN BE INIMICAL TO ECONOMIC EFFICIENCY AND WELFARE 6

A. EVIDENCE OF EFFICIENT OPERATION OF THE SINGAPORE TELECOMMUNICATIONS MARKET 6

B. SUMMARY OF THE IDA'S DISCUSSIONS CONCERNING ENTRY 8

C. THE MARKET HAS NOT DEEMED ENTRY TO BE EFFICIENT 10

D. SUBSIDIZED ENTRY CAN HAVE SUBSTANTIAL DIRECT AND INDIRECT COSTS 14

E. SIMILAR CONCERNS ARISE WITH RESPECT TO INDUCING MVNO ENTRY 19

I. QUALIFICATIONS AND QUESTIONS TO BE ADDRESSED

A. JANUSZ A. ORDOVER

1. My name is Janusz A. Ordover. I am Professor of Economics Emeritus and former Director of the Masters in Economics Program at New York University, where I have taught since 1973. During 1991-1992, I served as Deputy Assistant Attorney General for Economics at the Antitrust Division of the United States Department of Justice. As the chief economist for the Antitrust Division, I was responsible for formulating and implementing the economic aspects of antitrust policy and enforcement of the United States, including co-drafting the 1992 U.S. Department of Justice and Federal Trade Commission *Horizontal Merger Guidelines*. I also had ultimate responsibility for all of the economic analyses conducted by the Department of Justice in connection with its antitrust investigations and litigation, including economic analyses of collusion and other anticompetitive industry practices. I have written and consulted in the telecommunications sector and other network industries in the US, Australia, New Zealand, Hong Kong (on behalf of Hutchinson) and in the EU on behalf of private parties as well as regulators. In February 2011, I was the recipient of Global Competition Review's Economist of the Year award. In April 2015, I was awarded the 2015 Who's Who Legal Competition Economist Award, which is awarded to one economist each year and is the organization's top economist award. A copy of my curriculum vitae is attached as Exhibit 1.

B. ALLAN L. SHAMPINE

2. My name is Allan L. Shampine. I am an Executive Vice-President of Compass Lexecon, an economic consulting firm. I received a B.S. in Economics and Systems Analysis s*umma cum laude* from Southern Methodist University in 1991, an M.A. in Economics from the University of Chicago in 1993, and a Ph.D. in Economics from the University of Chicago in

1996. I have been with Compass Lexecon (previously Lexecon) since 1996. I specialize in applied microeconomic analysis and have done extensive analysis of network industries, including telecommunications and payment systems. I am the editor of the book *Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies,* and I have published a variety of articles on the economics of telecommunications and network industries and on antitrust issues. I am an editor of the American Bar Association journal *Antitrust Source*. I have previously provided economic testimony on telecommunications and other issues for the United States Federal Communications Commission, International Trade Commission, state public utility commissions, Federal Maritime Commission, United States district court, European Commission, Korean Fair Trade Commission, Chinese National Development & Reform Commission, and the Australian Competition & Consumer Commission. A copy of my curriculum vitae is provided as Exhibit 2.

C. STATEMENT OF INTEREST AND SUMMARY OF CONCLUSIONS

3. We have been asked to provide comments replying to the Consultation Paper issued by the Info-Communications Development Authority ("IDA") of Singapore on July 7, 2015 concerning the proposed framework for the allocation of spectrum for International Mobile Telecommunications ("IMT") and IMT-Advanced Services and for the enhancement of competition in the mobile market (*hereinafter*, the "Consultation Paper").

4. We are of the opinion that the proposed policy of providing substantial subsidies[1] to induce entry raises concerns that such entry will not, on net, be economically efficient, and may in fact be counterproductive, deterring future investment and imposing substantial costs on Singapore's economy. More specifically, we find that:

1. As we discuss in more detail later, both reserving spectrum solely for entrants and reducing the reservation price for that spectrum are forms of subsidization.

- The IDA has previously found the mobile market to be mature and competitive. The existing MNOs have continued to invest in their networks and roll out new services, and mobile penetration and data usage in Singapore have grown dramatically with the current number of MNOs. At the same time, the IDA has not shown that there are material competitive problems in Singapore mobile market or deficient investments that harm current and likely future subscribers.
- Entrants' unwillingness to undertake the investments required to enter without subsidization – given the physical availability of the requisite spectrum – is consistent with potential entrants' expectations that prices, post-entry, would be insufficient to earn a normal return on such investments. Regulatory inducement of entry that will not occur without a subsidy thus raises questions about the reasons why firms might be reluctant to enter or expand, the impact on future investment, the effects on incumbents that have already made sunk investments and are attempting to recover those costs, and about the sustainability of the resulting industry or, at least, some of its participants.
- Subsidized entry can have substantial direct and indirect costs, including the direct costs of lost auction revenue, and indirect costs including reduced incentives for further investment, and possibly significant deadweight losses from exit or consolidation should the induced entry prove not to be viable.

II. SUBSIDIZING NEW ENTRY CAN BE INIMICAL TO ECONOMIC EFFICIENCY AND WELFARE

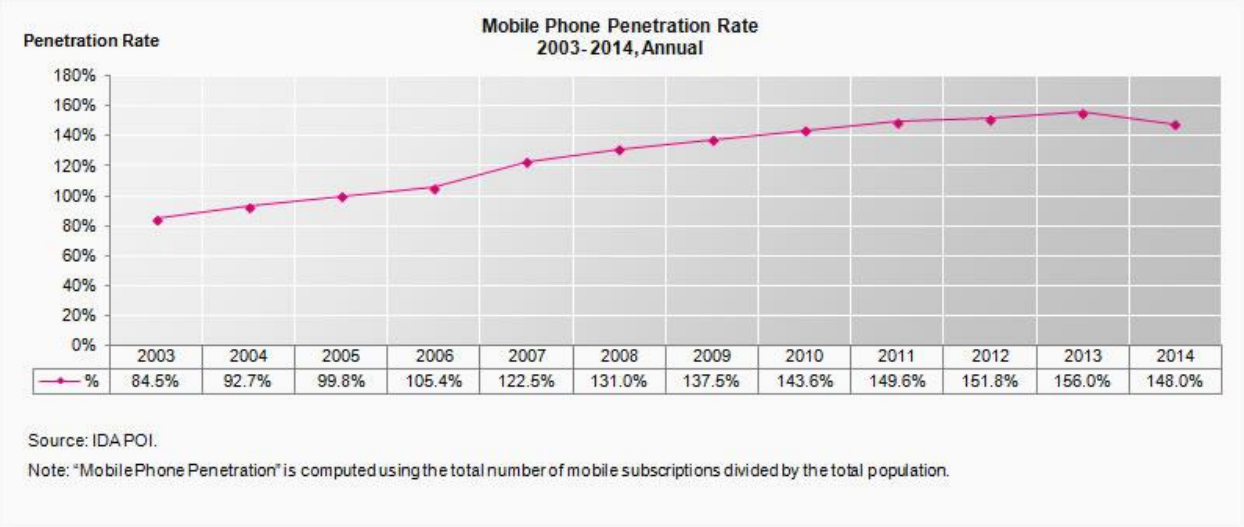
5. Before turning to the pros and cons of subsidizing additional entry, it is worthwhile to spend a moment reviewing the current state of the mobile market in Singapore.

A. EVIDENCE OF EFFICIENT OPERATION OF THE SINGAPORE TELECOMMUNICATIONS MARKET

6. Singapore is fortunate as a result of the IDA's sound regulatory oversight to have three mobile telecommunications providers with extensive coverage, including in-building and tunnel coverage.[2] The "IDA notes the incumbent MNOs' comments on the competitiveness of the mobile market. There are a variety of mobile plans and service offerings available in the market today, and IDA recognises the incumbent MNOs' network upgrades to provide improved or advanced mobile services to consumers."[3] In 2002, Mr. Leong Keng Thai, Deputy Chief Executive and Director-General (Telecoms) of the IDA stated that "Singapore has a healthy and competitive telecom market, where consumers are already enjoying innovative mobile services and attractive pricing packages. Singapore has one of the highest mobile market penetration rates in the world, with more than 3 million mobile subscribers and 76% penetration rate."[4] Since then, Singapore's mobile penetration rate has continued to increase, rising to roughly 150 percent today, meaning that, on average, every two persons have three mobile handsets.[5] By contrast, the U.S. Federal Communications Commission reports only a single U.S. city with a higher penetration rate (Grand Island, Nebraska). Of the 166 cities reported on, the other 165, including the largest cities in the United States, have substantially lower penetration rates than

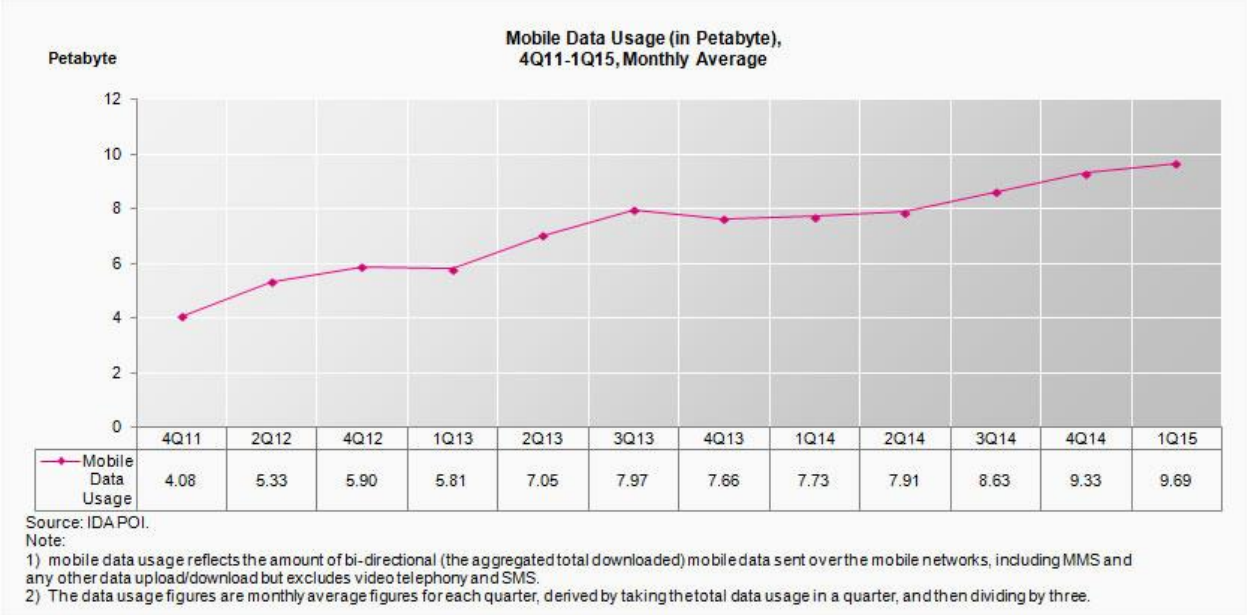
2. See, for example, Singapore market innovations table and Consultation Paper, ¶55. Nationwide 3G rollouts were completed in 2005. IDA Press Release, "Singapore's Mobile Market Gets New Impetus for Growth," January 3, 2005. 4G rollouts are proceeding well, with all three MNOs having at least 98.95 percent street level coverage as of February 2015 – 18 months ahead of the deadline. IDA Press Release, "IDA Survey Shows 4G Service Coverage Available at Most Outdoor Areas," February 13, 2015.
3. Consultation Paper, ¶55.
4. IDA Press Release, "IDA Retains Mobile Party Pays Charging Method," December 23, 2002.
5. http://www.ida.gov.sg/Tech-Scene-News/Facts-and-Figures/Telecommunications

Singapore. For example, the authors' home cities of New York and Chicago have penetration rates of only 115 and 114 percent, respectively, as of 2013, rates that Singapore surpassed years earlier.[6]



Mobile phone usage has also increased substantially. For example, total mobile data use has more than doubled over the past several years.[7] Combined with the chart above, what this chart shows is that the usage per handset has gone up, which is indicative that – despite a slight decline in penetration – the pricing and services on offer are not repressing demand growth.

6. U.S. Federal Communications Commission, 17th Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, December 18, 2014, ¶66, Table III.B.i (EA Penetration Rates). The reported penetration rates are for 2013 and are provided by Economic Area, which roughly corresponds to a city and the surrounding areas (*e.g.*, the authors live in the Chicago-Gary-Kenosha EA and the New York-North New Jersey-Long Island EA). Penetration is defined as the number of mobile wireless connections per 100 people.
7. http://www.ida.gov.sg/Tech-Scene-News/Facts-and-Figures/Telecommunications



	4Q11	2Q12	4Q12	1Q13	2Q13	3Q13	4Q13	1Q14	2Q14	3Q14	4Q14	1Q15
Mobile Data Usage	4.08	5.33	5.90	5.81	7.05	7.97	7.66	7.73	7.91	8.63	9.33	9.69

Source: IDA POI.
Note:
1) mobile data usage reflects the amount of bi-directional (the aggregated total downloaded) mobile data sent over the mobile networks, including MMS and any other data upload/download but excludes video telephony and SMS.
2) The data usage figures are monthly average figures for each quarter, derived by taking the total data usage in a quarter, and then dividing by three.

In 2005, the IDA again stated that "the mobile market in Singapore is mature and competitive."[8] As we discuss further below, and as noted by the IDA above, the MNOs have also continued to roll out new services, improve existing services, and invest in their networks.[9] Indeed, as Mr. Leong Keng Thai of the IDA notes, "[v]endors and the industry see us as a good market to launch their products because we have a base of savvy users, and a vibrant market and sufficient competition to drive innovation and technology adoption."[10] Importantly, we have seen no evidence that the regulatory infrastructure developed by the IDA acts as a break on entry and expansion by incumbent firms. Given the success to date, it is important to ask whether it would, on net, benefit Singapore to subsidize entry.

B. SUMMARY OF THE IDA'S DISCUSSIONS CONCERNING ENTRY

7. While the IDA notes the already competitive nature of the Singapore market, it also states that some firms have "expressed interest to enter the market" but have "highlighted

8. IDA Press Release, "Singapore's Mobile Market Gets New Impetus for Growth," January 3, 2005.
9. See, for example, Singapore market innovations table. Consultation Paper, ¶55.
10. Mr. Leong Keng Thai, "Transparent and balanced decision-making," May 23, 2013.

the need to facilitate their entry…"[11] The IDA has suggested "that a new MNO may potentially bring about net benefits over the long term that is driven by price decreases, as well as non-price improvements in service and pricing innovation."[12] The "IDA has also assessed that the entry of a new MNO in Singapore is potentially viable…"[13] With respect to viability, the IDA notes that some markets have supported four MNOs (*e.g.*, France and Spain), and that following recent consolidation Hong Kong has four MNOs. However, the IDA also notes that Germany, Norway and Ireland have all consolidated to three MNOs, and that the same may soon be true in the UK and Denmark.[14] There has also been substantial consolidation in the United States over the years.[15] The authors have personally been involved in a large number of such mergers.

8. The IDA has also emphasized its desire to leave matters generally "to market forces and allow competition in the mobile market to take its course."[16] We agree that entry induced by unimpeded market forces can bring many benefits to consumers. However, entry that occurs because of regulatory intervention (*e.g*. reserved spectrum and subsidies) and not subject to market forces may, in fact, be counterproductive and not deliver the expected benefits, especially if it is a result of government handicapping of the entry and investment process. Regulators should carefully consider the costs and benefits of intervention before inducing entry that has not resulted from market forces. If potential entrants state they would like to come in, but feel that incumbents would outbid them for the necessary spectrum in the auction, it is then

11. Consultation Paper, ¶54.
12. Consultation Paper, ¶57.
13. Consultation Paper, ¶59.
14. Consultation Paper, ¶59.
15. See, for example, U.S. Federal Communications Commission, 17th Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, December 18, 2014, ¶33 and Chart II.C.1, showing average concentration from 2008 to 2013, with the level of concentration increasing each year.
16. Consultation Paper, ¶62. See also Mr. Leong Keng Thai, "Transparent and balanced decision-making," May 23, 2013 ("When it comes to managing competition amongst industry players, our general approach is to leave it to the market and if the market is working, we do not intervene.").

important to ask why that would be the case. In particular, regulators should consider, as Mr. Leong Keng Thai has indicated, whether there is a market failure present, whether it can be most effectively remedied by the proposed policy, and whether the economic distortions created through intervention will be outweighed by any potential benefits. Here, it is not clear whether there is any market failure present that might justify subsidizing entry by a fourth MNO or what potential costs the IDA has considered with respect to subsidizing entry. It is likely that the costs to Singapore's economy of providing an entrant with subsidized spectrum – by means of denying that spectrum to its highest market valued use that the auction would otherwise result in – and of constructing a fourth physical network would be substantial. The presence of a fourth MNO might well result in somewhat lower prices in the short-term, but it is not clear that any quality increases would occur, and the long-term net effect on Singapore of subsidizing entry in this manner could well be negative.

C. THE MARKET HAS NOT DEEMED ENTRY TO BE EFFICIENT

9. The IDA's discussion makes clear that even though there is "strong interest" by potential entrants, those entrants are not interested in actually incurring the costs required to enter (*i.e.*, "Respondents who expressed interest to enter the market highlighted the need to facilitate their entry…").[17] In economic terms, the entrants' actions and statements are consistent with a belief that prices, post-entry, would not be sufficient to cover the costs of entry.[18] Less generously, perhaps, the request for entry subsidies (in a well-functioning capital market) is consistent with potential entrants trying to game the regulatory process for their own sake rather than to the benefit of all Singaporeans. Moreover, even when spectrum was reserved for a new

17. Consultation Paper, ¶¶54, 56.
18. Or, more precisely, that entrants do not believe that, given expected prices post-entry, they could obtain a risk-adjusted normal rate of return that would justify making the investments required to enter.

MNO in the 2013 4G spectrum auction, there were no applicants.[19] This fact has important implications for the likely effects of subsidizing entry. In particular, the fact that potential entrants are not willing to undertake the investments required to enter raises concerns about the impact on investments going forward if those entrants are subsidized to enter regardless.

10. The basic premise of economics is that the free market results in efficient allocation of resources (the IDA, for example, "will use a market-based approach to allocate the spectrum, i.e., an auction, as this is a fair, transparent and efficient method to allocate a scarce resource."[20]). We agree that an auction is a fair, transparent and efficient method for allocating spectrum, and in other forums we have advocated for the free operation of such auctions.[21] The IDA's assignment of spectrum to mobile wireless services has produced a competitive and successful industry, as discussed earlier. Once spectrum is assigned for use for mobile wireless services, neutral auction rules provide a fair, transparent and efficient method of allocating that spectrum amongst interested parties. However, the IDA now plans to substitute its own judgment as to the desirability of a new entrant for that of the market. Such intervention may perhaps make sense if there is clear evidence of market failure. However, no such clear failure is identified here. The IDA notes that there are substantial fixed costs required to enter,[22] but the presence of fixed costs is not in itself a market failure. That is, one might argue that spectrum is a vital, and regulated, resource, and so subsidizing an entrants' access to spectrum may be

19. Consultation Paper, ¶2.
20. Consultation Paper, ¶47.
21. More specifically, Dr. Shampine and a co-author have discussed how restrictions on such auctions can result in economic distortions and harm consumer welfare. Declaration of Robert H. Gertner and Allan L. Shampine, before the U.S. Federal Communications Commission, 2000 Biennial Regulatory Review, Spectrum Aggregation Limits for Commercial Mobile Radio Services, April 13, 2001. Reply Declaration of Robert H. Gertner and Allan L. Shampine, before the U.S. Federal Communications Commission, 2000 Biennial Regulatory Review, Spectrum Aggregation Limits for Commercial Mobile Radio Services, May 14, 2001.
22. Consultation Paper, ¶64. Fixed costs do not vary with the level of service actually provided. Therefore, average fixed costs decline with the size of the market served which makes it more economic to serve a larger market.

justified. However, such arguments are more plausible where spectrum is not being allocated through a market mechanism (*e.g.*, if spectrum is allocated by regulatory fiat, then, by definition, entry will not occur without regulatory intervention). But where spectrum is being allocated through an auction to its highest value use, then regulators should exercise caution in concluding that the auction results are not, in fact, appropriate.[23]

11. That is, as we discussed earlier, we agree with the IDA that access to the scarce resource of spectrum should be governed via a principled auction process. In Singapore, there are already three firms with extensive networks present. The fact that potential entrants won't enter without a subsidy simply demonstrates that they do not believe that the returns they could obtain with four MNOs would be sufficient to cover their investment costs. The IDA states that a "new MNO may not have the financial resources to participate and compete on a level playing ground in the same spectrum auction with the incumbent MNOs..."[24] However, the relevant question is why the MNO may be unable to obtain the necessary financial resources. The principle of free markets is that if entry was expected to be profitable, a firm should be able to obtain capital to undertake that entry.[25] If investors are unwilling to supply such capital, barring some market failure, it is presumably because they do not expect the investment to be worthwhile, *i.e.*, that prices after entry are not expected to justify the investments required to enter. Paying those investment costs for a potential entrant could certainly induce entry, but begs the question of how future investments will be funded – investments by either the entrant or the

23. Various kinds of market failures are possible, although they are generally better dealt with through other mechanisms than putting a thumb on the scale of spectrum auctions. For example, if exclusionary action were suspected, direct antitrust intervention might be used.
24. Consultation Paper, ¶65.
25. We are not aware of any claims that incumbents would, for example, engage in predatory pricing to counteract or deter entry. If such concerns were raised, however, they are likely better dealt with via scrutiny by a competition authority than distortion of the entry process.

incumbents – and of whether the benefits to consumers will be sufficient to justify the direct and indirect costs of such intervention.

12. The question before the IDA is thus whether it is, on balance, worthwhile for Singapore to expend the resources and incur the direct and indirect costs involved with inducing a fourth firm to enter when potential entrants have already concluded that potential returns are too low to justify the investment required to enter. That is far from clear. Beginning with the "benefit" side, the IDA discusses potential improvements in quality of service, but we understand that the existing MNOs are already subject to Quality of Service requirements. It is not clear whether the introduction of a fourth MNO would have any beneficial incremental effect on quality in light of the existing requirements.[26] In particular, in light of the fact that the new entrant apparently requires government support to make a go of it, a reasonable inference is that such an entrant is not likely to have any perceivable quality advantages over the incumbent firms. Moreover, while it is likely that there would be some price impact from introducing a fourth MNO, the magnitude of that effect is uncertain, and both the subsidization of the entrant and the price effects themselves would be associated with a variety of direct and indirect costs that we discuss in the next section. In general, the fact that in many countries consolidation in the mobile sector has occurred indicates that economies of scale and scope, and other efficiencies, are important, and while inducing entry may produce short-run reductions in prices, it would also reduce the efficiencies that ultimately produced consolidation in those other jurisdictions.[27] The fact that entrants appear to be conditioning their entry on obtaining subsidies

26. More formally, if the regulatory requirements on quality are binding (*i.e.*, market forces alone would not result in the required quality of service levels), then there is some range of additional competition that would not cause any further increases in quality. Indeed, it is possible that there is no level of additional competition that would further increase quality.

27. In merger proceedings, regulators must weigh the benefits to consumers of increased efficiencies from consolidation, including economies of scale and scope, against the costs to consumers of reducing the number of competitors. Here, the same analysis is appropriate but in reverse. However, in addition to the

raises questions as to the sustainability of the entrant and, potentially, the whole industry thereafter.

D. SUBSIDIZED ENTRY CAN HAVE SUBSTANTIAL DIRECT AND INDIRECT COSTS

13. There can be substantial direct costs associated with the subsidy process itself – a subsidy reflected in both the reservation of spectrum to be bid upon only by potential entrants, and in the substantial reduction in the reservation price for that spectrum.[28] Reserving a significant amount of spectrum that can only be bid upon by new entrants means diverting that spectrum from its highest-valued use. That is, the point of an auction is that the firm that can make the best use of the spectrum will be willing to pay the most for it. Here, the IDA's judgment would be substituted for that of the market. The market has already demonstrated that potential entrants do not value available spectrum more highly than the firms already present. There is a direct cost to Singapore of receiving less revenue in the auction from such a subsidy, and also of diverting the use of the spectrum away from the firms that would have been willing to pay the most for it. The latter cost may be particularly high to the extent that an entrant's spectrum is underutilized due to a relatively low number of subscribers that would be utilizing the subsidized spectrum holdings.

14. There can also be substantial indirect costs. It is not clear that the Singapore mobile marketplace can sustain a fourth MNO, whether its entry is subsidized or not. As noted above, the IDA has cited a variety of countries that have recently consolidated to three MNOs.

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loss in efficiencies from decreased economies of scale and scope from inducing entry, there are important concerns about the impact on future investments from regulatory uncertainty and from the costs of incorrectly inducing entry that proves not to be viable.

28. To be clear, both the reservation of spectrum that can only be bid upon by entrants and the substantial reduction in the reservation price for that spectrum are forms of subsidization. For example, if entrants were willing to bid enough to obtain the spectrum in open auction, there would be no need to reserve the spectrum. Reservation of the spectrum, particularly in light of the substantial discount in reserve price, is an acknowledgement that the purchase of the spectrum is being subsidized by the government and that the subsidy is expected to be substantial.

Furthermore, one of the countries that the IDA mentions as having four MNOs – Hong Kong – has itself experienced significant consolidation.[29] As Prof. Ordover has previously described in a report in Hong Kong, it can be difficult to cover fixed costs in small markets, particularly with a large number of firms.[30] The IDA's own cautious stance is therefore quite appropriate – entry may be "potentially viable", and there are certainly countries with four or more MNOs, but it is also the case that further entry may not be viable. As the IDA notes, "beyond facilitating the new MNO entry, IDA will leave it to market forces and allow competition in the mobile market to take its course."[31] As the IDA's discussion of consolidation in other countries makes clear, one possible outcome of such competition is exit or consolidation. It is important to consider that if entry occurs in response to a regulatory subsidy, but ultimately does not prove viable, there are real costs associated with that failure. That is, if there is excessive entry beyond what the market can sustain, the subsequent exit of one of the firms will be costly for the industry and for consumers. The losses can exceed the sunk costs of entry and include increased consumer confusion, slower market evolution, and additional fixed and variable costs associated with accomplishing any restructuring. Important skills and resources may be lost as a result and the provision of services may be disrupted causing unnecessary costs to subscribers. These additional adjustment costs are an unnecessary burden associated with encouraging excessive entry. Moreover, when entry proves not viable, the subsidized entrant can sell its holdings to the

29. As the IDA notes, there has been consolidation since then in Hong Kong, most recently from the remaining five MNOs to four. Consultation Paper, ¶59.

30. In 2004, Prof. Ordover and a co-author submitted a report to the Hong Kong Office of Telecommunications Authority discussing, in part, how firms were experiencing difficulty in covering their sunk costs due to the large number of competitors, and that promoting further entry through regulatory intervention could discourage investment. Prof. Ordover also noted that consolidation and exit have real costs that should be considered before choosing to promote entry through regulatory intervention. Prof. Janusz Ordover and Dr. William Lehr, "Mobile Service Relicensing in Hong Kong: Economic Considerations," June 18, 2004.

31. Consultation Paper, ¶62.

incumbents at "fire sale" prices. This is hardly desirable, if only because such asset-flipping engenders transaction costs and deprives the Treasury of revenues from a spectrum auction.

15. That is, should entry not prove viable, there can be substantial exit costs. While consumers can benefit from regulatory policies that promote effective competition, they can be harmed by excessive competition that reduces incumbent and entrant incentives and abilities to optimally invest in new infrastructure. Any costs incurred in subsequently consolidating mobile networks or in the exit of either incumbents or later entrants will be a deadweight loss to society and the industry. Furthermore, as we discuss next, subsidized entry can also discourage incumbents from making investments due to concerns that the playing field can be tilted one way or another to favor a particular provider, or new entrant, in the future.

16. The impact on incentives to invest is another indirect cost to subsidizing entry. As the IDA notes, purchasing spectrum and constructing a network are very expensive propositions. The three MNOs currently operating in Singapore have already undertaken those expenses for their 3G networks, and are in the process of doing so for their 4G networks, but they have also continued to make significant new investments, offering new services and upgrading their networks.[32] Indeed, the upcoming spectrum auction will, by necessity, be accompanied by network investments to make use of new spectrum licenses. Firms make such investments in anticipation of earning profits, *i.e.*, at least a risk-adjusted normal rate of return on the investments. If the risk-adjusted, expected profits on an investment are insufficient, then the firm will not make the investment or will scale back on its investment plans. In the regulatory context, sunk aspects of the investment create a

32. For example, Singtel's *Dash* mobile money service, its launch of the first commercial full-featured voice over LTE network, its continued investments in offering higher data speeds (150 Mbps as of June 2013 and 300 Mbps as of May 2014),and its investments in complementary WiFi services. *See* Singapore market innovations table. As the IDA notes, the presence of sunk costs presents a barrier for entry and new investment, but it does so in part because it increases the cost of exit. Because it is profit maximizing in the short-run to continue to sell service as long as prices are above short-run marginal costs, price competition in an industry characterized by large sunk and/or fixed costs can lead to prices falling below average total short-run costs or average total long-run costs (which includes sunk costs). Prices at either level are insufficient to sustain continued investment.

concern that after a firm has made an investment, the regulator may "expropriate" that investment by materially reducing (or even eliminating) the expected return.[33] Fears of such expropriation can raise the rate of return required to make investments and have significantly reduced infrastructure investments in many countries.[34] This concern is well known in the economics literature in general and the literature dealing with utility regulation.[35] The usual solution is a credible commitment to not expropriate firms' investments. Having a regulator act to subsidize entry that was not otherwise resulting from the normal operation of the market not only reduces returns expected on prior investments, but raises concerns that future investments may be similarly devalued.

17. While competition can be a potent motivator for investment and technological progress, artificially increasing the number of competitors can have exactly the opposite effect. Prices can be too low to be consistent with adequate incentives to invest in infrastructure and new services, with the result that consumers suffer. Even in the theoretical ideal of perfect competition, the number of competitors is indeterminate. In an industry such as telecommunication services where large fixed and sunk costs are common, excess competition can fragment the market raising industry costs for all and reducing overall efficiency and surplus. The normal operation of the market will likely result in exit and consolidation. However, as we have discussed above, there are costs associated with that process. While the benefits of competition in a static market in the form of lower prices and enhanced incentives to minimize

33. Mark Armstrong and David Sappington, "Recent Developments in the Theory of Regulation," in *Handbook of Industrial Organization*, M. Armstrong and R. Porter (eds), 2007, at 1631-32.
34. See, for example, Paul Levine, John Stern and Francesc Trillas, "Utility price regulation and time inconsistency: comparisons with monetary policy" *Oxford Economic Papers* 2005, 57, at 449; and B. Levy and P. Spiller (eds) (1996) *Regulations, Institutions and Commitment*, Cambridge University Press, Cambridge, at 2.
35. See, for example, David Newbery, *Privatization, Restructuring, and Regulation of Network Utilities*, 1999, MIT Press, at 29.

costs are easy to demonstrate, the relationship between market structure and dynamic efficiency is much more complex and the potential harm from excessive competition is more severe.[36]

18. The IDA has stated that it has "found no clear or direct correlation between new entry and a fall in mobile network investments by incumbent MNOs in other jurisdictions. While some countries have experienced a fall in mobile network investments following the entry of a new entrant, IDA has observed that such fluctuations in investment levels could have been influenced by macro-economic conditions, rather than a direct result of the new entrant. IDA also notes that there are examples of incumbent MNOs increasing their investment levels following the entry of a new MNO."[37] We note, first, that while it may be the case that other factors influence investment, so that an observed reduction in investment might be attributable to factors other than a change in the number of MNOs, the same is true with respect to instances of increased investment. We also note that there is a substantive difference between market entry and subsidized entry. As we have discussed above, the fact that entrants indicate they will not enter without subsidization is evidence that the prices expected post-entry would be insufficient to justify the investment costs of entry. While subsidizing entry may produce short-run benefits to consumers from lower prices, it is problematic for the firms that have already sunk the costs to enter and that are in the process of earning returns to cover those costs. Holding all else equal, there is no ambiguity as to the fact that unanticipated entry resulting from regulatory action will reduce the expected returns to current investment and raise uncertainty as to the returns on future investments.

36. For more on this issue, *see, e.g.*, William J. Baumol, *The Free-Market Innovation Machine*, 2014, Princeton University Press.
37. Consultation Paper, ¶58.

19. The economics of competing as a facilities-based provider necessitate incurring substantial fixed and sunk costs that give rise to substantial scale and scope economies[38] and which limit the number of economically viable carriers that can be sustained in a small market. Overall, while consumers may benefit in the short-run from bargain basement pricing resulting from subsidized entry, prices that fail to provide carriers with an adequate return on invested capital are not sustainable and deter infrastructure investment.

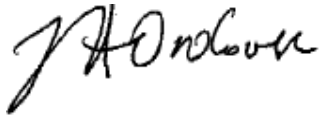
E. SIMILAR CONCERNS ARISE WITH RESPECT TO INDUCING MVNO ENTRY

20. Similar concerns arise with imposing regulatory changes to encourage further MVNO entry (although MVNO entry does not generally entail large fixed costs). In this case, we understand that some MVNOs have already entered after having successfully negotiated arrangements with one or more MNOs. The question is again whether there is some market failure that is preventing further entry or resulting in entry seen as insufficient by some metric. It is not clear that there is any such failure present. Again, to the extent the IDA is considering changing the regulatory regime to induce additional entry above and beyond what the market is producing, that could raise the concerns discussed above – reduced incentives for investment, potential deadweight losses from subsequent exit or restructuring, and inefficient use of scarce resources.

21. In sum, there are already MVNOs present that have successfully negotiated access agreements with the MNOs. If by some metric there are perceived to be fewer MVNOs than might be desired, the relevant question is why that is the case. Is there a market failure, or is this simply the outcome of normal market operations? As we are not aware of any claims that the

38. Economies of scale arise when average costs decline with the size of the market served. Fixed and sunk costs can give rise to scale economies. When these are important, firms must be able to expect to attain a minimum level of sales in order to be viable, which limits the number of firms that which can be economically viable in a market of given size. Economies of scope are analogous, but arise when resources can be shared over multiple product lines.

access arrangements being offered are anticompetitive, in our view caution should be exercised about regulatory intervention in the absence of a clear market failure.



Janusz A. Ordover

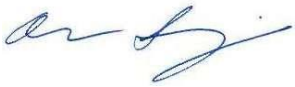


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EXHIBIT 1

March 2015

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EDUCATION

1968-1973	Columbia University, New York, New York Graduate Department of Economics and European Institute of the School of International Affairs Doctoral Dissertation: Three Essays on Economic Theory (May 1973). Ph.D. 1973.
1967-1968	McGill University, Montreal, Canada Departments of Economics and Political Science
1963-1966	Warsaw University, Warsaw, Poland Department of Political Economy. B.A. (equiv.), 1966.

HONORS

2015	Who's Who Legal: Competition Policy Award
2011	"The Economist of the Year 2010" voted by the Global Competition Review
1973	Columbia University: Highest distinction for the doctoral dissertation
1971-1972	Columbia University: Honorary President's Fellow
1969-1971	Columbia University: President's Fellow
1967-1968	McGill University: Honors Student
1964, 1965	Warsaw University: Award for Academic Achievement, Department of Political Economy
	Who's Who in the World Who's Who in America Who's Who in the East

PROFESSIONAL EXPERIENCE

June 1982 - present	Professor of Economics Department of Economics, New York University, New York, New York

Sept. 1996 - Aug. 2001	Director of Masters in Economics Program Department of Economics, New York University, New York, New York
Summer 1996-2000	Lecturer International Program on Privatization and Reform Institute for International Development, Harvard University, Cambridge, Massachusetts
Aug. 1991 - Oct. 1992	Deputy Assistant Attorney General for Economics Antitrust Division United States Department of Justice, Washington, D.C.
Sept. 1989 - July 1990	Visiting Professor of Economics School of Management, Yale University, New Haven, Connecticut
	Lecturer in Law Yale Law School
Mar. 1984 - June 1988	Visiting Professor of Economics Universita Commerciale "Luigi Bocconi," Milan, Italy
June 1982 - Feb. 1985	Director of Graduate Studies Department of Economics, New York University
Sept. 1982 - June 1986	Adjunct Professor of Law (part-time) Columbia University Law School, New York, New York
Feb. 1982 - June 1982	Acting Director of Graduate Studies Department of Economics, New York University
June 1978 - June 1982	Associate Professor of Economics Department of Economics, New York University
Sept. 1979 - May 1990	Lecturer in Economics and Antitrust New York University Law School
Sept. 1977 - June 1978	Member, Technical Staff Bell Laboratories, Holmdel, New Jersey
	Associate Professor of Economics Columbia University
	Visiting Research Scholar Center for Law and Economics, University of Miami, Miami, Florida
Sept. 1973 - Aug. 1977	Assistant Professor of Economics New York University
Summer 1976	Fellow, Legal Institute for Economists, Center for Law and Economics, University of Miami
Summer 1976	Visiting Researcher Bell Laboratories, Holmdel, New Jersey

OTHER PROFESSIONAL ACTIVITIES

2011	Organizer Session on the 2010 Agencies Horizontal Merger Guidelines, 2011 Spring Meetings, Antitrust Section, American Bar Association, Washington DC
2010 – present	Member ABA Section of Antitrust Law, Economics Task Force
2006 - present	Special Consultant Compass Lexecon (formerly Compass)/FTI Company, Washington, D.C.
2003 - 2006	Director Competition Policy Associates, Inc. ("Compass"), Washington, D.C.
1997 – 1999	Consultant Inter-American Development Bank, Washington, D.C.
1997 – 2009	Board of Editors *Antitrust Report*
1995 – 2001	Consultant The World Bank, Washington, D.C.
1998 – 2004	Senior Consultant Applied Economic Solutions, Inc., San Francisco, California
1995 - 2000	Senior Affiliate Cornerstone Research, Inc., Palo Alto, California
Various	Testimony at Hearings of the Federal Trade Commission
1994 - 1996	Senior Affiliate Law and Economics Consulting Group, Emeryville, California
1994 - 2000	Senior Affiliate Consultants in Industry Economics, LLC, Princeton, New Jersey
1993 - 1994	Director Consultants in Industry Economics, Inc., Princeton, New Jersey
1992 - 1993	Vice-Chair (*pro tempore*) Economics Committee, American Bar Association, Chicago, Illinois
1990 - 1991 1992 - 1995	Senior Consultant Organization for Economic Cooperation and Development, Paris, France
1991	Member *Ad hoc* Working Group on Bulgaria's Draft Antitrust Law The Central and East European Law Initiative American Bar Association
1990 - 1991	Advisor Polish Ministry of Finance and Anti-Monopoly Office Warsaw, Poland

1990 - 1991	Member Special Committee on Antitrust Section of Antitrust Law, American Bar Association
1990 - 1991	Director and Senior Advisor Putnam, Hayes & Bartlett, Inc., Washington, D.C.
1990 - 1996	Member Predatory Pricing Monograph Task Force Section of Antitrust Law, American Bar Association
1989	Hearings on Competitive Issues in the Cable TV Industry Subcommittee on Monopolies and Business Rights of the Senate Judiciary Committee Washington, D.C.
1989	Member EEC Merger Control Task Force, American Bar Association
1988 - present	Associate Member American Bar Association
1987 - 1989	Adjunct Member Antitrust and Trade Regulation Committee, The Association of the Bar of the City of New York
1984	Speaker, "Industrial and Intellectual Property: The Antitrust Interface" National Institutes, American Bar Association, Philadelphia, Pennsylvania
1983 - 1990	Director Consultants in Industry Economics, Inc.
1982	Member Organizing Committee Tenth Annual Telecommunications Policy Research Conference, Annapolis, Maryland
1981	Member Section 7 Clayton Act Committee, Project on Revising Merger Guidelines American Bar Association
1980	Organizer Invited Session on Law and Economics American Economic Association Meetings, Denver, Colorado
1978 - 1979	Member Department of Commerce Technical Advisory Board Scientific and Technical Information Economics and Pricing Subgroup
1978 – present	Referee for numerous scholarly journals, publishers, and the National Science Foundation

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

American Economic Association
American Bar Association

PUBLICATIONS

A. Journal Articles

"Exclusionary Discounts," with Greg Shaffer, *International J. of Industrial Org.*, vol. 31, 569-86, September 2013

"Coordinated Effects in Merger Analysis: An Introduction," *Columbia Bus. Law Review*, No. 2, 2007, 411-36.

"Wholesale access in multi-firm markets: When is it profitable to supply a competitor?" with Greg Shaffer, *International Journal of Industrial Organization*, vol. 25 (5), October 2007, 1026-45.

"Merchant Benefits and Public Policy towards Interchange: An Economic Assessment," with M. Guerin-Calvert, *Review of Network Economics: Special Issue*, vol. 4 (4), December 2005, 381-414.

"All-Units Discounts in Retail Contracts," with S. Kolay and G. Shaffer, *J. of Economics and Management Strategy*, vol. 13 (3), September 2004, 429-59.

"Archimedean Leveraging and the GE/Honeywell Transaction," with R. J. Reynolds, *Antitrust Law Journal*, vol. 70, no. 1, 2002, 171-98.

"Entrepreneurship, Access Policy and Economic Development: Lessons from Industrial Organizations," with M. A. Dutz and R. D. Willig, *European Economic Review*, vol. 4, no. 4-6, May 2000.

"Parity Pricing and its Critics: Necessary Condition for Efficiency in Provision of Bottleneck Services to Competitors," with W. J. Baumol and R .D. Willig, *Yale Journal on Regulation*, vol. 14, Winter 1997, 146-63.

"Competition and Trade Law and the Case for a Modest Linkage," with E. Fox, *World Competition, Law and Economics Review*, vol. 19, December 1995, 5-34.

"On the Perils of Vertical Control by a Partial Owner of Downstream Enterprise," with W.J. Baumol, *Revue D'économie industrielle*, No. 69, 3^{e} trimestre 1994, 7-20.

"Competition Policy for Natural Monopolies in Developing Market Economy," with R.W. Pittman and P. Clyde, *Economics of Transition*, vol. 2, no. 3, September 1994, 317-343. Reprinted in B. Clay (ed.), *De-monopolization and Competition Policy in Post-Communist Economies*, Westview Press 1996, 159-193.

"The 1992 Agency Horizontal Merger Guidelines and the Department of Justice's Approach to Bank Merger Analysis," with M. Guerin-Calvert, *Antitrust Bulletin*, vol. 37, no. 3, 667-688. Reprinted in *Proceedings of the 1992 Conference on Bank Structure and Competition: Credit Markets in Transition*, Federal Reserve Bank of Chicago, 1992, 541-560.

"Entry Analysis Under the 1992 Horizontal Merger Guidelines," with Jonathan B. Baker, *Antitrust Law Journal*, vol. 61, no. 1, Summer 1992, 139-146.

"Economics and the 1992 Merger Guidelines: A Brief Survey," with Robert D. Willig, *Review of Industrial Organization*, vol. 8, 139-150, 1993. Reprinted in E. Fox and J. Halverson (eds.), *Collaborations Among Competitors: Antitrust Policy and Economics*, American Bar Association, 1992, 639-652.

"Equilibrium Vertical Foreclosure: A Reply," with G. Saloner and S.C. Salop, *American Economic Review*, vol. 82, no. 3, 1992, 698-703.

"A Patent System for Both Diffusion and Exclusion," *Journal of Economic Perspectives*, vol. 5, Winter 1991, 43-60.

"R&D Cooperation and Competition," with M. Katz, *Brookings Papers on Economic Activity: Microeconomics*, 1990, 137-203.

"Equilibrium Vertical Foreclosure," with G. Saloner and S. Salop, *American Economic Review*, vol. 80, March 1990, 127-142.

"Antitrust Policy for High-Technology Industries," with W.J. Baumol, *Oxford Review of Economic Policy*, vol. 4, Winter 1988, 13-34. Reprinted in E. Fox and J. Halverson (eds.), *Collaborations Among Competitors: Antitrust Policy and Economics*, American Bar Association, 1991, 949-984.

"Conflicts of Jurisdiction: Antitrust and Industrial Policy," *Law and Contemporary Problems*, vol. 50, Summer 1987, 165-178.

"Market Structure and Optimal Management Organization," with C. Bull, *Rand Journal of Economics*, vol. 18, no. 4, Winter 1987, 480-491.

"A Sequential Concession Game with Asymmetric Information," with A. Rubinstein, *Quarterly Journal of Economics*, vol. 101, no.4, November 1986, 879-888.

"The G.M.-Toyota Joint Venture: An Economic Assessment," with C. Shapiro, *Wayne Law Journal*, vol. 31, no. 4, 1985, 1167-1194.

"Economic Foundations and Considerations in Protecting Industrial and Intellectual Property: An Introduction," *Antitrust Law Journal*, vol. 53, no. 3, 1985. 503-518, Comments, 523-532.

"Antitrust for High-Technology Industries: Assessing Research Joint Ventures and Mergers," with R.D. Willig, *Journal of Law and Economics*, vol. 28, May 1985, 311-334.

"Use of Antitrust to Subvert Competition," with W.J. Baumol, *Journal of Law and Economics*, vol. 28, May 1985, 247-266. Reprinted in *Journal of Reprints for Antitrust Law and Economics*, vol. 16, no. 2.

"Advances in Supervision Technology and Economic Welfare: A General Equilibrium Analysis," with C. Shapiro, *Journal of Public Economics*, vol. 25/3, 1985, 371-390.

"Predatory Systems Rivalry: A Reply," with A. O. Sykes and R. D. Willig, 83 *Columbia Law Review*, June 1983, 1150-1166. Reprinted in *Corporate Counsel*, Matthew Bender & Company, 1984, 433-450.

"The 1982 Department of Justice Merger Guidelines: An Economic Assessment," with R. D. Willig, 71 *California Law Review*, March 1983,535-574. Reprinted in *Antitrust Policy in Transition: The Convergence of Law and Economics*, E. Fox and J. Halverson (eds.), American Bar Association Press, 1984, 267-304.

"Unfair International Trade Practices," with A. O. Sykes and R. D. Willig, 15 *Journal of International Law and Politics*, Winter 1983, 323-338.

"On Non-linear Pricing of Inputs," with J. Panzar, *International Economic Review*, October 1982, 659-675.

"Herfindahl Concentration, Rivalry and Mergers," with A. O. Sykes and R. D. Willig, *Harvard Law Review*, vol. 95, June 1982, 1857-1875.

"A Reply to 'Journals as Shared Goods: Comment,'" with R. D. Willig, *American Economic Review*, June 1982, 603-607.

"Proposed Revisions to the Justice Department's Merger Guidelines," with S. Edwards, *et al., Columbia Law Review*, vol. 81, December 1981, 1543-1591.

"An Economic Definition of Predation: Pricing and Product Innovation," with R.D. Willig, *Yale Law Journal*, vol. 91, November 1981, 8-53.

"On the Consequences of Costly Litigation in the Model of Single Activity Accidents: Some New Results," *Journal of Legal Studies*, June 1981, 269-291.

"On the Political Sustainability of Taxes," with A. Schotter, *American Economic Review Papers and Proceedings*, May 1981, 278-282.

"Information and the Law: Evaluating Legal Restrictions on Competitive Contracts," with A. Weiss, *American Economic Review Papers and Proceedings*, May 1981, 399-404.

"Redistributing Incomes: *Ex Ante* or *Ex Post*," *Economic Inquiry*, April 1981, 333-349.

"On the Nonexistence of *Pareto Superior* Outlay Schedules," with J. Panzar, *The Bell Journal of Economics*, Spring 1980, 351-354.

"The Role of Information in the Design of Public Policy Towards Externalities," with R. D. Willig, *Journal of Public Economics*, December 1979, 271-299.

"On the Concept of Optimal Taxation in the Overlapping-Generations Model of Efficient Growth," with E.S. Phelps, *Journal of Public Economics*, August 1979, 1-27.

"Products Liability in Markets With Heterogeneous Consumers," *Journal of Legal Studies*, June 1979, 505-525.

"Costly Litigation and the Tort Law: Single Activity Accidents," *Journal of Legal Studies*, June 1978, 243-261.

"On the Optimal Provision of Journals Qua Excludable Public Goods," with R. D. Willig, *American Economic Review*, June 1978, 324-338.

"Distortionary Wage Differentials in a Two-Sector Growth Model: Some Theorems on Factor Earnings," *International Economic Review*, June 1978, 321-333.

"On the Optimality of Public-Goods Pricing with Exclusion Devices," with W.J. Baumol, *Kyklos*, Fasc. 1, 1977, 5-21.

"Public Good Properties in Reality: The Case of Scientific Journals," with W.J. Baumol, *Proceedings of the ASIS Meetings*, San Francisco, October 1976.

"Merger Illusions and Externalities: A Note," with A. Schotter, *Eastern Economic Review*, November 1976, 19-21.

"Distributive Justice and Optimal Taxation of Wages and Interest in a Growing Economy," *Journal of Public Economics*, January 1976, 139-160.

"Linear Taxation of Wealth and Wages for Intragenerational Lifetime Justice: Some Steady-State Cases," with E.S. Phelps, *American Economic Review*, September 1975, 660-673.

B. Books and Monographs

Proceedings of the Tenth Annual Telecommunications Policy Research Conference, editor with O. Gandy and P. Espinosa, ABLEX Publishers, 1983.

Obstacles to Trade and Competition, with L. Goldberg, OECD, Paris, 1993.

Predatory Pricing, with William Green, *et al.*, American Bar Association, Section of Antitrust Law, Monograph 22, 1996.

C. Book Chapters

"Coordinated Effects: Evolution of Practice and Theory," with J. Jayaratne, chap. 21, in R.D. Blair and D.D. Sokol (eds.), *The Oxford Handbook of International Antitrust Economics*, Oxford U.P., 2015, 509-28.

"Coordinated Effects," chap. 27, in *Issues in Competition Law and Policy*, vol. 2, American Bar Association, 2008, 1359-1384.

"Practical Rules for Pricing Access in Telecommunications," with R. D. Willig, Chap. 6, in *Second-Generations Reforms in Infrastructure Services,* F. Besanes and R. D. Willig (eds.), Inter-American Development Bank, Washington, D.C., April 2002, 149-76.

"Sustainable Privatization of Latin American Infrastructure: The Role of Law and Regulatory Institutions," with Evamaria Uribe, Chap. 1 in F. Basanes, E. Uribe, R. D. Willig (eds.), *Can Privatization Deliver? Infrastructure for Latin America,* The Johns Hopkins U. P. for Inter-American Development Bank, 1999, 9-32.

"Access and Bundling in High-Technology Markets," with R. D. Willig, Chap. 6, in J. A. Eisenach and T. M. Leonard, (eds.), *Competition, Innovation, and the Microsoft Monopoly: The Role of Antitrust in the Digital Marketplace*, Kluver Academic Press, 1999, 103-29.

"The Harmonization of Competition and Trade Law," with E. Fox, Chap. 15 in L. Waverman, *et al*. (eds.), *Competition Policy in the Global Economy*, Routledge, 1997, 407-439.

"Transition to a Market Economy: Some Industrial Organization Issues," with M. Iwanek, Chap. 7 in H. Kierzkowski, *et al.* (eds.), *Stabilization and Structural Adjustment in Poland*, Routledge, 1993, 133-170.

"Competition Policies for Natural Monopolies in a Developing Market Economy," with Russell Pittman, *Butterworth's Trade and Finance in Central and Eastern Europe*, Butterworth Law Publishers Ltd., 1993, 78-88, Reprinted in *Journal for Shareholders* (published by the Russian Union of Shareholder), Moscow, January 1993, 33-36; *Versenyfelugyeleti Ertesito* (Bulletin of Competition Supervision), Budapest, vol. 3, no. 1-2, January 1993, 30-41; *Narodni Hospodarstvi* (National Economy), Prague; *ICE: Revista de Economia*, No. 736 (December 1994) (in Spanish), 69-90.

"Antitrust: Source of Dynamic and Static Inefficiencies?" with W.J. Baumol, in T. Jorde and D. Teece (eds.), *Antitrust, Innovation, and Competitiveness*, Oxford University Press, 1992, 82-97. Reprinted in "The Journal of Reprints for Antitrust Law and Economics," vol. 26, no. 1, 1996.

"Economic Foundations of Competition Policy: A Review of Recent Contributions," in W. Comanor, et al., *Competition Policy in Europe and North America: Economic Issues and Institutions, Fundamentals of Pure and Applied Economics* (Vol. 43), Harwood Academic Publishers, 1990, 7-42.

"The Department of Justice 1988 Guidelines for International Operations: An Economic Assessment," with A.O. Sykes, in B. Hawk (ed.), *European/American Antitrust and Trade Laws*, Matthew Bender, 1989, 4.1-4.18.

"Predation, Monopolization, and Antitrust," with G. Saloner, in R. Schmalensee and R.D. Willig (eds.), *Handbook of Industrial Organization*, vol. 1, North Holland, 1989, 538-596.

"Supervision Technology, Firm Structure, and Employees' Welfare," in *Prices, Competition and Equilibrium*, M. Peston and R.E. Quandt (eds.), Philip Allan Publishers, Ltd., 1986, 142-163.

"Perspectives on Mergers and World Competition," with R.D. Willig, in *Antitrust and Regulation*, R. Grieson (ed.), Lexington Books, 1986, 201-218.

"Transnational Antitrust and Economics," in *Antitrust and Trade Policies in International Trade*, B. Hawk (ed.), Matthew Bender, 1985, 233-248.

"Pricing of Interexchange Access: Some Thoughts on the Third Report and Order in FCC Docket No. 78-72," in *Proceedings of the Eleventh Annual Telecommunications Policy Research Conference*, Vincent Mosco (ed.), ABLEX Publishers, 1984, 145-161.

"Non-Price Anticompetitive Behavior by Dominant Firms Toward the Producers of Complementary Products," with A.O. Sykes and R.D. Willig, in *Antitrust and Regulation: Essays in Memory of John McGowan*, F. Fisher (ed.), MIT Press, 1985, 315-330.

"Local Telephone Pricing in a Competitive Environment," with R.D. Willig, in *Regulating New Telecommunication Networks*, E. Noam (ed.), Harcourt Brace Jovanovich, 1983, 267-289.

"An Economic Definition of Predatory Product Innovation," with R.D. Willig, in *Strategy, Predation and Antitrust Analysis*, S. Salop (ed.), Federal Trade Commission, 1981, 301-396.

"Marginal Cost," in *Encyclopedia of Economics*, D. Greenwald (ed.), McGraw-Hill, 2nd ed. 1994, 627-630.

"Understanding Economic Justice: Some Recent Development in Pure and Applied Welfare Economics," in *Economic Perspectives*, M. Ballabon (ed.) Harwood Academic Publishers, vol. 1, 1979, 51-72.

"Problems of Political Equilibrium in the Soviet Proposals for a European Security Conference," in *Columbia Essays in International Affairs*, Andrew W. Cordier (ed.) Columbia University Press, New York, 1971, 1951-197

D. Other Publications

"Intellectual Ventures v. Capital One: Can Antitrust Law and Economics Get Us Past the Trolls?" with Michelle Miller, *Competition Policy International*, vol. 1, No. 2, Winter 2015, available at https://www.competitionpolicyinternational.com/intellectual-ventures-v-capital-one-can-antitrust-law-and-economics-get-us-past-the-trolls/

"Implementing the FRAND Commitment," with Allan Shampine, *Antitrust Source*, October 2014, available at http://www.americanbar.org/content/dam/aba/publishing/antitrust_source/oct14_full_source.authcheckdam.pdf

"Economics and Competition Policy: A Two-sided Market?" with Jith Jayaratne, *Antitrust Magazine*, vol. 27, No. 1, Fall 2012, pp. 78-80.

"Editorial: Thinking about coordinated effects," with Jith Jayaratne, *Concurrences 3-2012*, September 2012.

"The 2010 Horizontal Merger Guidelines: A Static Compass in a Dynamic World," with Jay Ezrielev, *Antitrust Source*, October 2010, available at www.antitrustsource.com.

"The Economics of Price Discrimination," with Doug Fontaine and Greg Shaffer, in *The Economics of the Internet, The Vodafone Policy Paper Series*, No. 11, April 11, 2010, 27-51.

"How Loyalty Discounts Can Perversely Discourage Discounting: Comment," with Assaf Eilat, *et al.*, *The CPI Antitrust Journal*, April 2010 (1).

"Economic Analysis in Antitrust Class Certification: *Hydrogen Peroxide*," with Paul Godek, *Antitrust Magazine*, vol. 24, No. 1, Fall 2009, pp. 62-65.

"Comments on Evans & Schmalensee's 'The Industrial Organization of Markets with Two-Sided Platforms.'" *Competition Policy International*, vol. 3(1), Spring 2007, 181-90.

"Safer Than A Known Way? A Critique of the FTC's Report on Competition and Patent Law and Policy," with I. Simmons and D. A. Applebaum, *Antitrust Magazine,* Spring 2004, 39-43.

"Predatory Pricing," in Peter Newman (ed.), *The New Palgrave Dictionary of Economics and the Law*, Grove Dictionaries, New York, 1999. Revised in *The New Palgrave Dictionary of Economics, 2nd edition*, S. Durlauf and L. Blume (editors) (forthcoming 2007).

Book review of L. Phlips, *Competition Policy: A Game Theoretic Perspective*, reviewed in *Journal of Economic Literature*, vol. 35, No.3, September 1997, 1408-9.

"The Role of Efficiencies in Merger Assessment: The 1997 Guidelines," *Antitrust Report*, September 1997, 10-17.

"Bingaman's Antitrust Era," *Regulation*, vol. 20, No. 2, Spring 1997, 21-26.

"Competition Policy for High-Technology Industries," *International Business Lawyer*, vol. 24, No. 10, November 1996, 479-82.

"Internationalizing Competition Law to Limit Parochial State and Private Action: Moving Towards the Vision of World Welfare," with E.M. Fox, *International Business Lawyer*, vol. 24, No. 10, November 1996, 458-62.

"Economists' View: The Department of Justice Draft for the Licensing and Acquisition of Intellectual Property," *Antitrust*, vol. 9, No. 2, Spring 1995, 29-36.

"Competition Policy During Transformation to a Centrally Planned Economy: A Comment," with R.W. Pittman, in B. Hawk (ed.), *1992 Fordham Corporate Law Institute*, 533-38.

"Poland: The First 1,000 Days and Beyond," *Economic Times*, vol. 3, no. 9, October 1992, 6-7.

"Interview: Janusz A. Ordover: A Merger of Standards? The 1992 Merger Guidelines," *Antitrust*, vol. 6, no. 3, Summer 1992, 12-16.

"Interview: U.S. Justice Department's New Chief Economist: Janusz A. Ordover," *International Merger Law*, no. 14, October 1991.

"Poland: Economy in Transition," *Business Economics*, vol. 26, no. 1, January 1991, 25-30.

"Economic Analysis of Section 337: Protectionism versus Protection of Intellectual Property," with R.D. Willig, in *Technology, Trade and World Competition*, JEIDA Conference Proceedings, Washington, D.C., 1990, 199-232.

"Eastern Europe Needs Antitrust Now," with E. Fox, *New York Law Journal*, November 23, 1990, 1-4.

"Understanding Econometric Methods of Market Definition," with D. Wall, *Antitrust*, vol. 3, no. 3, Summer 1989, 20-25.

"Proving Entry Barriers: A Practical Guide to Economics of Entry," with D. Wall, *Antitrust*, vol. 2, no. 2, Winter 1988, 12-17.

"Proving Predation After Monfort and Matsushita: What the New 'New Learning' has to Offer," with D. Wall, *Antitrust*, vol. 1, no. 3, Summer 1987, 5-11.

"The Costs of the Tort System," with A. Schotter, Economic Policy Paper No. PP-42, New York University, March 1986. Reprinted in *Congressional Record*, U.S. Government Printing Office, Washington, D.C., 1987.

"An Economic Definition of Predation: Pricing and Product Innovation," with R.D. Willig, Report for the Federal Trade Commission, October 1982, 131 pp.

"Market Power and Market Definition," with R.D. Willig, Memorandum for ABA Section 7 Clayton Act Committee, Project on Revising the Merger Guidelines, May 1981.

"Herfindahl Concentration Index," with R.D. Willig, Memorandum for ABA Section 7 Clayton Act Committee, Project on Revising the Merger Guidelines, March 1981.

"Public Interest Pricing of Scientific and Technical Information," Report for the Department of Commerce Technical Advisory Board, September 1979.

"Economics of Property Rights as Applied to Computer Software and Databases," with Y.M. Braunstein, D.M. Fischer, W.J. Baumol, prepared for the National Commission on New Technological Uses of Copyrighted Works, June 1977, 140 pp. Reprinted in part in *Technology and Copyright*, R.H. Dreyfuss (ed.), Lemond Publications, 1978.

Book review of O. Morgenstern and G.L. Thompson, *Economic Theory of Expanding and Contracting Economies*, reviewed in *Southern Economic Journal*, September 1978.

"Manual of Pricing and Cost Determination for Organizations Engaged in Dissemination of Knowledge," with W.J. Baumol, Y.M. Braunstein, D.M. Fischer, prepared for the Division of Science Information, NSF April 1977, 150 pp.

UNPUBLISHED PAPERS

"Activating *Actavis* with a More Complete Model," with Michael G. Baumann, John P. Bigelow, Barry C. Harris, Kevin M. Murphy, Robert D. Willig, and Matthew B. Wright, Revised version forthcoming in *Antitrust*, January 28, 2014

"Exclusionary Discounts," with Greg Shaffer, August 2006.

"Regulation of Credit Card Interchange Fees and Incentives for Network Investments," with Y. Wang, Competition Policy Associates WP, Washington D.C. September 2005.

"Economics, Antitrust and the Motion Picture Industry," C.V. Starr Center Policy Paper, July 1983.

"On Bargaining, Settling, and Litigating: A Problem in Multiperiod Games With Imperfect Information," with A. Rubinstein, C.V. Starr Working Paper, December 1982.

"Supervision and Social Welfare: An Expository Example," C.V. Starr Center Working Paper, January 1982.

"Should We Take Rights Seriously: Economic Analysis of the Family Education Rights Act," with M. Manove, November 1977.

"An Echo or a Choice: Product Variety Under Monopolistic Competition," with A. Weiss; presented at the Bell Laboratories Conference on Market Structures, February 1977.

GRANTS RECEIVED

Regulation and Policy Analysis Program, National Science Foundation, Collaborative Research on Antitrust Policy, Principal Investigator, July 15, 1985 - December 31, 1986.

Regulation of Economic Activity Program, National Science Foundation, Microeconomic Analysis of Antitrust Policy, Principal Investigator, April 1, 1983 - March 31, 1984.

Economics Division of the National Science Foundation, "Political Economy of Taxation," Principal Investigator, Summer 1982.

Sloan Workshop in Applied Microeconomics (coordinator), with W.J. Baumol (Principal Coordinator), September 1977 - August 1982.

Economics Division of the National Science Foundation, "Collaborative Research on the Theory of Optimal Taxation and Tax Reform," July 1979 to September 1980, with E.S. Phelps.

Division of Science Information of the National Science Foundation for Research on "Scale Economies and Public Goods Properties of Information," W.J. Baumol, Y.M. Braunstein, M.I. Nadiri, Fall 1974 to Fall 1977.

National Science Foundation Institutional Grant to New York University for Research on Taxation and Distribution of Income, Summer 1974.

EXHIBIT 2

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EDUCATION

Ph.D. UNIVERSITY OF CHICAGO: Economics, 1996
(Full scholarship from the University)
(Thesis: *An Evaluation of Technology Diffusion Models and Their Implications*)
(Field specializations: urban economics, agricultural economics)

M.A. UNIVERSITY OF CHICAGO: Economics, 1993
(Full scholarship from the University)

B.S. SOUTHERN METHODIST UNIVERSITY: Economics and Systems Analysis, Mathematics Minor, 1991
(Full scholarship from the University)
(Summa Cum Laude, Honors, Departmental Distinction)

PROFESSIONAL EXPERIENCE

Compass Lexecon (formerly Lexecon), Chicago, Illinois: (1996 – date)

Editor for *The Antitrust Source*, American Bar Association (2011 – Present)

PUBLICATIONS

BOOKS

Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies, (Editor) Nova Science Press (2003).
(Contributors include Debra Aron, Johannes Bauer, Peter Bernstein, David Burnstein, Robert Crandall, Nicholas Economides, Wayne Fu, Shane Greenstein, Charles Jackson, Junghyun Kim, Donald Kridel, Mercedes Lizardo, Paul Rappoport, Pablo Spiller, Lester Taylor and Steven Wildman)

ARTICLES

"Patent Litigation, Standard Setting Organizations, Antitrust and FRAND" with Dennis Carlton, 22 *Texas Intellectual Property Law Journal* 3 (2014).

"Implementing the FRAND Commitment" with Janusz Ordover, *Antitrust Source,* American Bar Association, October 2014.

"Identifying Benchmarks for Applying Non-Discrimination in FRAND" with Dennis Carlton, *CPI Antitrust Chronicle,* August 2014.

Review of "Strategic Patent Acquisitions" (by Fiona Scott Morton & Carl Shapiro), *Antitrust Source,* American Bar Association, October 2013.

"An Economic Interpretation of FRAND" with Dennis Carlton, 9 *Journal of Competition Law and Economics* 3, 2013.

"The Role of Behavioral Economics in Antitrust Analysis," 27 *Antitrust* 2, American Bar Association, Spring 2013.

"Testing Interchange Fee Models Using the Australian Experience," proceedings of the Bank of Canada Economics of Payments VI conference, May 24, 2012.

Review of "Why (Ever) Define Markets? An Answer to Professor Kaplow," (by Gregory Werden), *Antitrust Source,* American Bar Association, April 2012.

Review of "An Empirical Study of the Effects of *Ex Ante* Licensing Disclosure Policies on the Development of Voluntary Technical Standards," (by Jorge Contreras), *Antitrust Source,* American Bar Association, February 2012.

"Price Indexes, Hedonic Analysis and Patent Damages," 5 *Journal of Intellectual Property Law & Practice* 2 (2010).

"Credit Cards in Context: Framing the Discussion" and "Assessing the Social Effects of the Use of Credit Cards" in The Law and Economics of Interchange Fees and Credit Card Markets, International Center for Law & Economics, December 8-9, 2009.

"Reasonable royalties and the sale of patent rights," 4 *Journal of Intellectual Property Law & Practice* 8 (2009).

"The Evaluation of Social Welfare for Payment Methods," *2009 Oxford Business & Economics Conference Proceedings*, June 2009.

"Another Look at Payment Instrument Economics," 6 *Review of Network Economics* 4 (2007).

"The Telecom Boom and Bust: Their Losses, Our Gain?" with Hal Sider, *Milken Institute Review* (October 2007).

"Boom and Bust in Network Industries: Rising from the Ashes," with Hal Sider, *International Journal of Business & Economics, Proceedings* (2006).

"The Economics of Interchange Fees," with Alan Frankel, 73 *Antitrust Law Journal* 3 (2006).

"Handicapping Countries in the Race to Digital Switching," 5 *Review of Network Economics* 2 (2006).

"The Evolution of Telecommunications Switching in the Central Office," in Down to the Wire: Studies in the Diffusion and Regulation of Telecommunications Technologies, Nova Science Press (2003).

"The Welfare Implications of Advertising and Extension Under Uncertainty," with George Tolley, *Technological Forecasting & Social Change* 70 (2003).

"Determinants of the Diffusion of U.S. Digital Telecommunications," *Journal of Evolutionary Economics* 11 (2001).

"Compensating for Information Externalities in Technology Diffusion Models," 80 *American Journal of Agricultural Economics* 2 (1998).

Contributor to Guide to the Western Ephemera Collection at the DeGolyer Library, Southern Methodist University, 1993, edited by Kristin Jacobsen.

"The Impact of Technology on the Modern Labor Market," 11 *Southwestern Journal of Economic Abstracts* 1 (1990).

RESEARCH PAPERS

"Identifying Benchmarks for Applying Non-Discrimination in FRAND" with Dennis Carlton (2014 - SSRN)

"An Economic Interpretation of FRAND" with Dennis Carlton (2013 – SSRN)

"An Evaluation of the Social Costs of Payment Methods Literature" (2012 – SSRN)

"A New Direction in Mixed Income Housing," submitted to Chicago Housing Authority (1993).

"A Survey of the Economics of Information, Focusing on Water" (1992).

"Petroleum Price Shocks and Rationality," B.S. Honors Paper (1991).

OTHER PROFESSIONAL EXPERIENCE

Panelist at American University, Washington College of Law's Patent Pledges: Developing a Research Agenda conference, May 30, 2014.

Panelist at Texas Intellectual Property Law Journal's 15th Annual Intellectual Property Symposium, FRAND and the Antitrust / Intellectual Property Interface, February 21, 2014.

Panelist at Georgetown University Law Center's Hotel & Lodging Legal Summits, "Navigating Antitrust Issues Arising from the Online Distribution World" (October 24-25, 2013).

"An Economic Interpretation of FRAND" paper with Dennis Carlton, presented by Carlton at the Heath Lecture & Workshop on FRAND, University of Florida Law Advocacy Center (September 2013).

Interviewed by *IEEE Spectrum* for "The High Cost of Taking Your Money" (June 2012).

"Testing Interchange Fee Models Using the Australian Experience," presented as part of a special session "Interchange Fees: Regulation and Implications" at Economics of Payments VI conference, Bank of Canada, May 24, 2012.

Interviewed by *The Oregonian* for "Those credit card rewards cost us a lot of cash" (July 31, 2010).

Participant in "The Law and Economics of Interchange Fees and Credit Card Markets" symposium sponsored by International Center for Law & Economics (December 8-9, 2009).

"The Evaluation of Social Welfare for Payment Methods," 2009 Oxford Business & Economics Conference (June 24-26, 2009).

Interviewed by *Cards Insider* for "Payments: Cash Replacement, Anonymity provides lifeline for cash over cards" (January 28, 2008).

"Boom and Bust in Network Industries: Rising from the Ashes," 6th Global Conference on Business & Economics, Harvard University (October 15-17, 2006), with Hal S. Sider.

"House of Cards: The Economics of Interchange Fees," Presentation to the Federal Reserve Bank of New York Conference, *Antitrust Activity in Card-Based Payment Systems: Causes and Consequences* (September 16, 2005), with Alan S. Frankel.

"The Impact of Technology on the Modern Labor Market," 68th Annual Meeting of the Southwestern Social Science Association (March 29, 1990)

Presented papers on information externalities and technology diffusion at the *Economics and Public Policy Workshop* (3) and *Price Theory Workshop* (1), University of Chicago (1995, 1996)

Coordinated the *Conference on Valuing Non-Market Goods*, University of Chicago (July 21-22, 1995)

Assisted in coordinating the *Conference on Research in Health Economics*, University of Chicago (October 21-22, 1994)

Assisted in organizing the *Economic Policy and Public Finance Workshop*, University of Chicago (1993 - 1996)

Member of the *American Economics Association*

Associate member of the *American Bar Association*

Referee for the *Agricultural and Resource Economics Review*, *American Journal of Agricultural Economics*, *Antitrust Law Journal*, *Journal of Business* and *Journal of Evolutionary Economics*.

Finance Committee (2010 – 2014), Vestry (2007-2009), Treasurer (2006), St. Mary's Episcopal Church, Park Ridge

TESTIMONY

Trial Testimony, Before the United States International Trade Commission, Investigation No. 337-TA-613, Remand, January 28, 2015.

Rebuttal Witness Statement, Before the United States International Trade Commission, Investigation No. 337-TA-613, Remand, December 12, 2014.

Direct Testimony, Before the United States International Trade Commission, Investigation No. 337-TA-613, Remand, November 20, 2014. Amended Direct Testimony, November 25, 2014.

Reply Expert Report, Before the United States International Trade Commission, Investigation No. 337-TA-613, Remand, October 3, 2014. Deposition, October 22, 2014.

Expert Report, Before the United States International Trade Commission, Investigation No. 337-TA-613, Remand, September 12, 2014.

Supplemental Declaration, Before the Federal Communications Commission, MB Docket No. 10-71, Programming Exclusivity Rules, July 24, 2014 (with Mark Israel).

Report, Before the Korea Fair Trade Commission, Case No. 2014GiGuel1474 Regarding Microsoft Corporation and Nokia Corporation's Merger, July 21, 2014 (with Dennis Carlton).

Declaration, Before the Federal Communications Commission, MB Docket No. 10-71, Programming Exclusivity Rules, June 26, 2014 (with Mark Israel).

Whitepaper on Patent Licenses Negotiated Subject to Judicial Review, submitted to the Chinese NDRC on behalf of Qualcomm, May 16, 2014 (with Dennis Carlton).

Declaration Commenting on Commitments Offered by Google to Address Competition Concerns, Case COMP/C-3/39.740 – Foundem and others, July 1, 2013 (with Janusz Ordover).

Reply Declaration in the Matter of Special Access for Price Cap Local Exchange Carriers, Before the Federal Communications Commission, WT Docket No. 05-25, March 12, 2013 (with Dennis Carlton).

Supplemental Declaration before the Federal Maritime Commission, Docket No. 11-12, Hanjin Shipping Co., Ltd. et al., v. the Port Authority of New York and New Jersey, January 31, 2013 (with Fredrick Flyer).

Reply Declaration in the Matter of Policies Regarding Mobile Spectrum Holdings, Before the Federal Communications Commission, WT Docket No. 12-269, January 3, 2013.

Declaration in the Matter of Policies Regarding Mobile Spectrum Holdings, Before the Federal Communications Commission, WT Docket No. 12-269, November 26, 2012.

Expert Report to the Australian Competition & Consumer Commission with regards to the regulatory treatment of the National Broadband Network, September 24, 2012 (with Janusz Ordover).

Report in the Matter of Promoting Interoperability in the 700 MHz Commercial Spectrum, Interoperability of Mobile User Equipment Across Paired Commercial Spectrum Blocks in the 700 MHz Band, Before the Federal Communications Commission, WT Docket No. 12-69, July 16, 2012 (with Mark Israel and Michael Katz).

Declaration in the Matter of Joseph I. Marchese on Request for Inspection of Records, Comments of Deutsche Telekom AG and T-Mobile USA, Inc., FCC FOIA Control No. 2012-12, filed November 14, 2011.

Declaration in the Matter of Joseph I. Marchese on Request for Inspection of Records, AT&T Inc.'s Opposition to Bursor & Fisher, P.A.'s FOIA Request, FCC FOIA Control No. 2012-12, filed November 14, 2011.

Declaration in the Matter of Joseph I. Marchese on Request for Inspection of Records, Review of Freedom of Information Action, FCC FOIA Control No. 2011-445, filed September 22, 2011.

Declaration, In Re Bursor & Fisher, P.A., v. Federal Communications Commission, Case No. 1:11-cv-05457-LAK, U.S. District Court, SDNY, August 26, 2011.

Reply Declaration, in Re: the Merger of AT&T with T-Mobile: Before the Federal Communications Commission, WT Docket No. 11-65, June 9, 2011 (with Dennis Carlton and Hal Sider).

Declaration, In Re: the Merger of AT&T with T-Mobile: Before the Federal Communications Commission, WT Docket No. 11-65, April 20, 2011 (with Dennis Carlton and Hal Sider).

Declaration, In Re Payment Card Interchange Fee and Merchant Discount Antitrust Litigation (Master File No. 1:05-MD-1720-JG-JO), February 10, 2011.

Declaration on behalf of the Port Authority of New York & New Jersey re CFC recovery fee, December 9, 2010 (with Fredrick Flyer).

Supplemental Declaration to the Federal Communications Commission, in the Matter of Implementation of Section 224 of the Act; A National Broadband Plan for Our Future (WC Docket No. 07-245), November 2, 2010 (with Jonathan Orszag).

Declaration to the Federal Communications Commission, in the Matter of Implementation of Section 224 of the Act; A National Broadband Plan for Our Future (WC Docket No. 07-245), October 4, 2010 (with Jonathan Orszag).

Declaration, In Re Gabapentin Patent Litigation (MDL No. 1384, Master Docket No. 00-CV-2931 (FSH)), March 29, 2010.

Reply Declaration to the Federal Communications Commission, In the Matter of Special Access Rates for Price Cap Local Exchange Carriers (WC Docket No. 05-25), February 24, 2010 (with Dennis Carlton and Hal Sider).

Reply Declaration to the Federal Communications Commission, Verizon Wireless / ALLTEL transaction (WT Docket No. 08-95), August 19, 2008 (with Dennis Carlton and Hal Sider).

Declaration to the Federal Communications Commission, Verizon Wireless / ALLTEL transaction (WT Docket No. 08-95), June 13, 2008 (with Dennis Carlton and Hal Sider).

Ex parte filing before the Federal Communications Commission on behalf of Verizon, "Verizon/MCI Merger: Analysis of Special Access," September 9, 2005 (with Gustavo Bamberger and Dennis Carlton).

Comments to the New York Public Service Commission, In the Matter of the Joint Petition of Verizon Communications, Inc. and MCI, Inc. for a Declaratory Ruling Disclaiming Jurisdiction Over or, in the Alternative, for Approval of Agreement and Plan of Merger; and Joint Petition of SBC Communications Inc., AT&T Corporation, Together with its Certificated New York Subsidiaries, for Approval of Merger (CASE 05-C-0237 and CASE 05-C-0242), August 5, 2005 (with Gustavo Bamberger and Dennis Carlton).

Reply Declaration to the Federal Communications Commission, In the Matter of Verizon Communications Inc. and MCI, Inc., Application for Approval of Transfer of Control (WC Docket No. 05-75), May 24, 2005 (with Gustavo Bamberger and Dennis Carlton).

Declaration to the Federal Communications Commission, In the Matter of Verizon Communications Inc. and MCI, Inc., Application for Approval of Transfer of Control (WC Docket No. 05-75), March 9, 2005 (with Gustavo Bamberger and Dennis Carlton).

Reply Declaration to the Federal Communications Commission, In the Matter of Section 272(f)(1) Sunset of the BOC Separate Affiliate and Related Requirements (WC Docket No. 02-112) and 2000 Biennial Regulatory Review of Separate Affiliate Requirements of Section 64.1903 of the Commission's Rules (CC Docket 00-175), July 28, 2003 (with Dennis Carlton and Hal Sider).

Declaration to the Federal Communications Commission, In the Matter of Section 272(f)(1) Sunset of the BOC Separate Affiliate and Related Requirements (WC Docket No. 02-112) and 2000 Biennial Regulatory Review of Separate Affiliate Requirements of Section 64.1903 of the Commission's Rules (CC Docket 00-175), June 30, 2003 (with Dennis Carlton and Hal Sider).

Reply Declaration to the Federal Communications Commission in the Matter of 2000 Biennial Regulatory Review Spectrum Aggregation Limits for Commercial Mobile Radio Services, WT Docket No. 01-14, May 14, 2001 (with Robert Gertner).

Declaration to the Federal Communications Commission in the Matter of 2000 Biennial Regulatory Review Spectrum Aggregation Limits for Commercial Mobile Radio Services, Docket No. 01-14, April 13, 2001 (with Robert Gertner).

Report to Directorate General IV of the European Commission: "Remedies in the United States," in *Remedies in the United States,* in *Remedies in EU Competition Law: The Policy and Practice of the European Commission, A Report for Directorate General IV of the European Commission,* July 1998, Report (with James Langenfeld).

ACADEMIC HONORS

Undergraduate:
Graduated Summa Cum Laude, Honors, Departmental Distinction
Award for Excellence (given to the outstanding senior in the Economics Department as decided by the vote of the faculty)
Presidential Scholarship (full scholarship)
National Merit Scholar (honorary)
Hyer Society (honorary society of Southern Methodist University)
Honor Roll (1987-1991)
Phi Beta Kappa
Alpha Lambda Delta (Treasurer, honorary society recognizing academic achievement)
Phi Eta Sigma (honorary society recognizing academic achievement)
Omicron Delta Epsilon (international honor society in economics)
Kappa Mu Epsilon (honor society in mathematics)

Graduate:
Full Scholarship (tuition and stipend)

Annexure B

MNO	Details
Technology	
Singtel	28 July 2015: Boost in mobile connectivity with major upgrades to 4G and WiFi networks • First telco in Southeast Asia to offer a tri-band 4G network with LTE-900 on a commercial basis. The network upgrade will automatically enable Singtel mobile customers with supporting handsets to enjoy better indoor coverage. • By March 2016, network upgrade will be implemented at over 400 sites across the city. • Singtel and McDonald's have signed an agreement to equip 123 McDonald's outlets across the island with Singtel Premium WiFi.
Singtel	5 – 16 June 2015: First trial of video delivery with LTE Broadcast will be at the 28th South East Asian (SEA) Games
Singtel	23 August 2014: Launched world's first commercial 300Mbps 4G LTE-Advanced service for smartphones.
Singtel	19 August 2014: Launched range of mobile plans that are fully integrated with a premium high-speed WiFi network at crowded locations (e.g. shopping malls) and underground MRT stations • Customers are able to switch automatically between the 3G, 4G and Singtel WiFi network without a manual password login. • To ensure that customers always enjoy a high-speed and seamless experience, Singtel has permanently waived the 4G value-added service subscription charges.
Singtel	24 July 2014: First mobile operator in the world to offer a commercial 300Mbps 4G service with the launch of the Huawei E5786 mobile MiFi device
Singtel	28 May 2014: Offered first live 4G service in Singapore that is capable of offering data speeds of up to 300Mbps, double the speeds of currently available 4G services • Note: In 2013, Singtel was the first to launch nationwide dual-band 150Mbps 4G.

MNO	Details
Singtel	19 May 2014: Launched 4G ClearVoice, the world's first commercial full-featured Voice over LTE (VoLTE) service. It was, at that time, the only VoLTE service globally to offer the full suite of telephony features such as call waiting and forwarding on the 4G network.
M1	7 January 2014: Launched enterprise small cell solution
StarHub	27 May 2015: Nokia Networks, StarHub showcase LTE-Advanced at 600Mbps using 4X4 MIMO technology
StarHub	28 January 2015: Huawei and StarHub in commercial trial of Huawei's LampSite Solution
StarHub	24 October 2014: StarHub and Nokia Networks at the Edge of Mobile Content Delivery
StarHub	1 October 2014: Host Two StarHub Mobile Numbers on One SIM
Roaming	
Singtel	4 May 2015: Extended "Roam Like Home" DataRoam Saver to Australia. • Note: Singtel launched "Roam Like Home" DataRoam Saver to Malaysia in October 2014.
M1	10 July 2015: Launched M1 Data Passport: Roam overseas with existing M1 data bundles
StarHub	8 September 2014: 4G data access on 25 overseas mobile networks in 21 countries, including Australia, China, Hong Kong, South Korea, Taiwan, Thailand, US and UK
Pricing	
Singtel	16 June 2014: Launched Easy Mobile, the first postpaid mobile service in Asia to allow users to customise their tariff plans every month to suit their lifestyle needs and budget • Customers can quickly and conveniently tweak their voice, SMS and data bundle while on-the-move via the MySingtel smartphone app or the Easy Mobile online portal.
Singtel	11 March 2014: Launched the first mobile data plans in Singapore to cater to the needs of customers aged 55 and above • 20 per cent off the regular monthly subscription of Singtel's SuperLite and Lite plans, as well as a selection of handsets at no extra charge

MNO	Details
Singtel	8 January 2014: Launched Singapore's first prepaid Facebook mobile plan • Note: In August 2013, Singtel launched Whatsapp and Opera Mini Surf and Mail plans, which enables customers to send unlimited instant messages and surf the web as much as they wish from 50 cents per day.
M1	29 July 2015: Launched SIM-only mobile plans
M1	19 August 2014: Launched new plans for disabled and enhances senior and youth benefits
Payment	
Singtel	3 June 2014: Singtel and Standard Chartered Bank launched Dash, a first-of-its-kind collaboration between a telco and a bank, offering innovative mobile money solutions that update the way customers access, save or borrow money, make payments, and purchase insurance.
Singtel	6 March 2014: First mobile operator in Singapore to offer direct carrier billing • Allows customers to make secure purchases of Windows Phone apps and in-app content without the need for a credit card. All transactions are consolidated into a single bill for simplicity and easy management.
M1	19 June 2015: Launched new mobile Point of Sale (mPOS) solution, in collaboration with CIMB, MasterCard and Wirecard, which transforms smartphones and tablets into terminals that allow merchants to accept credit, debit and prepaid card payments from customers anytime, anywhere
MVNO	
M1	8 July 2015: M1 and Liberty Wireless announce MVNO agreement