The Critical Importance of Pro-competition Measures in the Canadian 3500 MHz Auction

Peter Cramton[1]

2 August 2019

Summary

I have been asked by Shaw Communications Inc., and its affiliate Freedom Mobile Inc., to comment on pro-competitive measures in the upcoming 3500 MHz spectrum auction to be undertaken in Canada by the Ministry of Innovation, Science and Economic Development (ISED). I focus primarily on the rationale for set-asides, the suitability of set-asides in Canada's 3500 MHz auction, and the overall experience with set-asides from other spectrum auctions. I believe a set-aside is necessary to address competition concerns in the rollout of 5G. In addition to a set-aside, a spectrum cap can further support 5G competition and reinforce the integrity of the set-aside. My comments are based on my review of "Consultation on a Policy and Licensing Framework for Spectrum in the 3500 MHz Band," June 2019, in which ISED outlines the proposed auction policy framework and design (ISED 2019). My comments are also based on twenty-five years of experience designing and implementing spectrum auctions for governments around the world, as well as my experience advising bidders in over forty major spectrum auctions. This is a topic I have studied extensively in many countries including Canada, the United Kingdom, and the United States. Indeed, this paper is based in part on a similar analysis that I did in advance of the U.S. 700 MHz auction (Cramton 2013b) and the Canadian 600 MHz auction (Cramton 2017).

Well-crafted set-asides can increase competition both in the market for mobile broadband services and in the spectrum auctions in which they are applied. The increased competition leads to consumer benefits such as price declines, increased innovation, accelerated deployment of advanced mobile services, and expanded consumer choice. These benefits are evident in the recent developments of Canada's mobile wireless market. It also can lead to improved auction efficiency and higher auction revenues (Cramton 2000).

Regulators commonly use set-asides to encourage competition (Cramton et al. 2011). There are many instances where the set-asides have been effective at increasing competition in the market for mobile services and in the auction (Ayres and Cramton 1996; Arthur D. Little 2009; Cave and Web 2013). The U.S. PCS auctions of 1994-96 are a vivid example. Set-asides in these auctions led to robust competition, innovative services, and rapid price declines (FCC 1999). In recent auctions, for example in the 4G spectrum auctions in Europe, regulators have used set-asides with respect to low-band—below 1 GHz—spectrum (Cave and Webb 2013). Most recently the 600 MHz auctions in the U.S. and Canada used set-asides to successfully increase competition. There is little evidence that set-asides have harmed auction revenue (Binmore and Klemperer 2001; Grimm et al. 2001).

[1] Professor of Economics, University of Maryland and University of Cologne, www.cramton.umd.edu. Since 1983, Peter Cramton has conducted research on market design; he has applied that research to design auction-based markets of radio spectrum, electricity, financial securities, and other products. He has written many widely-cited practical papers on spectrum auctions and competition policy. I thank Freedom Mobile for funding this research.

The market structure for mobile services in Canada is highly concentrated, with Rogers, Bell, and Telus commanding a 90% subscriber market share and a 92% revenue market share (CRTC 2018). Recognizing the importance of competition in 5G in the 3500 MHz auction, ISED should include a significant set-aside for eligible carriers that are not dominant incumbents. The set-aside should exclude the major nationwide incumbents (Bell, Telus, and Rogers). As has been demonstrated repeatedly in spectrum auctions in many countries, including Canada, the United States and the United Kingdom, a set-aside is a powerful and effective instrument to encourage competition and innovation in a concentrated wireless market.

To be most effective, the set-aside should be one-quarter (50 MHz) of the 200 MHz available in total at 3500 MHz—and restricted to facilities-based bidders, excluding the major nationwide incumbents. Given that some of the 3500 MHz spectrum will be retained by existing licensees, and that the amount retained depends on the service area, a more tailored, nuanced approach is necessary in some regions. Such a set-aside will motivate participation from smaller regional providers. This will have two important impacts: 1) it will make the auction more competitive, thereby improving the efficiency of the auction outcome, and 2) it will make the downstream market for 5G mobile services more competitive. The set-aside will expand the coverage and increase the capacity of 5G facilities-based network providers beyond those of Rogers, Bell and Telus.

The set-aside can be supplemented with a spectrum cap of 50 MHz. Such a cap would prevent excessive concentration of spectrum and reinforce the integrity of the set-aside. However, because some of the 200 MHz is unavailable, such a cap alone does not prevent foreclosure of non-dominant incumbents. Without a set-aside, the spectrum cap would need to be smaller to prevent foreclosure. A cap of less than 50 MHz may be apt to adversely impact competition in the auction. I view a spectrum cap as a supplement to the proposed set-aside, not a substitute.

A large set-aside is prudent in Canada's 3500 MHz auction because:

- Mobile broadband is highly concentrated. Lack of competition leads to high prices and low innovation. A set-aside directly addresses the limited competition.
- The 3500 MHz spectrum is essential for timely deployment of 5G. The 600 MHz spectrum allows coverage, but 3500 MHz is essential for speed, coverage and capacity. Absent a set-aside the major incumbents may attempt to foreclose competition in the 5G mobile market by limiting the blocks won by smaller providers.
- Given the large investment requirements of 5G, the risk of foreclosure is especially great. A significant set-aside greatly strengthens investment incentives in 5G for the non-dominant facility-based providers by ensuring access to some of the essential beachfront property for rapid deployment of 5G. Foreclosure is prevented.

Such a set-aside is consistent with ISED's design objectives. ISED's goals for the auction are: 1) to foster innovation and investment; 2) to support sustained competition, so that consumers and businesses benefit from greater choice; and 3) to facilitate deployment and timely availability of 5G services across the country, including rural areas (ISED 2019). A significant set-aside will encourage competitors to invest, promoting both competition and innovation for the benefit of all Canadians.

Rationale for set-asides

Spectrum is an essential input in the provision of wireless services (US DOJ 2013). Excessive concentration of this essential input undermines competition for wireless services, harming consumers. Set-asides can prevent excessive concentration of spectrum, encourage entry and prevent the foreclosure of non-dominant competitors, and motivate investment. These are the primary motivations for set-asides.

Critics of set-asides argue that the set-asides harm both auction efficiency and revenues, and ultimately are unsuccessful in promoting competition (Earle and Sosa 2013). Set-asides, if unsuited to the setting, may have these undesirable effects, but regulators can and often do design the set-asides to enhance competition and improve auction efficiency and revenues (Cramton 2002; Cramton et al. 2011).

At first glance, it may seem that a set-aside necessarily reduces auction revenues. Excluding the dominant incumbents from bidding on the set-aside blocks means that demand from the dominant incumbents may be reduced from what it would be absent the set-aside. Doesn't this reduced demand imply lower auction revenues? The answer would be yes, but for two countervailing forces that often are decisive: 1) the set-aside can motivate participation in the auction and thereby increase competition in the auction overall, and 2) the set-side can intensify competition by the dominant-incumbents for the non-set-aside blocks. Auction revenues are quite sensitive to the level of competition. Adding one or more bidders can have a pronounced impact in increasing revenues. Greater competition for non-set-aside blocks further increases auction revenues.

Critics of set-asides often trumpet the difference in price between set-aside and non-set-aside blocks as a harmful loss of revenues at the expense of consumers. This simplistic analysis has been demonstrated both theoretically and empirically to be false (Cramton 2002; Cramton et al. 2011), as it ignores the countervailing competitive forces that drive both revenues and efficiency in the auction.

For purposes of illustrating this dynamic, suppose there are three major incumbents. A spectrum auction creates the possibility that entry will occur and disrupt the triopoly. But the triopolists have a strong incentive to bid aggressively in the auction and acquire the entire award. Doing so prevents entry and preserves the higher triopoly profits. Non-dominant firms who anticipate this outcome will choose not to participate in the auction and avoid significant participation costs. As a result, only the three major incumbents compete, and they can coordinate to split the spectrum equally. The auction ends near the reserve price—well below the competitive price. This outcome is seen in practice, for example the 1999 German spectrum auction with two incumbents (Grimm, et al. 2003) and the 2012 Thailand 3G auction with three incumbents. In Thailand, the three incumbents each won one license and paid 2.8% above the reserve price.

Now suppose the regulator imposed a set-aside that prevented the triopolists from winning the entire award. This fundamentally alters the participation decision. Non-dominant firms know that at least one must be successful. This certainty motivates participation. The strongest non-dominant firms decide to participate, and the auction becomes more competitive with an expanded set of bidders.

The set-aside can also enhance auction efficiency. More societal value may come from awarding a spectrum lot to a small regional provider, rather than a dominant incumbent. Yet in an auction without

set-asides, the incumbent may nevertheless win. The reason is that the incumbent's value is inflated by the benefits it enjoys from reduced competition in the wireless market in the event the regional provider fails to acquire spectrum. The set-aside lets the incumbent win the spectrum it needs, but not so much that competition for wireless services is harmed.

The set-aside is especially powerful in motivating participation by non-dominant providers, as it guarantees that some non-dominant providers will win. Dominant incumbents cannot foreclose competition. Foreclosure is distinct from the problem of warehousing spectrum. The concern is not that the dominant incumbents would warehouse—not use—the 3500 MHz spectrum, but that dominant incumbents would inflate bids to exclude competitors.

These arguments do not imply that set-asides necessarily improve auction outcomes. Excessive set-asides without other eligibility constraints may allocate spectrum to less efficient providers who are unable to build out their spectrum, provide services, or increase competitive pressures (Cramton et al. 2011). The conclusion instead is that the regulator must carefully design set-asides to best achieve the auction objectives. Set-asides may be undesirable in settings with robust competition and little spectrum concentration; however, set-asides are desirable in settings with concentrated markets and concentrated spectrum holdings. The circumstance of the Canadian 3500 MHz spectrum auction certainly is one where the market is highly concentrated. Foreclosure of competition is a real risk absent a significant set-aside. The foreclosure risk is especially great given the large investment requirements of 5G and the critical role of 3500 MHz spectrum for timely 5G buildout.

Set-asides in the Canadian 3500 MHz auction

The Canadian mobile market consists of three nationwide carriers, Rogers, Bell and Telus, and several regional carriers. The market is highly concentrated. Rogers, Bell and Telus have a 90% subscriber market share and a 92% revenue market share (CRTC 2018). Several regional carriers serve the remaining 10% of subscribers.

A successful 5G build requires a combination of mid, low and high-band spectrum. Low-band spectrum is essential for providing coverage in an economically efficient way. This is especially important in Canada, where coverage is an important challenge, given Canada's vast geographic area. Coverage is what enables communications. A smart phone is an expensive paperweight in areas without coverage. Following the successful 600 MHz auction, regional operators now have the critical low-band spectrum. The second essential input is mid-band spectrum for capacity and speed. The 3500 MHz spectrum is the required complementary spectrum to provide a robust 5G service. A portfolio of low, mid and high-band spectrum would enable regional operators to compete in 5G with the Big 3. Indeed, because of the need for greater capacity in 5G, 3500 MHz spectrum is considered the beachfront property of 5G. Denying regional competitors the opportunity to acquire 3500 MHz spectrum would send a dangerous signal that policymakers do not intend for regional competitors to build share and that the dominance of the Big 3 would never be overcome.

Low-band (sub-1GHz) spectrum is best for coverage because of its propagation characteristics that enable signals to travel further, penetrate buildings and bend around obstructions. As a result, low-band

spectrum provides the foundation of coverage on which capacity can be built. This is true regardless of wireless generation—3G, 4G, and 5G are all best-served with a foundation of low-band spectrum.

Importantly, the demand for low-band spectrum does not scale with market share. Once you have sufficient low-band spectrum to provide coverage and some minimum level of capacity, higher levels of capacity are best obtained with mid-band and high-band spectrum. This is especially true in more densely populated regions where most wireless revenues are generated. In these areas, the carrier can economically build a denser network that makes best use of mid- and high-band spectrum. For a carrier like Bell with ample low-band spectrum, the need for 600 MHz spectrum was greatly reduced. This is why Bell did not win any spectrum in the 600 MHz auction. Their plan is to refarm existing low-band holdings, such as their 850 MHz spectrum, to 5G from its existing use. Verizon and AT&T have similar plans in the US. Refarming was a more economic approach for Bell to create a low-band layer for 5G than winning in the 600 MHz auction.

This basic result of physics and economics is why in the U.S. 600 MHz auction demand from the dominant incumbents (AT&T and Verizon) was nearly zero. Verizon never placed a bid in the auction. AT&T won little and bid in a way that suggested they did not want what they won even though prices were much lower than the prices in the earlier AWS-3 auction. Most recently, AT&T is in negotiations with Dish to transfer all its 600 MHz winnings to Dish (Piecyk 2017). This would leave both AT&T and Verizon with zero MHz from the U.S. 600 MHz auction. AT&T and Verizon's exit from the U.S. 600 MHz auction stems from the underlying economics and physics of mobile broadband and the fact that both carriers entered the auction with substantial low-band spectrum.

Given this near-zero economic demand for the U.S. 600 MHz spectrum, why then did the dominant carriers lobby so strenuously against a set-aside for non-dominant incumbents? Because absent a set-aside AT&T and Verizon could have foreclosed competition. T-Mobile was desperate for low-band spectrum to overcome the large coverage advantage enjoyed by AT&T and Verizon. AT&T and Verizon were desperate to avoid competition from the disruptive T-Mobile, who already was making large inroads in acquiring subscribers at the expense of the incumbents, much like regional competitors are now making inroads in challenging the dominance of the Big 3 in Canada. Thus, although the use-value of the 600 MHz spectrum was low for the Big Two, the foreclosure-value of the spectrum was high. This is why AT&T and Verizon feigned strong interest in the 600 MHz spectrum only to effectively not show up at the auction. The FCC's wise decision to include a set-aside for non-dominant bidders prevented the foreclosure of competition. T-Mobile could not be pushed aside in the auction. Because of the set-aside, T-Mobile and many others came to the auction loaded for bear and indeed won over 95% (price-weighted) of the spectrum. The set-aside played an essential role in preventing foreclosure by the dominant incumbents and thereby motivated much stronger participation from T-Mobile and others.

The economic setting of the Canadian 3500 MHz auction is similar, with the exception that the competition problem is more severe in Canada, since the dominant incumbents command an even more dominant position in Canada both in terms of market share and spectrum holdings. Absent a significant set-aside, foreclosure of competition would be likely—causing tremendous long-term harm to consumers.

The 3500 MHz auction is a critical opportunity to promote 5G investment and strengthen competition. To avoid excessive concentration of this beachfront band for 5G service and motivate participation in the auction from the newer rivals, a significant set-aside is essential.

Well-crafted set-asides can enhance competition for wireless services and increase competition in the auction. The U.S. experience demonstrates these benefits. The PCS auction was a success in bringing fresh competition and innovation to the mobile marketplace. In its 1997 Report to Congress (FCC 1997) on the results of the PCS auctions, the FCC observed that fifty-three percent of the licenses awarded went to new entrants, which had the result of "improving wireless service at lower prices." The FCC also noted that because of the auctions, capital investment in wireless networks increased to $26.7 billion in 1996, up from just $12.8 billion in 1993, while the average cellular subscriber bill decreased 27 percent during the same period. By 1999, the date of the Commission's Fourth Report on Commercial Services (FCC 1999), PCS deployment had resulted in the expansion of the mobile market to include at least five mobile telephone providers in each of the thirty-five largest regions of the U.S., and at least three mobile providers in 97 of the 100 largest regions. Even a casual student of today's mobile marketplace can observe that the wireless providers born of the PCS auction, such as Sprint and T-Mobile, which have brought important innovations and disciplined the incumbents. These smaller providers bring important innovations in pricing, contracts, and technology, which then discipline the Big Two for the benefit of all consumers. Both Sprint and T-Mobile already operate 5G New Radio networks in some US markets.

The set-asides in recent Canadian spectrum auctions have had a similar impact. New regional providers, such as Freedom Mobile, Videotron, and Eastlink, have emerged. These providers remain small but bring much needed competition and lower prices in major regions of Canada. Given their small size and the large investment requirements of 5G, the regional providers' position as a positive disruptive force would be far from clear absent a set aside. The set aside is needed to provide a clear path forward in 5G. The set aside somewhat offsets the competitive advantages the nationwide providers enjoy as a result of their dominance.

Well-crafted set-asides can enhance competition for wireless services and increase competition in the auction while generating little risk that the set-aside would adversely impact the auction outcome. In the Canadian setting, the potential regulatory risk comes from too small a set-aside that does not adequately motivate participation.

The 3500 MHz spectrum consists of twenty 10-MHz blocks (200 MHz). A set-aside of five blocks (50 MHz) or 25% of the total would be an effective pro-competitive measure to encourage 5G competition and prevent foreclosure. However, given that some of this spectrum will be retained by incumbents in some areas, a more nuanced rule is required:

- a 50 MHz set-aside in areas where at least 80 MHz is available for auction,
- a 40 MHz set-aside in areas where less than 80 MHz is available and the area includes a large population center as defined by ISED, and
- a set-aside of 50% of the available spectrum in areas where there is less than 80 MHz available and the area does not include a large population center.

The proposed set-aside would be ideal in the Canadian 3500 MHz auction. The significant set-aside maximizes participation and competition among non-dominant facilities-based carriers. It guarantees that at least one facilities-based carrier in each service area can obtain the spectrum needed to compete against the dominant incumbents. Such disruptive competition would create enormous social value. In nearly all cases, dominant incumbents still would have access to sufficient spectrum through incumbent holdings, auction winnings, or sharing arrangements (Bell/Telus).

Experience with set-asides

The regulator faces difficult tradeoffs in designing set-asides. Fortunately, the regulator can draw on experience with set-asides over the last twenty-five years in spectrum auctions worldwide.

One of the important early uses of set-asides was in the U.S. PCS auctions from 1994 to 1996 (Arthur D. Little (2009). At the time of the first PCS spectrum auction, the market structure was quite close to the duopoly—in every region of the country there were two cellular carriers, each with one-half of the available spectrum (Cramton 1997). Were the PCS auctions conducted without set-asides, the outcome likely would have been much less competitive. The set-aside motivated robust competition both in the auctions and in the market for wireless services (Cramton et al. 2011). The market experienced rapid innovation and U.S. consumers enjoyed better services and lower prices. This progress is well-documented in the FCC's annual reports on wireless competition from 1995 to 2003.

The PCS auctions also revealed that some policies distinct from the set-asides were mistakes. The largest mistake was providing small businesses with excessively attractive installment payment terms (Cramton 2000). This policy led to rampant speculative bidding. Most of the winners defaulted on payments and many of the spectrum licenses got tied up in bankruptcy court. The FCC learned from this mistake. Installment payments to encourage small players to participate in auctions were dropped from consideration in future auctions. Some critics point to this experience as a reason to avoid set-asides (Earle and Sosa 2013), but the mistake with installment payments has nothing to do with the successful policy of set-asides.

Nearly all the European spectrum auctions had set-asides or spectrum caps (Cave and Web 2013). My overall assessment is that the set-asides often were effective in promoting competition both in the auction and in the market for wireless services. I discuss below some relevant examples.

The United Kingdom 3G auction of 2000 illustrates well how the auction framework can enhance competition (Börgers and Dustmann 2002). The regulator packaged the 3G spectrum into five licenses, two large licenses and three smaller licenses. No bidder could win more than one license (Cramton et al. 2011). The incentive for entry was further strengthened by designating one of the two large licenses for a new entrant (Binmore and Klemperer 2001). This structure provided strong motivation for new entrants to participate. In fact, thirteen bidders including nine potential entrants competed in the auction.

Strictly in terms of revenues produced, the U.K. 3G auction experience contradicts claims that pro-competitive instruments reduce auction revenues. On the contrary, the U.K. case illustrates the role that these instruments can play in enhancing revenues by motivating participation and thereby encouraging auction competition. Had the regulator instead designed the auction without such instruments, then I

would expect the outcome to be dramatically different, including a significant possibility of no participation by newer players and the auction quickly concluding at low prices with the two large carriers each winning a large license and the two smaller carriers each winning a smaller license, much like in the duopoly example. In this low-revenue outcome, the ability of the large incumbents to bid for multiple licenses is what can keep the smaller incumbents from bidding on the large licenses, since the smaller incumbents are then vulnerable to retaliation should they bid for the large licenses.

In addition to the record-setting auction revenues, the U.K. 3G auction gave rise to the operator "3," which has had a disruptive influence on pricing, service, and innovation in the market (Cave and Webb 2013). 3UK was the first operator to roll out 3G in the U.K. and it pioneered video telephony and video download. It was also the first operator to offer unlimited data and the first to offer MiFi capability.

The German 3G auction came shortly after the U.K. 3G auction. The regulator chose the same 2x15 MHz in-auction-spectrum-cap, but the available spectrum was split into twelve 2x5 MHz lots. A bidder could win either two or three lots, which meant that there would be between four and six winners. Two outcomes appeared especially likely: (1) five winners with the two larger incumbents each winning three lots and (2) six winners with each winning two lots, including two new entrants (Grimm et al. 2001). In the case of this German auction, the pro-competitive instrument likely motivated the participation of three strong new entrants and that participation made for a highly competitive auction. The prices paid in the auction, and the ultimate failure of the new entrants that won licenses in this auction, have been used to criticize pro-competitive measures in auction design (Earle and Sosa 2013). However, this criticism is flawed. The ultimate failure of the new entrants from Germany's 3G auction rested on the entrants assigning too high a value to be a new entrant in a six-carrier German market, in part because of continued fallout from the dot com bubble, not from the fact that a pro-competitive measure was used.[2]

In the Canadian AWS-1 auction of 2008, Industry Canada set aside 40 MHz of AWS-1 spectrum exclusively for new entrants. Critically, the Canadian AWS-1 auction has resulted in reinvigorated challengers, Freedom Mobile—formerly Wind Mobile—Eastlink and Videotron, to the three Canadian incumbents. Together, these competitors have over two million subscribers, serving a small but significant share of Canadians and starting to provide disruptive competition. (Disclosure: Freedom Mobile funded this research.)

Furthermore, the set-asides motivated several new entrants to participate in the auction. The result was a highly competitive auction that generated $4.25 billion in revenue, nearly three times initial revenue expectations. Canada represents another clear case where the set-aside for new entrants increased auction revenues (Hyndman and Parmeter 2015).

[2] Given the experience of the German 3G auction and the subsequent bursting of the dot com bubble, it is not surprising that the Austrian 3G auction had a much different outcome despite having essentially the same market and auction structure (12 lots with a 3-lot limit). The government set a low reserve price that was one-eighth of the reserve set in the German auction, and the auction ended quickly with each of the six bidders winning two lots (Klemperer 2002). With only six bidders, this low-price equilibrium was focal. The two strongest incumbents knew that they could end the auction quickly by reducing demand from three lots to two lots early in the auction, while trying for a third lot would require much higher bidding to drive out another bidder. The incumbents therefore did not bid at their limits and so this low-price outcome with six winners had nothing to do with the set-asides.

The next spectrum auctions were the 4G auctions in Europe and elsewhere beginning in Germany in 2010. These typically were multiband auctions involving both low-band (below 1 GHz) and mid-band (above 1 GHz) spectrum (GSMA 2012).

To provide service in a market, carriers require a portfolio of spectrum together with network infrastructure (cell sites, backhaul, etc.) that provides both coverage and capacity. Low-band spectrum has propagation characteristics that make it ideally suited to provide coverage in less populated areas as well as within buildings. Mid-band spectrum is better suited to provide capacity in more densely populated areas.

Regulators typically have in-auction-spectrum-caps or set-asides for low-band spectrum in the recent auctions. Low-band auction prices were high in several countries despite these pro-competition instruments, for example in Germany and Italy. In many countries, a combinatorial clock auction was used, which does not give prices for individual lots. The U.K. 4G auction included both low-band in-auction-spectrum-caps and a spectrum floor that guaranteed that at least four companies would win a sufficient portfolio of spectrum for effective operation in the U.K. wireless market (Myers 2013).

Earle and Sosa (2013) argue that set-asides ultimately have been ineffective in increasing the number of competitors in a market and therefore set-asides are both ineffective and costly. I disagree. Set-asides have played an essential role in creating competition and fostering innovation in wireless communication. Moreover, the evidence suggests that the impact on auction revenues has generally been positive, not negative. While it is true that there has been some consolidation in recent years as the wireless industry has matured, this is a natural tendency in most industries. The process of competition inevitably involves entry of some companies who succeed and grow and other companies who fail and exit or merge with successful rivals. As the industry matures, entry and exit become less common. The competition shifts to fights over market share. In these more mature markets, set-asides still have a role in avoiding excessive concentration.

One example of the success of ISED's use of set-asides is the impact of regional operators in fostering competition. Freedom Mobile offers the lowest prices in each of its markets. Quebec has the second-highest regional-operator penetration at 16% and has the lowest prices as measured by ARPU (CRTC 2018). The regional operators have lower prices (an ARPU of $52.2) than the Big 3 (an ARPU of $66.9). The regional operators also have a much higher intensity of capital investment relative to revenues—2.4 times the intensity of investment of the Big 3 (CRTC 2018). These competitive benefits will be lost if the regional operators are unable to compete in 5G.

In the 600 MHz auction, ISED set aside 43% of the spectrum for regional facilities-based carriers. Again, the auction succeeded in encouraging participation and promoting wireless competition. Regional operators such as Freedom Mobile, Videotron, and Eastlink were able to get the low-band coverage layer to compete in 5G. Revenues of $3.5 billion were reasonable. Dominant incumbents, Rogers and Telus, were still able to win substantial spectrum. Bell in a press release following the auction (10 April 2019), "announced it decided not to acquire 600 MHz low band wireless spectrum," emphasizing its existing low-band spectrum at 700 and 850 MHz, and its intent to re-farm its 850 MHz spectrum for 5G. Bell did participate in the auction, but its bids were not competitive. There is no evidence that the set-aside

undermined auction competitiveness or that revenues were suppressed. The set-aside had its intended effect of motivating the participation and success of the regional operators.

A set-aside remains essential

The dominant incumbents will argue that the time for set-asides has passed. The argument is that 5G is a new ecosystem on which operators compete on an equal basis, so no set-aside is needed. This argument is false. Each step in technology—2G, 3G, 4G, and 5G—requires new investment and new equipment. The steps are evolutionary, not revolutionary. With each step, users rely on the prior technologies whenever the latest technology is unavailable. Initially a 5G device may operate with 4G or 3G at some times and locations. Incumbent operators leverage their existing spectrum, network, and customers to develop a business plan for 5G. Thus, incumbent operators enjoy significant competitive advantages in 5G. Moreover, dominant incumbents have strong incentives to protect and extend these advantages in a 5G world. This is the market failure that set-asides mitigate by preventing foreclosure and limiting the competitive advantage of dominant incumbents. The result is enhanced competition and innovation.

Another argument raised by the dominant incumbents is that foreclosure in the 3500 MHz band could be addressed in a subsequent award, such as the 3800 MHz band. Such a delayed approach is inconsistent with the dynamics of competition in the industry. To reap the benefits of competition, it is necessary that the regional providers offer a viable competitive offering to consumers. The globally harmonized 3500 MHz spectrum is necessary for a timely rollout of 5G. This is a critical moment for the regional providers. If these providers have a delayed and uncertain path to 5G, customers will view their offering as less competitive. It will be more difficult for the regional providers to attract the customers required for a viable business plan. The 3800 MHz band, given its uncertain availability and lack of 5G harmonization, is a poor substitute for the 3500 MHz spectrum. Dominant incumbents are better suited to handle the uncertainty and delay of the 3800 MHz band. Thus, the subsequent award of the 3800 MHz band is an argument for a *larger* set-aside in 3500 MHz, not a smaller set-aside. To maximize the chance of successful competition in 5G, competition must be encouraged early, rather than late.

Conclusion

Given limited competition in mobile communications, ISED has recognized the potential benefit of a set-aside for non-dominant facility-based carriers in the 3500 MHz auction. Such a set-aside is essential to the success of the auction. An auction without a set-aside would let the dominant incumbents foreclose competition. By contrast, an auction with a significant set aside prevents the foreclosure of competition, and thereby improves auction efficiency and promotes long-run facilities-based competition, consistent with ISED objectives. In addition to a set-aside, a cap will further promote competition by preventing excessive concentration of spectrum and reinforcing the integrity of the set-aside.

Experience from around the world shows that set-asides, when properly applied, are an effective tool for promoting competition and social welfare. In the Canadian 3500 MHz auction, a significant set-aside is essential to encourage auction participation and a competitive 5G rollout. The proposed set-aside achieves ISED goals for the benefit of Canadians.

References

Arthur D. Little (2009), "Mobile Broadband, Competition and Spectrum Caps," paper prepared for the GSM Association, January. Available at https://goo.gl/W2AKvi.

Ausubel, Lawrence M., Peter Cramton, Marek Pycia, Marzena Rostek, and Marek Weretka, "Demand Reduction and Inefficiency in Multi-Unit Auctions," *Review of Economic Studies*, 81(4), 1366-1400, October 2014.

Ayres, Ian and Peter Cramton (1996), "Deficit Reduction Through Diversity: How Affirmative Action at the FCC Increased Auction Competition," *Stanford Law Review*, 48:4, 761-815.

Binmore, Ken and Paul Klemperer (2001), "The Biggest Auction Ever: The Sale of the British 3G Telecom Licenses," *Economic Journal*, 112, C74, C90.

Börgers, Tilman and Christian Dustmann (2002), "Rationalizing the UMTS Spectrum Bids: The Case of the UK Auction," *Ifo Studien*, 48, 77-109.

Bundesnetzagentur (German Regulatory Authority for Telecommunications and Posts) (2004), *Annual Report 2004*. Available at https://goo.gl/S9tJ7o.

Canadian Radio-television and Telecommunications Commission (2018), "2018 Communications Monitoring Report." Available at https://crtc.gc.ca/eng/publications/reports/policymonitoring/2018/index.htm.

Cave, Martin and William Webb (2013), "Set-asides and Auction Revenue: the European Experience," attached to *Ex Parte* Presentation of Sprint Corporation, GN Docket No. 12-268 & WT Docket No. 12-269, July 29.

Cramton, Peter (1995), "Money Out of Thin Air: The Nationwide Narrowband PCS Auction," *Journal of Economics and Management Strategy*, 4, 267-343.

Cramton, Peter (1997), "The FCC Spectrum Auctions: An Early Assessment," *Journal of Economics and Management Strategy*, 6:3, 431-495.

Cramton, Peter (2000), "Lessons from the United States Spectrum Auctions: Testimony Before the United States Senate Budget Committee," February 10. Available at https://goo.gl/VH4HLU.

Cramton, Peter (2002), "Spectrum Auctions," in Martin Cave, Sumit Majumdar, and Ingo Vogelsang (eds.) *Handbook of Telecommunications Economics*, Amsterdam: Elsevier Science B.V., Chapter 14, 605-639.

Cramton, Peter (2013a), "Spectrum Auction Design," *Review of Industrial Organization*, 42:2, 161-190, March.

Cramton, Peter (2013b), "The Rationale for Spectrum Limits and Their Impact on Auction Outcomes," filed on behalf of T-Mobile USA in the U.S. 700 MHz auction rule-making, August. Available at https://goo.gl/xHXif7.

Cramton, Peter, Evan Kwerel, Gregory Rosston, and Andrzej Skrzypacz (2011), "Using Spectrum Auctions to Enhance Competition in Wireless Services," *Journal of Law and Economics*, 54, 2011.

Cramton, Peter, Andrzej Skrzypacz, and Robert Wilson (2007), "The 700 MHz Spectrum Auction: An Opportunity to Protect Competition in a Consolidating Industry," submitted to the U.S. Department of Justice, Antitrust Division, November 13. Available at https://goo.gl/xub7kF.

Earle, Robert and David Sosa (2013), "Spectrum Auctions Around the World: An Assessment of International Experiences with Auction Restrictions," Analysis Group, Inc. Attached to *Ex Parte* Presentation of Mobile Future, GN Docket No. 12-268 and WT Docket No. 12-269, July 31. Available at https://goo.gl/wcr1HD.

Federal Communications Commission (1997), *The FCC Report to Congress on Spectrum Auctions*, WT Docket No. 97-150, Report, FCC 97-353, 23-24, October 9.

Federal Communications Commission (1999), *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services*, Fourth Report, FCC 99-136, June 24. Available at https://goo.gl/gtusS4.

Federal Communications Commission (2016), *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services*, Nineteenth Report, DA 16-1061, September 23. Available at https://goo.gl/ty8445.

Grimm, Veronika, Frank Riedel, and Elmar Wolfstetter (2001), "The Third Generation (UMTS) Spectrum Auction in Germany," CESifo Working Paper Series, October. Available at https://goo.gl/cnGdQp.

Grimm, Veronika, Frank Riedel, and Elmar Wolfstetter (2003), "Low Price Equilibrium in Multi-Unit Auctions: the GSM Spectrum Auction in Germany," *International Journal of Industrial Organization*, 21:10, December, 1557-1569.

GSMA (2012), "Auctions Summary," *Digital Dividend*, Section 1.4, Page 4. Available at https://goo.gl/ctNA4d.

Hyndman, Kyle and Christopher F. Parmeter (2015), "Efficiency or Competition? A Structural Econometric Analysis of Canada's AWS Auction and the Set-Aside Provision," *Production and Operations Management*, 24:5, 821-839.

Innovation, Science and Economic Development Canada (2017), "Consultation on a Technical, Policy and Licensing Framework for Spectrum in the 3500 MHz Band," Notice SLPB-005-17, August.

Innovation, Science and Economic Development Canada (2019), "Consultation on a Policy and Licensing Framework for Spectrum in the 3500 MHz Band," Notice SLPB-002-19, June.

Klemperer, Paul (2002), "How (not) to run auctions: The European 3G telecom auctions," *European Economic Review*, 46:4-5, 829-845.

Myers, Geoffrey (2013), "Spectrum Floors in the UK 4G Auction: An Innovation in Regulatory Design," The 41st Research Conference on Communication, Information and Internet Policy. Available at https://goo.gl/u5arUJ.

Piecyk, Walter (2017), "AT&T Quietly Deploying Band 29 for LTE and Why That is Positive for Dish," BTIG Research, September 22. Available at https://goo.gl/UF46Sg.

U.S. Department of Justice (2013), "*Ex Parte* Submission of the United States Department of Justice," WT Docket No. 12-269, April 11. Available at https://goo.gl/NZNpWF.