Chicken Little Eats Crow:

How the Critics Got It Wrong about Spectrum Auctions

by IAN MUNRO

October 2008

Atlantic Institute for Market Studies

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AIMS would like to thank the Aurea Foundation for their financial support for this project.

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EXECUTIVE SUMMARY

Over the past decade Industry Canada has held five spectrum auctions, raising almost $6 billion. These auctions have allowed the government to get hundreds of spectrum licences into the hands of service providers quickly, efficiently, fairly, and transparently.

When the concept of auctioning spectrum licences first became prominent in Canada in the mid 1990s, there was widespread and often rancorous opposition. These "Chicken Littles" claimed that the introduction of auctions would cripple service providers, gouge consumers, eliminate the government's ability to regulate in the public interest, and – the reliable neutron bomb of public discourse in Canada – reflect an "Americanization" of Canadian communications policy.

This paper examines those criticisms, plus some newer ones raised during the recently completed auction of licences for Advanced Wireless Services, and determines that the sky actually did not fall as predicted.

This is not to say, however, that improvements cannot be made with regard to auction policy and practice.

After assessing the evidence on spectrum auctions for the past decade, five broad recommendations emerge.

First, Industry Canada should formalize auctions as the one and only means by which licences are assigned in an excess demand situation. Currently the Minister of Industry has the discretion to choose an auction process or a "comparative selection and licensing" process (the "beauty contest" approach) to assign spectrum when demand for frequencies exceeds supply. The comparative selection and licensing process is cumbersome, disconnected from market realities, and prone to perceived, if not real, favouritism, and as such it should be removed from the government's tool-kit.

Second, to provide more consistency in the Canadian communications sector, the CRTC also should adopt auctions for the assignment of broadcasting licences. As traditional distinctions between "telecommunications" and "broadcasting" wither away, it is nonsensical that two radically different licensing and regulatory regimes can apply to portions of the spectrum that are identical from a practical and technical viewpoint.

Third, Industry Canada should move beyond auctioning licences to a model of property rights in spectrum. The department embraces a market-driven approach in using auctions, yet it also reaches deeply into licensees' businesses with regulation and is reluctant to let the same market forces work unencumbered after initial licensing processes. In view of the success of its spectrum auction program, Industry Canada should embrace a market-based approach more fully.

Fourth, Industry Canada should upgrade its now outdated spectrum auction software platform. Canadian spectrum auctions are still being run on rules and software developed in the mid 1990s. Since that time, improvements and refinements have been developed elsewhere that allow for faster and more efficient auctions. It is time for Canada to catch up.

Fifth, other government agencies with responsibilities for allocating scarce resources should learn from Industry Canada's success with sophisticated auction mechanisms and adopt best practices in their own operations. Federal, provincial, and municipal governments buy and sell billions of dollars worth of goods and resources each year, so even a small improvement in the efficiency of these processes could generate substantial benefits for Canadian taxpayers.

INTRODUCTION

On July 21, 2008, the Government of Canada completed an auction for Advanced Wireless Services (AWS) licences.[1] Final bids from the fifteen winning bidders (for 282 licences across Canada) totalled close to $4.3 billion.

The use of auctions as a means of assigning wireless licences is not a new idea; Ronald Coase (the 1991 Nobel Laureate in Economics) proposed the concept in 1959.[2] However, it took decades for the idea to be put into practice. New Zealand was the first to do so in 1989, followed shortly thereafter by Australia.

In 1994, the Federal Communications Commission (FCC) held the United States' first spectrum auction, generating substantial attention both in the U.S. and in Canada. North of the 49th parallel, many commenters were of the view that spectrum auctioning was an "American concept" that would bring ruin to the Canadian communications marketplace if introduced here. Despite such opposition, the Canadian government began the development of its own spectrum auction program in the mid 1990s. The first Canadian spectrum auction was held in the fall of 1999.

A decade – and five Canadian spectrum auctions worth almost $6 billion – later, it is interesting to review and assess the original claims and prognostications about spectrum auctions. Such a review provides useful lessons both for Canadian spectrum management going forward, and more generally for today's debates regarding the relative roles of government regulation and market processes in the Canadian economy.

Following this introduction, sections 2 and 3 provide brief primers on spectrum management and auctions, respectively. Section 4 reviews the atmosphere surrounding the introduction of spectrum auctions in the 1990s and lays out the key objections raised at the time, and some new ones raised more recently. These claims are assessed against the actual evidence of the past 15 years in section 5. Section 6 concludes and makes policy recommendations for the future.

[1] Industry Canada states that Advanced Wireless Services include "a wide range of services, such as third generation cellular, multimedia and broadband Internet." Industry Canada, *Licensing Framework for the Auction for Spectrum Licences for Advanced Wireless Services and Other Spectrum in the 2 GHz Range*, December 2007, p. 30, http://www.ic.gc.ca/epic/site/smt-gst.nsf/vwapj/awslicensing-e.pdf/$FILE/awslicensing-e.pdf.

[2] "The Federal Communications Commission," Coase, R. H., *Journal of Law and Economics* (2), October 1959, pp. 1-40.

SPECTRUM MANAGEMENT

It is a typical winter weekday in Canada. The clock radio comes on at 7:00 with the sounds of your favourite FM station. You turn off the radio and notice via the baby monitor that the little one in the next room also has woken up. Moving downstairs, you turn on the television in the kitchen to catch the news and weather. Hearing how cold it is outside, you click on the garage door opener and then on the car's remote starter to warm it up for a few minutes. You are just about to leave the house at 8:00 when your cellular phone rings …

In the preceding description of a very mundane hour in a typical Canadian's life, there are at least six separate uses of radio frequencies.[3] Most people understand that the local golden-oldies and alt-rock stations use transmitter towers to broadcast the signals that can be tuned in on the AM and FM dials, and that radio frequencies also are used to send the "start" signal from your key fob to your car and to carry cellular phone conversations.

Less well understood is the underlying spectrum management framework that allows all these uses of radio frequencies to occur.

Generally speaking, if two users attempt to transmit a signal in the same place at the same time using the same radio frequency, each transmission will interfere with the other, with the end result that it may be impossible for any useful communication to take place. This is why the rock music station in a given city will broadcast over, say, 104.3 MHz, while the country music station will be at 101.9 MHz; if the latter also transmitted its signal at 104.3 MHz (or even 104.1 MHz or 104.5 MHz, perhaps) listeners would be unable to obtain a clear signal from either station. Taking another example, two people standing side by side and making calls with their cellular telephones will be using different frequencies with sufficient spectral separation between them to ensure they do not cause interference to one another. (This will not be readily apparent to the two callers because they do not need to choose frequencies or actively manage interference concerns – this task is handled by the software that underlies the cellular telephone networks.)

What these facts of physics imply in economic terms is scarcity: only one user can employ a given frequency in a given place at a given time, or put another way, one person's use of a frequency requires, generally speaking, the exclusion of all other users at that time and in that place in order for effective communications to take place.

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[3] The radio frequency spectrum is the range of useable radio frequencies, between 3 kilohertz (3 kHz) and 400 gigahertz (400 GHz), typically used for radio and television broadcasting, cellular telephone, satellite, radars and other forms of wireless communications. In this paper, the terms "radio frequencies," "frequencies," and "spectrum" are used interchangeably.

Below radio frequencies, human hearing covers a range from roughly twenty hertz (20 Hz) to 20 kHz. Moving up the spectrum above radio frequency, one encounters infra-red waves (from 300 GHz to 400 THz (400 terahertz)), visible light (400-790 THz), ultraviolet radiation (790 THz to 30 PHz (30 petahertz)), X-rays (30 PHz to 30 EHz (30 exahertz)), and Gamma rays (above 30 EHz). Note that 1 kHz equals one thousand hertz (1000 Hz), one megahertz (1 MHz) equals one million hertz, 1 GHz equals one billion hertz, one terahertz equals one trillion (10^{12}) hertz, one petahertz equals one quadrillion (10^{15}) hertz, and one exahertz equals one quintillion (10^{18}) hertz.

As technology improves and more information can be carried over less spectrum, spectrum scarcity *may* diminish. However, even if technology does enhance the effective supply of spectrum, demand for wireless communications, and hence for spectrum, continues to grow by leaps and bounds. It is not clear at all that scarcity is on a downward trend; in fact, if the market believed that technology would soon make spectrum scarcity a thing of the past, then it is hard to explain Industry Canada's ability to sell 105 MHz of the stuff for $4.3 billion earlier this year. There is no reason to expect that the need for competitive licensing processes will vanish anytime soon.

The fundamental scarcity of spectrum means that coordination and rules are required to determine who will be permitted to use specific frequencies and how and when they may be used.

At the highest level this coordination takes place through the International Telecommunication Union (the ITU), a United Nations agency that provides a forum for nation states to coordinate their use of radio frequencies. If, for example, the United States government managed its spectrum without regard to Canadian interests and vice versa, then Americans and Canadians living near the border would be causing interference to one another constantly and degrading each others' communications. Also, if governments throughout the world could not agree to designate the same frequencies for certain uses, then efficiency and safety would be compromised. (Air traffic control provides a good example here: if, say, the United Kingdom, Canada, and Japan all used different frequency bands for air traffic control communications, then an aircraft flying from London to Tokyo via Toronto would need three different pieces of radio apparatus on board. A flight from, say, Dublin to Moscow that crosses over the U.K., the Netherlands, Germany, Poland, Lithuania, and Belarus – all within a few hours – highlights the potential for even greater complexity.)

Below the ITU level national governments manage spectrum in two broad ways: they *allocate* certain spectrum bands to specific *uses* – for example, in Canada the bands 825-850 MHz and 870-895 MHz are allocated to cellular telephone service and the band 87.5-108.0 MHz is allocated to FM radio broadcasting; and they *assign* frequencies to *users* – for instance, Rogers Wireless has a national licence for half of the cellular frequencies noted above and "Kool FM", a classic hits station, is licensed to broadcast at 96.5 MHz in Halifax.

In Canada these roles are split between Industry Canada and the Canadian Radio-television and Telecommunications Commission (the CRTC).

The *allocation* of spectrum to uses – such as cellular communications, radio and television broadcasting, marine and aircraft communications, satellite communications, terrestrial military communications, etc. – is the responsibility of Industry Canada.

Moving down to the level of *assignment*, the CRTC is responsible for assigning frequencies to users of broadcasting spectrum; that is, the CRTC decides who will receive licences to operate radio and television stations. All non-broadcasting spectrum is assigned to users by Industry Canada; it is Industry Canada that decides which parties will receive licences to operate cellular or paging operations, to operate radio systems in taxis and delivery trucks, to operate police and fire radiocommunication systems, etc.[4]

[4] Some frequencies are allocated to unlicensed uses. Examples here include garage door openers, cordless telephones, and baby monitors. Interference concerns are addressed by setting the maximum transmission power for these devices to very low levels.

Industry Canada has used three broad types of processes to assign spectrum licences.

The majority of licences historically have been assigned on a first-come, first-served basis. This has been possible because as a practical matter, spectrum scarcity often was not a binding constraint. Sufficient spectrum remains available for many uses in many areas such that Industry Canada has frequencies "in stock" with no exhaustion foreseeable anytime soon. (One would likely not have much difficulty, for example, in finding available frequencies to run a taxi radio service in Iqaluit.)

In more populated areas and in spectrum bands allocated to lucrative business opportunities like cellular telephone service, however, demand for spectrum does outstrip supply. In this case the government requires a process to decide which competing applicants will receive licences and which ones will not.

Prior to 1999, the "comparative selection and licensing process" – informally referred to by some as the "beauty contest" method – was used. Here applicants would submit written submissions (often measured in boxes, rather than pages), in which they would argue their case as to why they should be selected over their competitors. Licensees chosen through these processes generally were required to pay licence fees, but the level of these fees was set administratively with no real bearing on the value of the spectrum resource.

Many observers, particularly economists, highlighted a number of real and potential flaws with this system.

- Applicants face an incentive to make the promises that they think bureaucrats and politicians want to hear in terms of technology choices, service offerings, retail price plans, and coverage areas. However, few industries are as dynamic as the wireless communications sector. If circumstances change such that variances from the promised plans are warranted, then one of two undesirable things can happen: 1) the government can require the licensee to stick to its now suboptimal promises, to the detriment of consumers, or 2) it can allow these changes, rendering the original promises – the basis for the licence award – meaningless. (In practice, the second option has tended to prevail.)

- Because applicants' submissions contain confidential business information, these materials are reviewed and licence award decisions are made by bureaucrats and politicians behind closed doors. This raises the potential for perceived, if not real, favouritism and corruption.

- Since market forces are not permitted to act, it is questionable as to whether the government's licensing decisions will ensure that the spectrum ends up in its highest value use. As well, since the licence fee is set administratively it is unlikely that the full value of the resource will be recovered, at the expense of the public treasury.

- Comparative review processes are incompatible in practical terms with large numbers of competing applications that vary significantly in terms of the frequencies and the geography requested. It can be a reasonably straightforward administrative task to assess and rank, say, multiple requests for a national licence. However, it is far more complex to compare mutually exclusive requests for national, regional, provincial, and local licence areas – adding in multiple sizes of spectrum blocks (e.g., 10 MHz and 20 MHz licences) complicates things further.

In contrast, auctions can be designed to be completely open and transparent; the winner of a licence is the winner solely because he or she is willing and able to bid more than any other bidder for that licence. As Industry Canada noted in its initial consultation paper on the subject of spectrum auctions, "[a]uctions substitute real world investors and consumers for public servants in the determination of who has the better business plan, the most innovative ideas, the most highly beneficial services, the right technology and the best management team."[5] Auctions also generate, by definition, market prices for spectrum licences, thus avoiding give-aways of public assets at artificially low prices. As well, computerized auction platforms allow for flexibility in terms of bidder demands: smaller players who wish to bid on localized areas can compete on the same objective footing as larger players who wish to amass regional or national footprints.

Auction design issues are discussed briefly in the next section.

[5] Industry Canada, *Consultation on Issues Related to Spectrum Auctioning*, August 1, 1997, p. 7.

AUCTIONS: A PRIMER

The most basic auction types are reasonably familiar to most people, including the sealed bid auction – all bidders submit a price in a sealed envelope and once the envelopes are opened, the winner is the bidder who submitted the highest bid, and the open ascending auction (often referred to as the "English auction") – an auctioneer calls out ever-higher prices until only one bidder remains, who wins at the last price called. With the widespread popularity of sites like eBay, many people now also are familiar with Internet-based bidding mechanisms.

Depending on such factors as the type of item(s) being sold (e.g., is there a single item or are there multiple items? if there are multiple items, are they interrelated in value? if so, to what extent are the items substitutes for and/or complements to one another?) and the nature of the bidders expected to compete in the auction (e.g., are there many bidders or few bidders? are the bidders similar or dissimilar in terms of financial means or auction objectives?), different auction formats and rules are most appropriate. Any particular auction may be unsuccessful if the wrong design and rules are chosen.

The auction format used by Industry Canada (and by other administrations around the world) to assign spectrum licences is known as the simultaneous ascending auction. This auction design can at first appear complex in some respects, but at its base are simple and easily understood concepts: prices rise over time and whoever eventually submits a bid for a licence that no one else is willing to top wins that licence.

Spectrum auctions typically feature large numbers of licences. In the most recent Industry Canada auction for example, 292 licences were available. This included a mixture of spectrum block sizes (20 MHz, 10 MHz, and 5 MHz) across the geography of Canada (some spectrum blocks were offered over larger regional areas – e.g., the province of New Brunswick was offered as a single service area, while other blocks were offered over much finer geographic divisions – e.g., New Brunswick was split into three sub-areas).

Prior to each auction a public consultation process is held to solicit the input of prospective bidders on issues such as how the available spectrum should be packaged into licences: if 100 MHz across Canada is available, would bidders prefer two 50 MHz licences in each of ten provinces, or perhaps five 20 MHz licences across a larger number of sub-provincial areas, or some other configuration?

Licences have ten-year terms with a significant expectation of renewal at the end of that term, giving them a quasi-perpetual nature.[6] Licensees may sell their licences, in whole or in part, to other eligible parties (e.g., parties that comply with Canadian ownership requirements).

These details and all conditions of licence and bidding rules are finalized and made known well before the auction begins. Government commitment to firm rules and procedures is critical to a successful auction.

[6] Albeit with some significant restrictions – this is discussed more fully in section 6.

Bidding in the auction occurs over a series of discrete rounds with strictly enforced starting and ending times. Bids are submitted and auction information is disseminated via an auction web site hosted by Industry Canada. All licences are available for bidding simultaneously. After new bids are received for licences in each round, the minimum acceptable bid rises for the next round. Bidders are able to switch among licences from round to round; thus a bidder who initially hoped to win block A licences in Ontario may switch to bidding on block B licences in Quebec if during the course of the auction the prices of the former become too high for her budget and the prices of the latter remain attractive. As prices rise round to round, the field of bidders will be winnowed down. Once a round goes by with no new bids on any licence, the auction ends and the bidder with the standing high bid on a licence entering that round is declared the winner of that licence.[7]

The recent Industry Canada auction required 331 rounds of bidding between its opening on May 27, 2008, and its closing on July 21, 2008.

[7] This is a highly simplified discussion of the auction rules. For more detail, see Industry Canada's *Framework for Spectrum Auctions in Canada*, October 2001, http://www.ic.gc.ca/epic/site/smt-gst.nsf/vwapj/framework-e.pdf/$FILE/framework-e.pdf.

CRITICISMS: THEN & NOW

In the spring of 1994, just months before the first American spectrum auction, Industry Canada launched a public review of its comparative selection and licensing process. The consultation document[8] sought input on how improvements could be made in terms of procedural attributes such as responsiveness, openness, and cost; the document also solicited advice as to whether policy changes were warranted to ensure economically efficient resource allocation and appropriate licensing revenues for the government via the comparative selection and licensing process.

The introduction of auctions was not specifically proposed in this document. Nonetheless, almost all of the 22 parties who submitted comments addressed the topic. The majority of these responses were opposed to the introduction of spectrum auctions, some vehemently so.

It is interesting that these critical voices included such disparate parties as PIAC (the Public Interest Advocacy Centre, which describes itself as "a non-profit organization that provides legal and research services on behalf of consumer interests, and, in particular, vulnerable consumer interests, concerning the provision of important public services"[9]), Rogers Communications (already an incumbent wireless carrier at the time and one of Canada's largest corporations, both then and now), and Clearnet (at the time a relatively small player on the Canadian communications scene, Clearnet would go on to receive a licence for personal communications services – i.e., second-generation cellular telephone service – in 1996 through a comparative selection process before being taken over by TELUS in 2000).

Some responses simply reflected a basic philosophical disagreement with increased reliance on market forces. Others looked more like classic rent-seeking behaviour: parties who expected to benefit from the comparative selection process had strong incentives to see that it remained the government's spectrum assignment mechanism of choice. In some cases commenters mistook the possibility of introducing a new, more market-oriented licence assignment process as being equivalent to plans for the complete abdication of any government role in spectrum management whatsoever.

The following is a summary of the objections and concerns that were raised.

- Only a small number of bidders with "deep pockets" will be able to win.
- One bidder could win all the licences and establish a monopoly, to the detriment of consumers.
- Firms may bid for purely speculative purposes and "warehouse" spectrum instead of using it to provide services to the public.

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[8] Industry Canada, *Public Review of the Comparative Selection and Licensing Process*, April 1994, http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf01563e.html.

[9] http://www.piac.ca/information

- Bidders may bid "too much", leaving them with insufficient capital to build out networks and deliver services after the auction.

- Any amount paid by winning bidders will translate into higher consumer prices.

- Auctions remove the government's ability to regulate in the public interest.

- Auctions would result in only the biggest markets being targeted while smaller, rural, and more remote areas would be denied service.

- Auctions would prevent public service users like police and fire departments from accessing spectrum.

More recently, the highest profile criticism of auctioning spectrum licences has come from the *National Post*'s Terence Corcoran.[10] This is perhaps surprising at first glance given Mr. Corcoran's usual preference for market mechanisms over government regulation and control. His criticisms and contentions (not counting some of those already listed above) include the following:

- The government limits the availability of spectrum and artificially creates shortages and scarcity.

- Winning bidders buy the equivalent of a licence to use spectrum, not a tradable property right.

- The structure of the recently concluded AWS licence auction was faulty because some spectrum was set aside for new entrants (incumbents such as Bell, Rogers, and TELUS were ineligible to bid on 40 MHz of the 105 MHz available in the auction).

The next section examines these points, both from the perspective of economic theory and in terms of the past 15 years of real-world evidence.

[10] See Mr. Corcoran's *Financial Post* columns of July 8th (http://www.financialpost.com/analysis/columnists/story.html?id=aaa7c128-49ae-4677-ab28-bb304c567a87) and July 23rd (http://www.financialpost.com/analysis/columnists/story.html?id=12812dd0-b74f-4d09-9bd7-9a8b7132f701), 2008.

ASSESSING THE EVIDENCE

Canada and the United States are not the only countries to have adopted spectrum auctions following New Zealand's and Australia's pioneering efforts in the late 1980s and early 1990s. A diverse range of countries from all parts of the globe, including Germany, Guatemala, Hong Kong, Mexico, the Netherlands, Nigeria, Switzerland, Trinidad and Tobago, and the United Kingdom also have held auction processes to assign spectrum licences. Sophisticated auction mechanisms also have been implemented by policy-makers in other sectors, including electricity, oil and gas, mineral extraction, and transportation, for example.

Another broad indicator of the success of auctions as a means to assign spectrum is the fact that once introduced, auctions are used repeatedly. For example, Canada has now held five auctions, the United States 72, Australia 35, and New Zealand 10. If the critics' worst fears had turned out to be true, then one would expect that the fall-out from the first failed auction would have been sufficient to sour governments on using them again.

Moving beyond these general indicators, what about the more precise criticisms itemized in the previous section?

Two of the concerns can be dismissed immediately as unfounded.

First, it is clear that the introduction of auctions as an assignment mechanism did not cause the government to cease regulating spectrum usage. The licences awarded in the most recent auction come with a myriad of conditions, including Canadian ownership restrictions, technical limitations to mitigate potential interference with users of "neighbouring" frequencies, requirements to assist law enforcement agencies (e.g., with wire-tapping – or perhaps "wireless-tapping" is the more appropriate term), and mandated spending on research and development. Whether the public interest truly is well-served by all these regulations is debatable, but the fact that the government still can and does force companies to spend a given portion of their revenues on research and development clearly demonstrates that regulation can occur within an auction framework.

Second, the introduction of auctions has not prevented safety services and other public sector users from accessing spectrum. To date, only spectrum anticipated to be used by commercial entities has been awarded by auction. There are in fact good economic arguments as to why safety services should acquire their spectrum via the marketplace – the same way they acquire their labour, vehicles, electricity, paper clips, etc. However, Industry Canada has given no indication that such a policy is under consideration.

Three more criticisms are easily disproved by looking at the results of the auctions that Industry Canada has held.

Figure 1 clearly shows that more than a "small number of bidders with deep pockets" can win licences via auction. Four of the five auctions in fact featured double-digit numbers of winning bidders and three of the five featured at least one winner who acquired a licence for no more than $5,000 (the cost of a decent, but unspectacular, second-hand car).

Figure 1: Summary of Industry Canada Auction Results

Auction (Date)	Total Revenue	# of Licences Available	# of Winning Bidders	Largest # of Licences Won by One Bidder; Highest Total Winning Bids*	Smallest # of Licences Won by One Bidder; Lowest Total Winning Bids**
24 & 38 GHz – fixed broadband (1999)	$172 million	354	12	92 licences; $74 million	1 licence; $5,000
Personal Communications Services (PCS) (2001)	$1.482 billion	62	5	23 licences; $720 million	1 licence; $600,000
2300 & 3500 MHz (2004)	$11 million	849	22	138 licences; $6 million	1 licence; $5,000
2300 & 3500 MHz Residual (2005)	$58 million	457	15	130 licences; $35 million	1 licence; $1,250
Advanced Wireless Services (AWS) (2008)	$4.255 billion	292	15	59 licences; $999 million	1 licence; $739,000

*, **May not be the same bidder in some cases.

Similarly, these data show that in no auction did a single bidder win all the licences and establish a monopoly. Not only did the auctions themselves generally result in numerous competing licensees in each service area, it also is important to remember that these winning bidders face competition from other sources, including incumbent cable, telephone, and cellular companies, service resellers, satellite service providers, and winning bidders from previous (as well as perhaps future) auctions. To the extent that there are legitimate fears that a spectrum auction could result in a single monopoly service provider for a certain type of service or technology, other remedies are available including the government's ability to impose an auction rule limiting the amount of spectrum that any one bidder can win in a given service area; such limits have been imposed in Industry Canada auctions.

Each Industry Canada auction also has seen interest in smaller, rural, and remote areas, contrary to the claim that only the big cities would be served if licences were awarded via an auction. The first auction, for the 24 & 38 GHz band, saw licences being awarded for such communities as Prince Edward Island, the Gaspé region of Québec, Dawson Creek (British Columbia), and the three northern territories. Licences for the 2300 & 3500 MHz bands were assigned for Labrador, Chibougamau (Québec), Marathon (Ontario), and Thompson (Manitoba). In the most recent auction for Advanced Wireless Services spectrum, examples of smaller communities that

received winning bids include Cape Breton, Chicoutimi (Québec), Kirkland Lake (Ontario), and Nanaimo (British Columbia).

There also is little evidence that spectrum was acquired at auction for speculative warehousing. This line of argument requires that the winning bidder be able to "flip" its spectrum to another buyer for a price greater than the winning bid in the auction. (Before even getting to the facts of the matter, it is worth asking why that buyer would not have participated in the auction itself, rather than waiting to pay an inflated price later in the secondary market.) Some auctioned licences indeed have changed hands in the secondary market, but these have been relatively small transactions, not windfall events for the sellers. For example, Syncrude Canada Ltd. purchased a portion of a northern Alberta 24 GHz licence from its original auction winner, WNI Networks Inc., in order to set up an internal communications system in the oil-patch. Contrary to the Syncrude example, it is generally true that little has occurred in terms of service roll-out with the 24 and 38 GHz frequencies auctioned almost a decade ago, but this is due to the fact that affordable radio equipment suitable for delivering multipoint communications services to the home has not become available as anticipated at the time of the auction. In contrast, PCS licence winners, for example, quickly moved to provide services to customers with the frequencies they had won.

Spectrum may or may not be put into use quickly due to marketplace realities, but this will be the case no matter how the frequencies are assigned. The incentive to engage in speculation actually will be higher in a non-auction process because here the licensees will not have to pay a market price for their spectrum, creating the opportunity for large windfall profits when the spectrum's true value is realized in the secondary market.

The charge that auctions will induce businesses to bid "too much" as a general practice also remains unproven. Undoubtedly from auction to auction – as in any business transaction – there will be bidders who, using the information available to them at the time, overestimate the value of one or more spectrum licences. However, the claim that winning bidders over-pay on a widespread basis, leaving them with insufficient funds to build out networks and serve customers, is contradicted by the dozens, if not hundreds, of auction winners around the world who are now serving customers.

A variant on the "bidders will bid too much" argument is that *any* revenue received by the government for spectrum licences is unjustifiable because this will have a negative impact on licensees' abilities to develop infrastructure and deliver services. First, until such time as technology overcomes constraints currently imposed by the laws of physics, spectrum will remain a scarce resource with a positive economic value. Second, no matter how spectrum is assigned, its market value will be captured by someone; if that value is not realized by the government through an auction process, then it will accrue to the initial licensee (or its shareholders) as a windfall gain through the stock market or through a secondary market transaction.[11] From the public finance perspective, revenues derived from the marketplace sale of assets like spectrum (or oil rights, timber rights, used vehicles, or surplus office furniture) are preferable to tax revenues because the former do not distort choice and create deadweight losses as do taxes on, say, income or consumption. This point is examined by Adele Morris of the U.S. Department of the Treasury, who concludes that "spectrum auctions can be a relatively more efficient way to raise revenue for

[11] One of the factors that drove the FCC to implement auctioning in the United States was embarrassment over the windfall gains received by the initial licensees selected in other types of processes. In one notorious example a group of dentists won, via lottery, the right to provide cellular telephone service in Cape Cod and promptly "flipped" the licence to Southwestern Bell for $41 million.

the government than other revenue instruments, thus making it more efficient to auction spectrum and 'recycle' the revenue to offset more distortionary revenue instruments."[12, 13]

Without recognizing that the two claims contradict one another, those who argued that auction winners would be unable to afford to build out their networks also often argued that winning bid amounts would be passed through to consumers in the form of higher retail prices for communications services. Kwerel refutes the latter claim first with basic microeconomic theory.

> "Standard economic theory predicts that sunk costs are irrelevant to the pricing and output decisions of firms. A sunk cost is one that is not escapable. It does not vary with output or even if the firm goes out of business, and thus should have no effect on any business decision. The amount paid for a spectrum license in an auction is such a sunk cost. Once it is paid, the payment cannot be recovered from the government and it does not vary with output. Therefore, the historical cost of winning bids at auctions should have no effect on the price or availability of spectrum-based communications services for customers.
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> …
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> Observations are consistent with the theory that sunk costs do not affect prices. This is true regardless of market structure. For example, in competitive rental markets rents do not depend on the historical costs of acquiring a property. Those who paid high prices for their property are not able to charge higher rents. Nor do owners who acquired their properties cheaply or even for free charge less, absent government price controls."[14]

For empirical evidence he turns to the natural experiment created by the fact that the United States cellular/PCS marketplace features a mix of licensees who received their licences for free and licensees who paid for their spectrum in an auction or in the secondary market. He provides three compelling conclusions:

- "within a given market, the prices charged by cellular operators who purchased their licenses in the after-market are not generally higher than those of firms who acquired their licenses for free;"
- "within each market, a comparison of prices before the sale date and after the sale date indicates no increase after the sale;"
- "we examined whether prices were falling by even larger percentages in markets with no license sales during the same period ... [a] reasonable conclusion from this is that paying for a license (the first sale of a license that was acquired free of charge) had no effect on

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[12] "Spectrum auctions: Distortionary input tax or efficient revenue instrument?" Adele C. Morris, *Telecommunications Policy*, 29 (2005) pp. 687-709.

[13] Considering the difference between government revenues derived from the sale of assets and non-renewable resources, on the one hand, and income or consumption tax revenues, on the other, there is a further argument that the two should not be treated in the same manner and that the former should be applied to outstanding debt or deposited to a trust like the Heritage Savings Trust in Alberta or the petroleum fund in Norway, rather than used to finance current spending. See, for example, *The 100% Solution*, Atlantic Institute for Market Studies, July 2006, http://www.aims.ca/library/Equalization3.pdf.

[14] "Spectrum Auctions Do Not Raise the Price of Wireless Services: Theory and Evidence," Evan Kwerel, Office of Plans and Policy, Federal Communications Commission, October 2000, pp. 1-2, http://wireless.fcc.gov/auctions/data/papersAndStudies/SpectrumAuctionsDoNotRaisePrices.pdf.

> prices, or even may have reduced prices as the new licensee gained full control of the business."

The more recent criticisms by Terence Corcoran are different in nature (aside from his claims, already addressed above, that bid prices would both cripple bidders and lead to higher prices for consumers – he too fails to recognize that these two theories are at direct odds with one another). His arguments that government artificially creates scarcity, that licences should be tradable property rights, and that the policy of setting aside spectrum blocks for newcomers in the most recent Industry Canada auction was misguided, are really focused on "how to" auction spectrum, rather than "whether to."

If one accepts that market forces are an appropriate means of assigning spectrum licences in the first instance, then it follows that market forces also should be relied upon going forward. Industry Canada in fact does explicitly allow for auctioned spectrum to be bought and sold in the secondary market, but these licences do not yet constitute full property rights: although there is a presumption of renewal, licences officially have only 10-year terms; intrusive and questionable licence conditions – such as mandated spending on research and development – remain in place; and, while flexibility is increasing, restrictions continue to apply as to how auctioned spectrum may be used. Non-auctioned spectrum is even less property-like; for example, holders of non-auctioned licences have no clear right to transfer their licences to others in the secondary market. Richard French, an adjunct research professor at the University of Ottawa and one-time wireless industry executive, uses a real estate metaphor to describe the situation.

> "Imagine a municipality which operated a zoning regime for commercial property based on the standard 'command and control' spectrum management regime. Commercial property would not be sold, but leased for periods of ten to twenty years. Municipalities would place restrictive conditions on all leases: exactly what use the property is put to; what kinds of products or services could be sold from it; what kind of building, housing what kind of technology, could be built on it and by when; whether and how the lease could be transferred to another holder; sometimes what prices lease-holders could charge their customers, and so forth. It is a safe bet that such a municipality would look much different from the municipality we in the West are used to and, say the economists, it would be far less productive."[15]

With regard to the set-aside of spectrum for new entrants in the recent AWS spectrum auction, Mathewson and Tepperman support Corcoran's contention that such regulatory intrusion in the marketplace was unwarranted.

> "Any short-term consumer benefits that might accrue from special entry-inducing rules need to be measured against the increased risk and long-term costs of inefficient entry. The risk is not justified by any evidence of existing or potential future market failure. Therefore, public policy directed at regulating the auction to tilt toward entrants and away from incumbents is not required."[16]

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[15] "Spectrum Auctions 101," Richard French, *Optimum Online: The Journal of Public Sector Management*, Vol. 38, Issue 2, May 2008, p. 19, http://www.optimumonline.ca/article.phtml?id=305&page=19.

[16] "The Advanced Wireless Services Auction: Let the Market Decide the Players," Frank Mathewson and Andrew Tepperman, *Policy Options*, November 2007, p. 58, http://www.irpp.org/po/archive/nov07/mathewson.pdf.

Mathewson and Tepperman note that, even prior to the addition of new spectrum via the AWS auction, both the CRTC and the Competition Bureau had found that the provision of wireless services in Canada to be competitive and therefore concluded that there was no market failure in terms of marketplace entry that required a regulatory intervention via the auction process. By manipulating the playing field through a spectrum set-aside, the government may have promoted the entry of firms who, but for that effectively subsidized entry, would not be competitive and who otherwise would have made the rational choice not to enter the market. Since the market already *was* competitive prior to the auction, the entry of new, subsidized firms will not cause the market to become competitive. Since competition within the auction was artificially limited for a portion of the spectrum, the government has foregone revenues that otherwise would have accrued to Canadian taxpayers. And since set-aside bidders were potentially diverted from their optimal (non-subsidized) investment opportunities, the investment in entry into the wireless marketplace for these firms may have been an inefficient allocation of resources.

To summarize, Corcoran usefully identifies means by which spectrum auctions could be improved, but unfortunately misconstrues these deficiencies in *how* auctions are conducted as reasons *why* auctions should not be used to assign spectrum.

CONCLUSIONS & RECOMMENDATIONS

Although the core concept is rooted in fairly basic economics, the introduction of auctions as a spectrum assignment mechanism generated tremendous controversy at the time.

Spectrum auctions, however, have proven themselves on several levels.

While there have been exceptions where errors were made in the auction design and rules,[17] in general auctions have performed well: they have assigned large numbers of licences in relatively short periods of time, they have captured the (significant) value of spectrum resources for the public, and they largely have avoided the real or perceived favouritism that tends to accompany less objective and less transparent processes (like "beauty contests"). Canada has a particularly good track record and although there has been disagreement from some quarters over specific policy choices within auction processes, there have been no real problems or suggestions of poor management or wrong-doing with any of Industry Canada's auctions.[18]

It is interesting that in recent pre-auction consultation processes,[19] there is really no longer any debate over whether an auction is the appropriate licence assignment mechanism, rather, discussion focuses on specific rules and policy options within the auction process.

This is not to say, however, that no further work is required. Both Industry Canada specifically, and all Canadian governments generally, should learn from the experience of spectrum auction programs (in Canada, and abroad) and consider ways to improve current processes for assigning licences, resource rights, and other valuable assets.

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[17] For example, in one of the first Australian spectrum auctions, no rules were implemented to prevent bidders from reneging on their bids. This led to insincere bids being submitted and a collapse in auction revenues. The Australians – and others, including Canada – learned from this mistake and now bid withdrawal penalties are common in spectrum auctions.

In another example of faulty design, in early American spectrum auctions certain classes of bidders were permitted to pay their bid amounts in multi-year instalments with very generous financing terms. This led to bidders "gambling" with inflated bid amounts, knowing they could walk away with little money down if business did not develop as they had hoped. The result of this policy was a very large number of bid defaults and significant delays in getting the spectrum into the hands of licensees who actually were able to implement their business plans and serve customers. Once again the lesson was taken by regulators and today auction bid amounts generally are due in full shortly after the close of the auction (30 days later in the Canadian case).

[18] In contrast to the still unresolved multimillion dollar lawsuit launched by an unsuccessful participant in a comparative selection process in the mid 1990s.

[19] See the comments received with regard to the AWS auction, for example: http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf08769e.html.

In order to maximize benefits for Canadians, action on five fronts is recommended.

1. Industry Canada should formally remove the comparative selection and licensing process (the "beauty contest" method) from its spectrum assignment options.

The effectiveness, efficiency, and fairness of auctioning have been demonstrated and are now widely accepted. The comparative selection and licensing process remains unable to efficiently process overlapping demands for multiple licences, it fails to identify and capture the value of the spectrum resource, and it leaves far too much power to be exercised by politicians and bureaucrats behind closed doors. Auctions should be identified as THE process to be used when demand for spectrum is expected to outstrip supply.

2. The CRTC should adopt auctions for assigning broadcast spectrum.[20]

Currently the CRTC holds lengthy bureaucratic processes to award licensees, generally on a market-by-market basis meaning that the process of selecting licensees for a given spectrum band across the country can take years. As well, the licence fees charged by the CRTC are largely divorced from the market value of the spectrum in question. Furthermore, the normal licence terms and conditions imposed by the CRTC result in licences that are much further away from true property rights than are the licences auctioned by Industry Canada. Traditional distinctions between telecommunications and broadcasting are rapidly blurring and it is a bizarre state of affairs that two federal organizations could use such highly different approaches to assign frequencies that are, in some cases, identical in their technical characteristics.

Some may counter that broadcasting is "different" and that an auction process cannot deal with the social and cultural aspects of broadcasting (as opposed to the private and more utilitarian nature of telecommunications). This criticism falters on two counts. It is now not only possible, but increasingly common, for people to consume cultural content like movies, music, and television and radio programming via telecommunications (Internet) devices and networks: YouTube, iPods, and video-capable cellphones are well-known examples. When one can choose between downloading a movie to a laptop computer via an Internet connection provided by the phone company or select the same movie from the video-on-demand service of the cable provider, what difference remains between telecommunications and broadcasting? The same question applies when listening to the local rock station over an FM frequency versus over the Internet, or when watching CBC news programming via an old television with rabbit ears versus watching it as a podcast. Furthermore, to the extent that the CRTC believes it necessary to attach conditions to broadcasting licences to achieve social and cultural goals, this can be done within an auction framework, so long as these conditions are defined and made known to bidders before the auction.

3. Industry Canada must do more to advance a property rights regime in spectrum.

Its current approach is to be "half pregnant": despite reliance on market forces to assign licences in auctions, the government then second-guesses the market after the fact by limiting licence terms to 10 years and then conducting a review to determine if licensees should be permitted to keep the licences they

[20] Some, including the federal Telecommunications Policy Review Panel (http://www.telecomreview.ca/epic/site/tprp-gecrt.nsf/en/h_rx00054e.html), have called for a reorganization of the telecommunications and broadcasting regulatory apparatus that would see all spectrum assignment and regulation responsibilities placed under one roof. In such circumstances the new agency should adopt auctioning as its method of assigning licences.

paid for. As for non-auctioned licences, these are even less akin to property rights than are auctioned ones.

The case for property-like spectrum licences is straightforward. If a licensee has certainty in spectrum tenure, then it constantly faces an incentive to invest in the complementary infrastructure (antenna towers, system software, etc.) and to provide the best services that will attract and retain customers. If instead a licensee is approaching the end of a licence term and it is uncertain whether the licence will be renewed (or it is certain that it will not), then these incentives to provide the best possible services and to grow its customer base diminish.

If a licensee has the right to sell its spectrum to another party– and it must be remembered that all the licence conditions attached to the original licence would remain fully in effect for the buyer – without concern about delays while the Minister considers the political optics of the transaction, the opportunistic addition of new licence conditions, or attempts to tax supposed windfall gains, then economically efficient transfers will occur as original licensees sell to buyers who can make better use of the frequencies. If instead licences are not treated as property and transactions are subject to these forms of regulatory risk, then transfers will be deterred and spectrum may remain in second-best uses.

Examples of worrisome backsliding can be seen in the current process to determine whether the 1999 auction winners of 24 & 38 GHz licences should be permitted to keep their licences after the first 10-year term is up, and if so, under what conditions.[21] It should first be noted that the news is not all bad; Industry Canada has recognized that markets are unpredictable places, especially ones as technologically dynamic as wireless communications, and has backed off on requiring licensees to implement service by some arbitrary milestone date within their licence term, whether or not equipment is available and profits are likely. However, despite paying lip service to the effectiveness of secondary markets, Industry Canada proposes to conduct the same type of service implementation assessment as part of the licence renewal process at the end of the nominal 10-year term.

More troubling is the proposal to impose a new licence fee for renewal, on top of the bid prices originally paid in the auction. So long as these licences are subject to the forces of supply and demand in the secondary market, the imposition of new fees will do nothing to improve allocative efficiency. That leaves cost recovery or resource rent capture as arguments for imposing renewal fees. The reserve prices for the 24 & 38 GHz auction were established on a cost recovery basis. The total of the reserve prices for all 354 licences was just under $10 million. As the auction produced more than $170 million in revenue, it is hard to argue that the government's costs have not been covered, even if one splits hairs by saying that the $10 million accounted only for the initial 10-year term. As for the resource rent capture argument, given the difficulties that licensees have had in acquiring suitable equipment and launching services, it seems unlikely that things unforeseen at the time of the auctions have led to the development of windfall gains thereafter. More generally, if after any auction the value of spectrum rises relative to what was paid in the original bid price, this value will tend to be crystallized in stock market or secondary market transactions, so there is no way for the government to "capture" it via a new licence fee.

The more uncertainty that the government injects into future licence terms, the greater will be the disincentive for licensees to invest in new and better technology and service offerings (and the lower will be the initial auction revenues for such licences). Just as an auction market can determine the optimal

[21] See *Consultation on the Renewal of 24 and 38 GHz Spectrum Licences and Spectrum Licence Fees for 24, 28, and 38 GHz Bands*, Industry Canada, April 2008, http://www.ic.gc.ca/epic/site/smt-gst.nsf/vwapj/dgrb-001-08-e.pdf/$FILE/dgrb-001-08-e.pdf.

distribution of licences initially, a secondary market (unencumbered by regulatory risk) can ensure an efficient distribution over time. The natural reluctance of politicians and bureaucrats to "let go" must be overcome and spectrum licences should be made perpetual.[22]

4. Industry Canada should adopt best practices in auction design and implementation.

Auction design and auction technology continue to evolve and improve. Industry Canada, which continues to use an auction software platform developed in the mid 1990s (the era of Netscape, Windows 95, and 3.5 inch floppy disk drives), should update its auction system so that it has more flexibility in setting rules and choosing more sophisticated auction formats.

The most recent auction lasted for close to two months. Bidders typically dedicate a team (perhaps five to fifteen people) of personnel full time to the auction process and significant demands also may be placed on the time of senior executives. These are not insignificant costs. By adopting proven practices from other countries in terms of how bids are submitted to the auction software, it may be possible to significantly reduce the time required to complete an auction.[23]

A more fundamental change would be the incorporation of "combinatorial bidding" which allows bidders to bid a single price for a package of licences, rather than being required to bid separately on each licence within the package. Combinatorial bidding is particularly helpful where there are strong complementarities across licences. For example, a bidder's business plan may hinge on receiving a national footprint. If the bidder is forced to bid separately for, say, an Eastern Canada licence and a Western Canada licence, then it risks winning only one of the two, which would be worse than winning nothing at all. With combinatorial bidding, the bidder can bid on the East-West package, and if prices rise too high for the package, it can walk away cleanly.

5. The rest of the federal government, as well as provincial and municipal governments, should become better acquainted with Industry Canada's spectrum auction experience with a view to improving allocation processes for other assets and resources and also procurement processes ("buy side" auctions).

The basic economic fundamentals that make auctions an appropriate tool for assigning spectrum licences apply equally to such diverse items as drilling rights for oil and gas, timber licences, mineral rights, and fish quotas. Bidding processes are used in some cases for these assets, but typically these are simplistic auctions that fail to take advantage of the great strides that have been made over the past 20 years in applied auction theory and Internet-based bidding technology.[24]

Industry Canada's spectrum auction program is a case study in good policy trumping rent-seeking behaviour from vested interests and intellectual laziness from those who automatically recoil at the

[22] Licences should remain subject to cancellation in case of unlawful behaviour such as failure to respect technical conditions that prevent harmful interference to other users. Also, in those rare cases of an unforeseen and overriding public need developing, the government could exercise its right of eminent domain, with appropriate compensation for the licensee that is required to vacate its spectrum.

[23] For example, Industry Canada's auction software only allows bidders to bid "yes" or "no" to an offered bid price for each licence. Other spectrum managers allow bidders more discretion in entering a bid price – this allows for prices to rise more quickly, meaning that less time is required to reach final bid levels.

[24] As such changes and improvements are made in bidding processes for these other assets and resources, careful attention will be required in defining the rights and assets to be auctioned. What geographic scope is optimal? What length of tenure is best and what renewal process is appropriate? Should perpetual rights be granted?

thought of government command and control being replaced by reliance on market mechanisms. Industry Canada should build on its success by expanding its reliance on the marketplace to guide spectrum usage, and other government agencies should look for ways to emulate this experience in their own operations.

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