Report for TELUS

Falling Behind: Comparing 5G spectrum policies in Canada and OECD countries

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1 Overall findings

- Of the 24 countries studied, 22 had made assignments in the 3.4GHz-4.2GHz band, 16 via auctions, one (France) via a mix of direct sale and auction, three via temporary assignments (Belgium, Iceland, New Zealand), and one (Japan) via an award system based on deployment plans. **Canada was one of only three countries, along with the Netherlands and Norway, that had not assigned spectrum in the 3.4GHz-4.2GHz band before July 2021**. Canada was four years behind the earliest principal assignment (Ireland).

- **The auctions held in Canada in July 2021 assigned 200MHz of spectrum between 3.45GHz and 3.65GHz. This is a lower amount than in the principal auctions or assignments in all but three countries.** Moreover, of this 200MHz, only 111MHz (average weighted by population) was actually up for auction, with the remaining 89MHz retained by incumbents (principally Bell Canada, Rogers and Xplornet).

- In 14 of the 22 countries that have assigned spectrum, at least one operator possesses 100MHz of contiguous spectrum. 100MHz is the minimum technical requirement as specified by the International Telecommunication Union (a UN body) to meet the original objectives of 5G elaborated by IMT-2020. **In Canada, only one national operator possesses such a block in one out of 172 service areas**.

- **In Canada, there was a more limited supply of spectrum available to national operators at the principal auction than in any of the benchmarked countries**. Depending on the size of population centres, and depending on the amount of unencumbered spectrum available, 47MHz of the 3.45-3.65MHz block was set aside for facilities-based providers other than the national mobile service providers (NMSPs), defined as those mobile network operators (MNOs) with >10% national market-share. This reduced the total spectrum actually available at auction to NMSPs to 64MHz. A further 89MHz (on a national average basis) was transitioned, of which 69MHz was held by NMSPs. This means that until the 330MHz currently being investigated for potential future use is assigned (not before 2025 in urban areas and 2027 in rural areas) only 133MHz of spectrum will be available to be shared among the NMSPs. This is a lower figure than in any of the benchmark countries where assignments have been made. Of that 330MHz of spectrum currently being investigated for potential future use, 80MHz has been ear-marked for shared use, and it is possible, though this has not been decided, that a further 50MHz will be set aside for non-NMSPs.

- **Canada is the only country routinely to use set-asides that limit the amount of spectrum available to larger established operators.** The only other set-aside in recent 5G spectrum auction was implemented in Italy specifically as a merger remedy.

- **Canada has among the most stringent population coverage obligations** for 3.4GHz-4.2GHz spectrum of all of the 24 countries benchmarked for those operators that have made use of their

spectrum for 4G. It has, however, relaxed conditions for those operators that left that spectrum fallow.

- **The average price paid at the Canada July 2021 auction, USD1.833 per MHz/pop, was the highest price paid.** It was 164% of the average price paid in the USA, the next highest average price paid in any country. It was around 10 times higher than in France and 11 times higher than in the UK. NMSPs paid an even higher average price, USD 2.62 per MHz/pop.

2 Introduction

Radio spectrum is the life-blood of mobile networks. Without radio frequencies there would be no mobile networks, and the less spectrum available to mobile network operators (MNOs) the poorer (slower) the service. Usage of mobile networks continues to rise everywhere on the planet, but the level of usage is itself a consequence not only of underlying consumer demand but also of supply-side factors including, importantly, the amount of spectrum made available to MNOs. Opportunities to use spectrum for brand new purposes that could boost productivity and economic development – for example in transport or industrial networks – are stifled if insufficient spectrum is made available.

Radio spectrum is a natural and scarce resource, in demand not only by public mobile operators, but also by a plethora of other interested parties (broadcast radio and TV, the aviation sector, defence and other public sectors to name but a few), and some is also set aside for general unlicensed and non-service-specific use, such as the so-called ISM bands that are used for Wi-Fi.

In Canada, as in every country, spectrum for mobile networks is assigned by state agencies mostly in the form of exclusive licences for a fixed duration. Assignment happens in different ways in different jurisdictions.

- Most commonly, it is auctioned. Auctions can serve as a means to allocate spectrum efficiently, but also as a means to raise revenue for the state. How jurisdictions balance these two demands varies greatly. This in turn has an impact on the structure and rules of auctions, especially in terms of how much spectrum is made available, of what coverage obligations have to be met, and of the limits to the amount that can be licensed to any individual MNO.

- In some jurisdictions allocation is based on so-called ‘beauty contests’, where operators compete against one another on the basis of commitments in their plans. This is, for example, the case in Japan.

- In other jurisdictions, mainly but not exclusively those where economic planning is more centralised, spectrum can be directly offered or assigned to MNOs provided they commit to various conditions. This can be short-term, and may or may not involve a fixed financial transaction. Among the countries studied in this report, there are recent examples in Belgium, France, Iceland and New Zealand.

Whatever the mode of assignment, in practically all jurisdictions assignment is treated as a means to curate competition in mobile markets. For example, in a minority of markets, it has been historical practice to structure spectrum assignment in order to stimulate competition or to enable new types of player.

New network technologies (of which the latest is 5G) have two effects. Firstly, spectrum bands which were unsuitable for previous technological generations become useful. Thus, new spectrum

bands can be used for radio acces networks. Secondly, spectrum bands already used for previous generations of radio access networks can be repurposed or 'refarmed' for use with the next generation. Early deployments of 5G will mostly utilise these new bands, where they are made available, before refarming the bands that are already in use over to 5G.

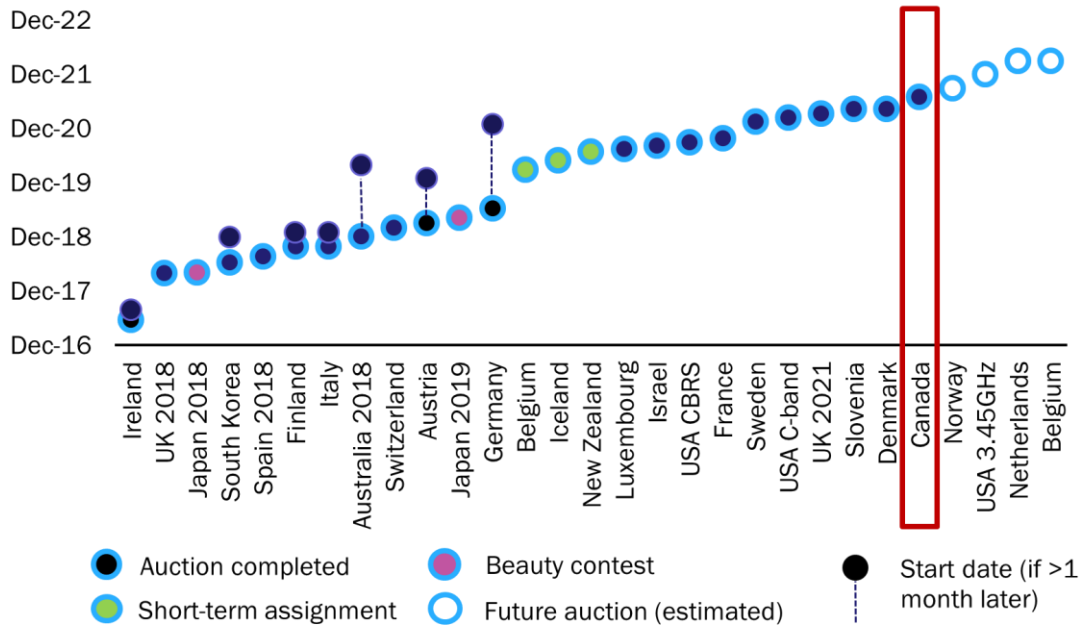
The 3.4GHz-4.2GHz spectrum block is the focus of initial 5G deployments around the world. It offers, uniquely among the principal 5G candidate bands, a good combination of capacity and coverage benefits. It provides substantial additional capacity to meet rising demand, together with sufficient reach to enable near-to-similar levels of coverage to 4G with the existing set of cell-sites.

This paper captures 3.4GHz-4.2GHz spectrum availability in 24 higher-income OECD markets (those with an annual GDP per capita above USD25 000), and contrasts spectrum availability – and in particular spectrum availability for national mobile network operators – in Canada with these countries. It also captures the timing of licence assignments, the level of set-asides, the deployment conditions and the full price paid for spectrum licences. We have calculated the total spectrum currently available to MNOs and other entities in each market, and that expected to be available in the future. Expected availability takes account of proposals published by regulators in each market in relation to making additional mobile spectrum available.

3 Timing of assignments

Of the 24 countries studied, Canada was the 22nd to assign spectrum in the 3.4GHz-4.2GHz band. Norway has an auction scheduled for September 2021 and the Netherlands has an auction scheduled for early 2022. Figure 1 shows the dates of the principal assignments only. At the time of writing four countries (Australia, Spain, UK and USA) had held two auctions, and a third is scheduled for the USA in late 2021.

Figure 1: Dates of principal assignments of 3.4GHz-4.2GHz spectrum [Source: Analysys Mason, 2021]



Note that France had a hybrid auction and direct sale format. Note that not all spectrum will become immediately usable in Canada

The 3.4GHz-4.2GHz band has a number of legacy occupants (WiMAX, fixed wireless) whose licences data back sometimes to before 2010. However, the first auction that made a substantial portion of the band available, on a long-term basis, to national MNOs can be dated to Ireland in May 2017. Canada's first 3.4GHz-4.2GHz band auction was therefore over four years behind the first assignment.

A number of countries have issued short-term licences. Of those countries, Belgium's were assigned pending an auction likely in early 2022, and Iceland will consider long-term extensions (as opposed to auctions) after December 2021 based on *inter alia* roll-out targets. The New Zealand licences were directly offered, for a fixed charge of USD1.4 million, to parties that were to participate in an auction for short-term licences that had been abandoned because of the COVID-19 pandemic. They run until October 2022, and future arrangements for the band between 3.41GHz and 3.8GHz are still

under discussion. Denmark had, prior to the principal auction in April 2021, already issued short-term licences in 2020.

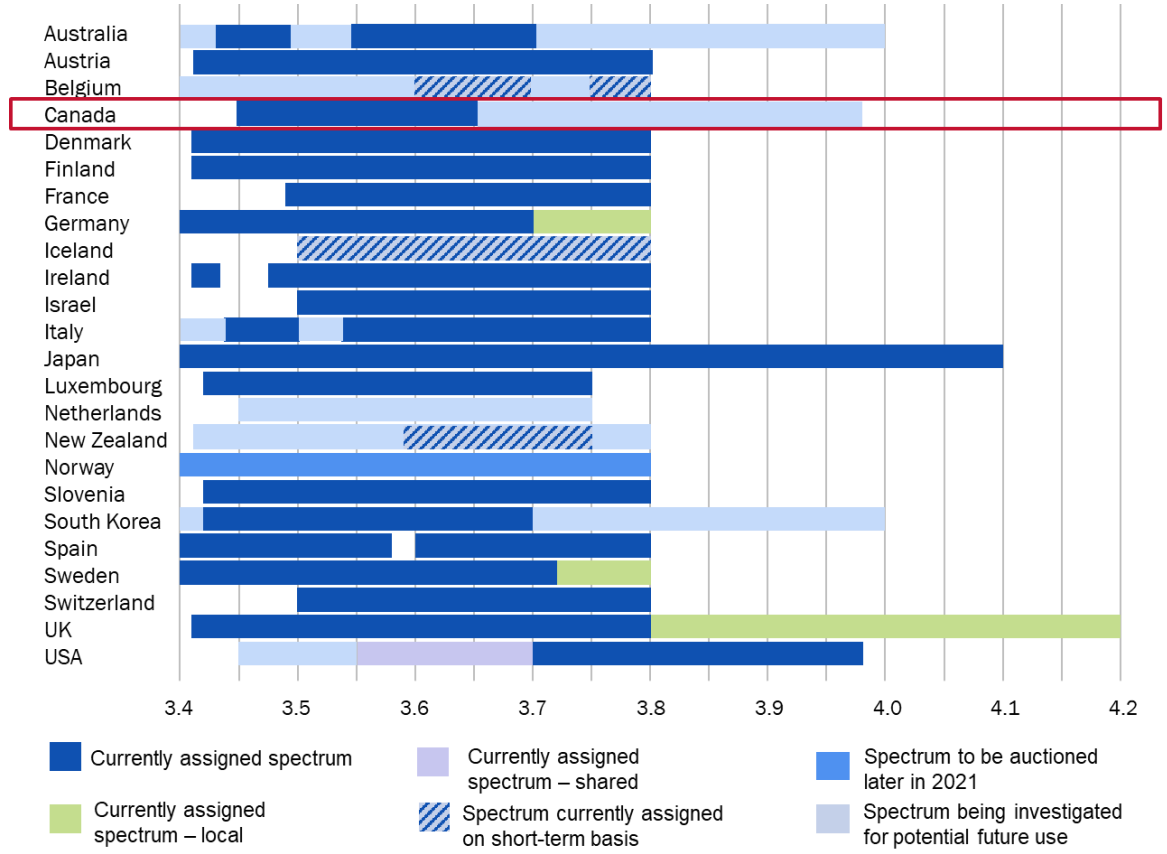
In most cases, licences started within one month of the conclusion of the assignment. In Canada, the date at which operators can actually use the spectrum is postponed. Mobile use for all licences is postponed for six months in urban areas and two years in rural areas, and a large portion of the licences will have a portion of the area encumbered for an indefinite period.

4 Total spectrum

At the July 2021 auction in Canada, licences for 200MHz of 3.4GHz-4.2GHz spectrum were assigned. This was one of the lowest amounts of spectrum on offer at principal auctions or assignments. Among the 21 countries that had already assigned spectrum (long- or short-term), only three (Italy (200MHz), New Zealand (160MHz) and UK (180MHz)) had lower or equal amounts to be sold at the principal auction or assignment. In the cases of Italy and the UK, some MNOs already held licences for different spectrum in the 3.4GHz-4.2GHz band from pre-5G assignments, in the UK a second auction took place for a further 120MHz, and in New Zealand the assignments were short-term until 2022, when a further 230MHz is expected to be assigned.

Of that 200MHz in Canada, 47MHz (weighted national average) was set aside for bidders other than national mobile service providers (NMSPs). NMSPs are defined as having >10% market share nationally. 64MHz was available to Canadian NMSPs at auction, with the remaining 89MHz retained by current occupants of the bands, which were assigned as WiMAX/fixed wireless licences between 2004 and 2009. The main incumbents in these bands are Bell Canada, Rogers and Xplornet. The figure of 64MHz is the most limited supply of spectrum available to national MNOs of all of the primary auctions and assignments among the benchmarked countries.

Figure 2: 3.4-4.2GHz spectrum allocation at 2 August 2021 [Source: Analysys Mason, 2021]



The total of 530MHz in Canada that was either auctioned in July 2021 or is under consideration for future use is, however, higher than the total assigned or under consideration in all but four countries (Australia, Japan, South Korea and UK) and equal to that in the USA. Of that total, though, only 350-400MHz will actually be available to Canadian NMSPs and the 3.65GHz-3.98GHz band will not be made available until 2025 in urban areas and 2027 in rural areas. Other countries may well consider and assign this or other additional spectrum in the 3.4GHz-4.2GHz block well before Canada does.

5 Set-asides and spectrum caps

Set-asides come in two main forms, which in practice sometimes overlap.

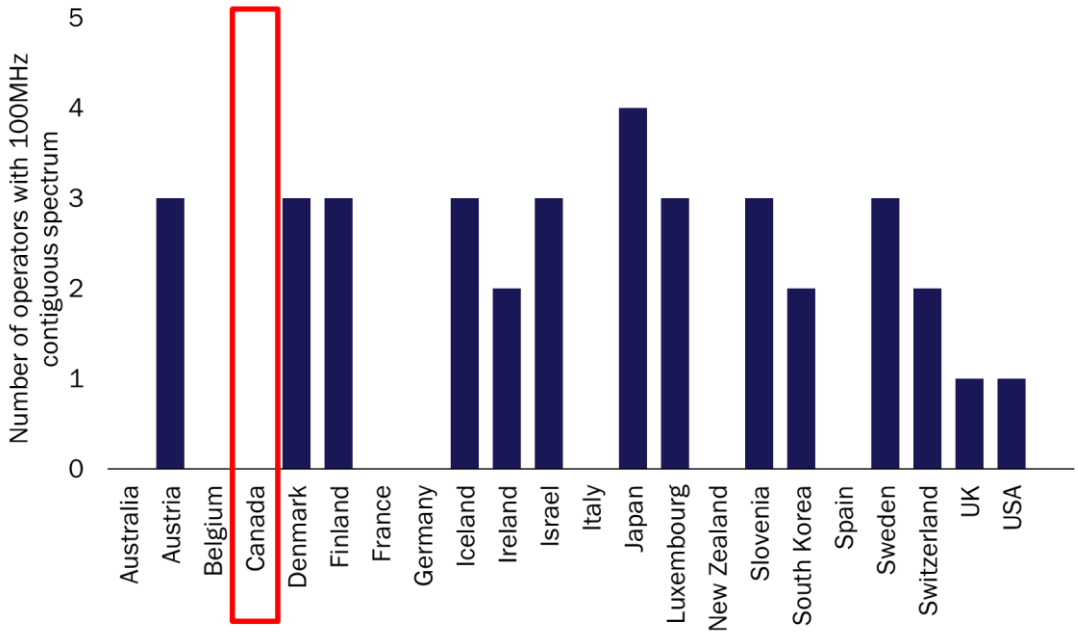
- First, as a potential means to foster market entry. Spectrum is set aside for new operators to enter the market, or for existing, but spectrum-light, operators to migrate away from dependence on national roaming. There was a *de facto* pro-competition set-aside in Japan, where spectrum is assigned via a beauty contest, and the Italian auction was constructed in such a way as to facilitate the foothold of a recent new entrant following a merger. In most service areas in Canada 50MHz was set aside for bidders other than NMSPs in the July 2021 auctions for the 3.45GHz-3.65GHz ranges. A further 50MHz may be set aside in the upper ranges currently under consideration. Canada is the only OECD country that repeatedly uses set-asides. Furthermore, not all candidates for set-asides in Canada are actually new entrants; many are established regional operators that happen to fall below the 10% national market-share threshold. This is unique.

- Second, to encourage local initiatives. Spectrum is set aside for entities including industrial verticals to operate local public and/or private networks. Such set-asides have been applied in the 3.4GHz-4.2GHz band in Germany (100MHz), Sweden (80MHz) and the UK (400MHz). 80MHz of the 3.7GHz-3.98GHz range has been earmarked for similar purposes in Canada.

Spectrum caps on existing operators can deliver something like a set-aside. Norway will auction 400MHz but there is a cap of 120MHz on any one bidder, and there are three national MNOs. However, this form of indirect set-aside is likely to have entirely different outcomes at auction from direct set-asides where the remaining spectrum has no, or less-stringent, caps, since the latter can result in high bidding for ultimately highly asymmetric assignments. ISED explicitly declined to use a cap at the 2021 auction in Canada.

The ITU's minimum technical requirements to meet the IMT-2020 criteria specify at least 100MHz channels per operator, i.e. 100MHz of contiguous spectrum. While aggregation of non-contiguous blocks of spectrum is possible (and actually more effective with 5G than with 4G), 100MHz of contiguous spectrum enables faster networks allows for more-efficient operation of networks. 14 out of the 22 countries that have assigned spectrum have at least one operator with over 100MHz of contiguous spectrum. Where one or more operators has 100MHz of contiguous spectrum, this has sometimes happened as a direct result of the structure of the assignments and auctions (in other words as a direct result of policy), but sometimes as an outcome of differently timed assignments or of spectrum swapping. In Canada, no NMSP acquired 100MHz of contiguous spectrum on a national basis following the 2021 auction. In a single service area (Edmonton), one operator met the ITU recommendation.

Figure 3: Number of operators with 100MHz of assigned contiguous 3.4GHz-4.2GHz spectrum at national level, 5 August 2021 [Source: Analysys Mason, 2021]



6 Licence conditions

Licence obligations imposed on holders are extremely varied, and not altogether comparable.

The majority are not technology-neutral and require 5G deployment, but in eight countries where licences have been assigned no such deployment condition has been imposed. In Canada, although recent licences are technology neutral, licence-holders are compelled to deploy the spectrum on relatively stringent terms over existing LTE footprints. This means that, although technically 5G is not a requirement of the licence in Canada, spectrum licences effectively compel 5G rollout.

Most licences require a minimum level of population coverage within a defined timeframe, although Australia, Finland, Spain, Sweden and the UK do not. The UK explicitly regards the spectrum as capacity overlay. Other countries that have imposed weaker coverage conditions include South Korea (30% of existing macrocells to be upgraded within 5 years) and Switzerland (25% coverage by 2024)

Given the different criteria for coverage used in each jurisdiction it is difficult to rank them in order of strictness. Germany arguably has the strictest; existing licence holders that win a new licence have to build out their networks (using any spectrum) to achieve a floor of 98% coverage at 100Mbit/s by 2022. There are less-stringent conditions for new entrants that also won 2.1GHz spectrum at the same auction, and even less-stringent conditions for new entrants that won 3.6GHz spectrum only. Denmark requires the new spectrum to provide 60% population coverage by 2023 and 75% coverage by 2025.

The coverage obligations imposed in the 2021 auction in Canada depend critically on the extent of the licence holder's LTE mid-band footprint. For those that have made use of LTE spectrum, the 3.45GHz-3.65GHz obligations are among the most onerous. The complex set of licence conditions require, within 5 years of the initial issuance date, coverage to 90% of the population in the operator's mobile mid-band LTE footprint, and, within 7 years, coverage to 97% of the population in that footprint. In rural areas around urban centres the licence-holder is obliged to cover 95% of the population outside that large population centre within 10 years. The base conditions imposed regardless of LTE footprint are less onerous: between 25% or 30% population coverage within 7 years and 60% or 70% population coverage within 20 years for service areas with large population centres, and between 5% and 30% population coverage within 7 years and 20% and 70% coverage within 20 years for service areas without large population centres. Arguably this dual set of obligations punishes operators that have made effective use of LTE spectrum, and rewards operators that have allowed spectrum to lie fallow. Germany, which also has a two-tier set of obligations, imposes somewhat stricter conditions on new entrants than Canada.

A summary of licence conditions with respect to technology and coverage is included in Annex B.

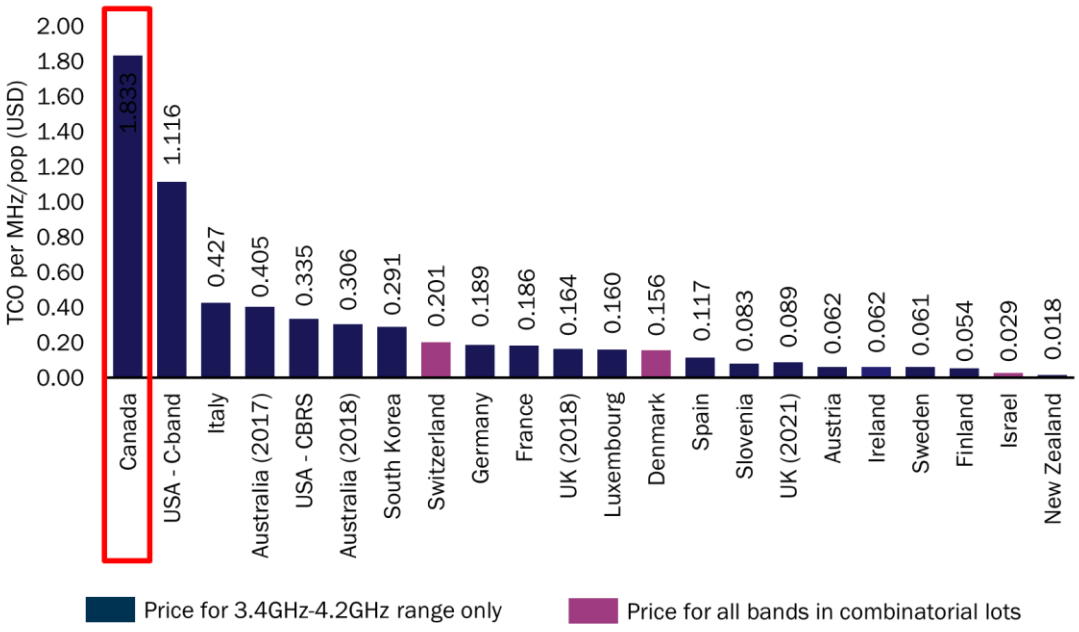
While conditions set a floor for coverage, they bear little other relationship with the extent of actual deployment. In South Korea, for example, actual coverage has far outstripped the minimum

requirements: within one year of launch, the operators had, collectively, exceeded the 3-year targets for deployment by a factor of between 4x and 5x. Some of the countries with the weakest, or non-existent, obligations for coverage are already among those with the most expansive actual deployment so far: for example Austria, Finland and Switzerland.

7 Prices paid

Prior to the Canadian auction in July 2021, prices paid at dedicated auctions for 3.4GHz-4.2GHz spectrum among the 24 countries studied varied from USD1.116 per MHz/pop in the US auctions in 2021 to just USD0.054 in Finland. The average price paid at the Canadian auction, USD1.833, exceeded the average US price by 64%, making the average price paid at auction the highest in the world so far (including all non-OECD countries that have also conducted auctions).

Figure 4: Average (weighted) prices paid for 3.4GHz-4.2GHz spectrum (USD/MHz/pop) [Source: Analysys Mason, 2021]



The prices in the figure above are normalised to the same 20 years licence duration that applies in Canada. The figure includes the prices paid in direct sales in France and New Zealand as well as that paid in auctions. It also includes annual licence fees, but only where these can be known in advance, and in these cases a discount rate has been applied over future years' fees.

The opening bid prices at the auction in Canada varied, according to location, from USD0.190 down to USD0.042 per MHz/pop. The national weighted average was USD0.109. Canada's average opening bid price was higher than the final price paid for assignments in at least ten countries (Austria, Belgium, Finland, Iceland, Ireland, Israel, Japan, New Zealand, Slovenia and Sweden).

The prices paid by the three Canadian NMSPs at auction were higher still. For a national average of 64MHz, they paid a total of CAD7.347 billion (USD5.897 billion), which is equivalent to CAD3.27 or USD2.62 per MHz/pop. The price per MHz/pop paid by Canadian NMSPs was 49 times higher than that paid by their equivalents in Finland, and 8 times higher than paid in Italy, the highest price paid in Europe.

Of the 89MHz held by incumbents and transitioned, a national average of 69MHz was held by NMSPs, with the largest holdings on a nationally averaged basis held by Bell Canada and Rogers. Even if these transitioned holdings are included in the calculation, the average price paid per MHz/pop by NMSPs is CAD1.575 or USD1.264, still higher than the average price paid at the C-band auction in the USA, three times that paid in Australia in 2017, and a full 23 times higher than that paid in Finland.

8 Conclusion

Of the 24 comparable countries benchmarked, Canada comes:

- 22nd out of 24 in terms of timeliness of assignment;
- 21st out of 24 in terms of amount of spectrum assigned to mobile operators;
- Last (24th) in terms of amount of spectrum available to the main national operators (national mobile service providers or NMSPs) at the principal auction.
- Unlike in 14 of the countries, no bidder ended up with 100MHz of contiguous spectrum at a national level after the July auction in Canada.
- Canada is the only country among the 24 to use set-asides regularly in spectrum auctions, and it does so in a way that makes the set-aside available for companies that are already well established.
- Canada also has the second most-stringent coverage obligations imposed as a condition of licences, but these obligations apply only to those with existing LTE footprints.
- The opening bid price for Canada was higher than the final price paid in 10 countries out of 24.
- Canada recorded the highest price paid per MHz/pop not only in the benchmarked countries, but in the world.

In most of the countries benchmarked, 3.4GHz-4.2GHz based 5G deployment is already well underway, and in some countries, such as South Korea and the UK, 5G services based on 3.4GHz-4.2GHz spectrum have been available for over two years. Finland, Japan and South Korea all have high levels of 5G coverage, and competitive markets with high levels of take-up and usage. An association can be discerned between these outcomes and a more abundant supply of spectrum with fewer set-asides, looser obligations on coverage, and the realistic opportunity to own >100MHz of contiguous spectrum.

By limiting immediate supply of valuable 3.4GHz-4.2GHz spectrum, and by creating large set-asides that do not apply in other advanced markets, Canada directly risks trailing in the development of 5G. However, there three additional areas of indirect impact.

- **Canadian consumers may face higher bills**. While it is difficult to directly associate high spectrum prices with high consumer tariffs, there is nonetheless a risk that the consumer has to cover much of the cost. One analysis indicates that because of similar policies limiting supply to NMSPs in earlier auctions, the three Canadian NMSPs have had to charge their subscribers an average of CAD74 (USD59) per year to cover the cost of their spectrum investments, or 9.4%

of the average bill, and furthermore that the prices paid in the recent 5G auction could add another 3.1 percentage points to the average bill, or CAD25 (USD20) per subscriber per year. [1]

- **Canada risks damaging investment in other areas of telecoms/ICT**. While it is also difficult to directly associate high spectrum prices with constraints on mobile network deployment, they will certainly have downstream effects within the industry. High spectrum costs could for example force companies to make tough decisions on other areas requiring intensive investment (for example on the modernisation of fixed networks), or on operating costs (for example on jobs).

- **Canada risks losing out on broader economic benefits.** 5G has the potential to bring significant economic benefits, both by enhancing performance and productivity in existing sectors of the economy, and by enabling new use-cases. Projections of these benefits inevitably have many critical dependencies and uncertainties, but PwC projects a global economic impact, of USD1.3 trillion by 2030, an uplift of 1.0% on projected global GDP at that date.[2] PwC's projected uplift for the USA is USD484 billion, which if proportionately applied to Canada on the basis of GDP, would amount to USD40 billion in 2030. This assumes that Canada reaps the benefit of 5G in proportion to its current share of global GDP. Whether this is a realistic assumption depends upon the extent to which Canada's policy framework allows it to capitalise on 5G relative to elsewhere.

The limited supply of 5G spectrum is not only a loss for Canadian operators, but also holds back the economic and societal benefits that modern telecoms infrastructure undoubtedly brings.

[1] See Robert W. Crandall, *Canada's Spectrum Policy Drives up Mobile Rates* (August 2021)

[2] PwC: *The global economic impact of 5G,* 2021. Available at https://www.pwc.com/gx/en/industries/technology/publications/economic-impact-5g.html

Annex A One page summary

	Date(s) of principal auctions or assign-ment	Total MHz	Total MHz neither set aside for local or new entrants, nor shared	Duration of licences	Price paid at principal assignment (where known) (USD/MHz/ pop)	Number of MNOs with contiguous 100MHz on national basis
Australia	Dec-18	600	400	11	0.306	0
Austria	Mar-19	390	390	20	0.062	3
Belgium	Mar-20	150	150	2	-	0
Canada	Jul-21	111	64	20	1.833	0
Denmark	Apr-21	390	390	21	n/a	3
Finland	Oct-18	390	390	15	0.054	3
France	Oct-20	310	310	15	0.186	0
Germany	Jun-19	400	300	20	0.189	0
Iceland	Apr-20	300	300	1.5	-	3
Ireland	May-17	350	350	15	0.062	2
Israel	Aug-20	300	300	10	n/a	3
Italy	Oct-18	263	263	19	0.427	0
Japan	Apr-18 and Apr-19	800	700	5 and 5	-	4
Luxembourg	Jul-20	380	380	20	0.160	3
Netherlands	*2022*	*300*	*300*			
New Zealand	Jul-20	160	160	2	0.018	0
Norway	*Sep-21*	*400*	*360*			
Slovenia	Apr-21	380	380	20	0.083	3
South Korea	Jun-18	600	600	10	0.291	2
Spain	Jul-18	380	380	20	0.117	0
Sweden	Jan-21	400	320	25	0.061	3
Switzerland	Feb-19	300	300	15	n/a	2
UK	April-18 and Mar-21	790	390	20 and 20	0.164	1
USA	Sep-2020 and Feb - 21	530	380	10 and 15	1.116	1

Annex B Summary of licence conditions of existing long-term licence holders

	Allowed use	Coverage obligation	Detail
Australia (2018)	Neutral	No	
Austria	5G	Yes, defined	Basic coverage requirement: 150 base stations nationwide (or 5-25 per region). 5G coverage (not simply using midband) should cover 93% of the population by 2025 and 95% of urban population by 2025 with a minimum 30Mbit/s downlink and 3Mbit/s uplink.
Canada	5G	Yes, defined	*Where operators already have a mid-band LTE footprint*. Coverage to 90% of the population of their mobile mid-band LTE footprint as of June 5, 2019, within 5 years of the initial issuance date, coverage to 97% of the population of their mobile mid-band LTE footprint as of June 5, 2019, within 7 years of the initial issuance date; in rural areas around urban centres to provide coverage to 95% of the population outside the large population centre within 10 years of the initial issuance date. *General obligations*. These vary according to individual service area. In service areas with large population centres, the population coverage requirements vary between 25% and 30% within 5 years, between 40% and 50% within ten years and between 60% and 70% within 20 years. In service areas without a large population centre, the population coverage requirements vary between 5% and 30% within 5 years, between 10% and 50% within 10 years and between 20% and 70% within 20 years.
Denmark	5G	Yes, defined	60% population coverage by the end of 2023 and 75% by the end of 2025
Finland	Neutral	No	
France	5G	Yes, defined	3.4-3.8GHz licensees must supply 5G services in at least 2 cities before the end of 2020 and at 3000 sites by 2022.
Germany	Neutral	Yes, defined	Separate obligations for existing players and new entrants. The coverage obligations for the licence winners excluding new entrants include (but are not limited to) coverage with a transmission rate of at least 100Mbit/s for at least 98% of households in each federal state by the end of 2022, operation of 1,000 base stations (5G) by the end of 2022 and operation of 500 base stations with a transmission rate of at

	Allowed use	Coverage obligation	Detail
			least 100Mbit/s in not-spots by the end of 2022. There are further obligations for road, rail and inland waterway coverage. New entrants must supply coverage of at least 25% of households by the end of 2023 and at least 50% of households by the end of 2025. If a new entrant purchases spectrum in the 3.6GHz band only, however, a coverage of at least 25% of households must be achieved by 31 December 2025. If a new entrant purchases spectrum in the 3.6GHz band, it must put into operation 1000 5G base stations by the end of December 2022. In each federal state, coverage must be rolled out in accordance with the proportionate share of federal territory.
Ireland	Neutral	Yes, defined	Separate regionally defined obligations depending on amount of spectrum held
Israel	5G	Yes, no strict definition	To complete deployment within 5 years
Italy	5G	Yes, defined	Complex set of coverage requirements. Coverage obligations for those winning the 80MHz blocks only. Obligation includes coverage of a list of towns/municipalities by end-2024 (including at least 10% of towns with population < 5000 and identified as “white areas”)
Japan	5G	Yes, defined	Each licensee must adhere to the pledged 5-year population coverage in the beauty contest application: NTT 97%, KDDI 93%, Softbank 64% and Rakuten Mobile 56%.
Luxembourg	5G	Yes, defined	Licensees must provide service at minimum 10 sites by the end of 2020 and at least 20 sites by the end of 2021
Slovenia	Neutral	Yes, defined	The operators are obliged to use spectrum in at least one city within one year and all major cities within five years
South Korea	5G	Yes, defined	Coverage obligation of 150,000 base stations among all operators. 15% of these should be built within 3 years and 30% within 5 years.
Spain (2018)	5G	No	
Sweden	Neutral	No	
Switzerland	5G	Yes	25% population coverage by end of 2024
UK (2018)	Neutral	No	The spectrum is considered to provide operators with capacity not coverage
UK (2021)	Neutral	No	The MNOs (EE, O2, Three and Vodafone) have committed to achieve more comprehensive mobile coverage in the 'Shared Rural Network' programme. Their commitments, now agreed with the Government, are included in their current spectrum licences

	Allowed use	Coverage obligation	Detail
USA (2020)	Neutral	Yes, no strict definition	Priority Access Licensees must provide substantial service in their licence area by the end of the initial licence term. "Substantial" service is defined as service which is sound, favourable, and substantially above the level of mediocre service which might minimally warrant renewal. Failure by any licensee to meet this requirement will result in forfeiture of the licence without further Commission action, and the licensee will be ineligible to regain it.
USA (2021)	Neutral	Yes, defined	Licensees shall provide reliable signal coverage and offer service within eight (8) years from the date of the initial license to at least 45% of the population in each of its license areas ("First Buildout Requirement")