

Final report for CTIA

**Mid-band spectrum
geographical licensing
approaches**

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1 Executive summary

In April 2018, Analysys Mason published a report (the '5G readiness report'¹) for CTIA, describing 5G spectrum and infrastructure policies in leading markets around the world. We benchmarked the situation in the US to that in nine other countries, specifically: Canada, China, France, Germany, Japan, Russia, Singapore, South Korea, and the UK.

This latest report builds on the earlier 5G readiness report, exclusively focusing on mid-band spectrum for 5G, examining in particular geographic licensing approaches. In this analysis, we have extended our benchmark countries to include Australia, Spain and Sweden.

The report structure and key findings are as follows:

Section 1.1 provides an updated, high-level overview of the plans identified in each of our benchmark countries for releasing mid-band spectrum for 5G. The US is considering the 3450-3550MHz and 3700-4200MHz ranges, though plans are currently at a preliminary stage. The most developed plans are in the 3550-3700MHz range (the CBRS band), in which spectrum will be made available through a three-tiered sharing arrangement.

Key Finding: The US sharing approach in 3.5GHz differs from all our benchmark countries, which have developed plans for exclusive assignment to mobile.

Section 1.2 compares the geographical licensing approach being considered for the CBRS band in the US with the approaches adopted (or proposed) in our benchmark countries.

Key Findings: The majority of leading markets are planning to (or are expected to) release mid-band spectrum for 5G on a national basis (or predominantly on a national basis). In the two countries adopting a regional approach, those license areas will cover a significantly larger population per license compared to the US census tract proposal. In fact, the most granular set of regions previously defined for purposes of spectrum allocation (Canada's Tier 4, which consists of 172 localized service areas) cover populations around 50 times larger (on average) than in the potential US census tract approach. Furthermore, the average geographical area of Canada's Tier 4 service areas are over 400 times larger than the US census tracts; if the licensing size in Canada was a baseball field, including outfield, the US census tract proposal would be smaller than the pitcher's mound.

¹ 'Global race to 5G – spectrum and infrastructure plans and priorities'. We refer to this report as the '5G readiness report'. See https://api.ctia.org/wp-content/uploads/2018/04/Analysys-Mason-Global-Race-To-5G_2018.pdf

1.1 Overview: mid-band 5G spectrum release

Mid-band 5G spectrum release in the US

The FCC is in the process of releasing the citizens broadband radio service (CBRS) band (3550–3700MHz) for shared wireless broadband use. Usage is expected to initially focus on LTE, but the band is also being considered for the implementation of 5G².

The band is governed by a three-tier authorization framework that allows commercial users to share spectrum with existing federal and non-federal users:

- Tier 1 consists of incumbent users (primarily the US military), which have top priority.
- Tier 2 organizations can be granted priority access licenses (PALs) for a fee. A maximum of seven PALs, each 10MHz in size, will be licensed in any given geographical area. Use of these bands can be pre-empted by Tier 1 users.
- Tier 3 users have general authorized access (GAA) – opportunistic use of any available block of the 3550–3700MHz band without a defined license term. These users must accept interference from Tier 1 and 2 users.

The FCC is also considering use of the 3.7–4.2GHz range for 5G, and the NTIA has identified 100MHz (3450–3550MHz) for potential repurposing to commercial wireless. However, plans for these bands are currently in preliminary stages.

Mid-band 5G spectrum release in rest of world

In the rest of the world, mid-band 5G spectrum plans are also being developed, with several countries at an advanced stage with these plans. A summary of the plans in each of our benchmark countries is shown in Figure 1.1 below:

Figure 1.1: Mid-band spectrum release plans in benchmark countries [Source: Analysys Mason, 2018]

Country	Details
Australia	<ul style="list-style-type: none"> • Australia has planned an auction of spectrum in the 3575-3700MHz range for October 2018.
Canada	<ul style="list-style-type: none"> • An auction of spectrum in the 3450-3650MHz range is expected in late 2020. • Canada is also seeking preliminary comments on use of the 3400–3450MHz and 3650–4200MHz bands for 5G.
China	<ul style="list-style-type: none"> • 500MHz of spectrum (within 3.3–3.6GHz and 4.8–5.0GHz) will be released in China, with the 3.3-3.4GHz range subject to indoor use. Details have not been specified, but assignment is expected in 2018/19 in line with commercial launch timelines. • Reports also indicate that China is likely to assign the 3.6-4.2GHz range to 5G use in the future, subject to coordination with existing satellite uses.

² See, for example, <https://ecfsapi.fcc.gov/file/106191696422731/T-Mobile%203.5%20GHz%20Petition%20for%20Rulemaking%20--%2012-354%20--%2017.2017.pdf>

Country	Details
France	<ul style="list-style-type: none"> 40MHz of 3.4GHz spectrum (3420–3460MHz) is to be reserved for fixed wireless access (FWA) use in currently underserved areas (with an additional 10MHz (3410–3420MHz) in certain areas). An auction of the remaining spectrum in the 3410–3800MHz range is expected in 2018/19. ARCEP expects 300MHz of contiguous spectrum to be available for 5G by 2020, and 340MHz (390MHz in areas with no FWA) by 2026.
Germany	<ul style="list-style-type: none"> Germany³ plans to award a total of 400MHz (3.4–3.8GHz) in early 2019.
Japan	<ul style="list-style-type: none"> Japan has already assigned 40MHz of unpaired spectrum to each of the country's three MNOs (in the 3.48–3.6GHz range) on a national basis. Japan aims to release up to 500MHz of spectrum within the 3.6–4.2GHz and 4.4–4.9GHz ranges by March 2019 We understand that Japan is also currently in the process of⁴ releasing spectrum in the 3.4–3.48GHz range
Russia	<ul style="list-style-type: none"> 5G spectrum assignment plans are unclear, with the government's 5G roadmap scheduling a formal decision regarding spectrum to be made in 2018. However, the SCRF has allocated test licenses in the 3.4–3.8GHz range to some operators.
Singapore	<ul style="list-style-type: none"> The IMDA's 2017 5G consultation states that the regulator is 'exploring the possibility' of assigning spectrum from the 3.4–3.6GHz band for mobile use.
South Korea	<ul style="list-style-type: none"> South Korea auctioned 280MHz of spectrum in the 3420-3700MHz range on a national basis in June 2018.
Spain	<ul style="list-style-type: none"> Three of Spain's MNOs currently own 2x20MHz national licenses in the 3.4GHz band. Spain is planning to auction spectrum in the 3600-3800MHz range in July 2018.
Sweden	<ul style="list-style-type: none"> Sweden⁵ plans to award a total of 400MHz mid-band spectrum (3.4-3.8GHz) in 2019.
UK	<ul style="list-style-type: none"> UK MNO Three already holds national licenses in the 3480–3500MHz, 3580–3600MHz, 3605–3689MHz and 3925–4009MHz ranges.⁶ 150MHz of spectrum from the 3.4–3.6GHz band was auctioned in April 2018. The UK anticipates awarding spectrum in the 3.6–3.8GHz band in 2019; the spectrum is expected to 'be deployed in many areas from around 2020, and nationwide by 2022'. The 3.8–4.2GHz range is 'a candidate band for enhanced spectrum sharing.'
US	<ul style="list-style-type: none"> See discussion above

³ Each of the three MNOs in Germany currently has been assigned 42MHz of spectrum in the 3.4GHz band on a nationwide basis. Licenses expire at end-2021.

⁴ The exact current status of the band is unclear. The MIC had previously announced its intention to release the spectrum by March 2018. However, on April 6, 2018, the MIC announced that, based on a report from the Radio Regulatory Council, it "plans to designate" the 3.44-3.48GHz range to Softbank and the 3.4-3.44GHz range to NTT DOCOMO. See http://www.soumu.go.jp/menu_news/s-news/01kiban14_02000333.html and <https://www.telegeography.com/products/commsupdate/articles/2018/04/09/mic-advisory-panel-gives-green-light-to-rakutens-mobile-bid/>

⁵ Two MNOs in Sweden own national 2x20MHz licenses in the 3.6-3.8GHz band: TDC Sverige (owned by Tele2) (3600-3620MHz, 3700-3720MHz) and B2 Bredband (owned by Telenor) (3620-3640MHz, 3720-3740MHz). These licenses are technology and service neutral and expire in December 2022.

⁶ UK operator UK Broadband provided LTE TDD FWA services in specific locations of the UK, using its national license in the 3480–3500/3580–3600MHz range. The operator was bought by UK MNO Three in early 2017. The spectrum held by UK Broadband also includes a national license in the 3605–3689/3925–4009MHz range, which has previously been used only for fixed (point-to-point/point-to-multipoint) links. Three has applied to Ofcom for a change of use of its 3.6GHz spectrum (changing from fixed to mobile use); Ofcom is consulting on this at the moment and we understand that it is likely to approve Three's request. See <https://www.ofcom.org.uk/consultations-and-statements/category-2/variation-uk-broadbands-spectrum-access-licence-3.6-ghz>

In contrast to the three-tiered spectrum-sharing CBRS band in the US, all other countries assessed for this report have predominantly⁷ committed to an exclusive licensing approach for mid-band 5G spectrum, within the parts of the bands being released for 5G use.⁸

1.2 Comparison of geographical licencing approaches

There are three main approaches that can be used in the geographical licensing of spectrum:

- National licensing
- Regional licensing
- Combination of national and regional licensing

Below we compare the approach being considered by the US in the CBRS band with the approach adopted (or under consideration) in the rest of our benchmark countries.

Geographical licensing approach in the US

Spectrum auctions in the US have historically been conducted on a regional basis.⁹ Various regional breakdowns have been used, including Partial Economic Areas (PEAs) and Cellular Market Areas (CMAs).¹⁰ In fact, the FCC began its cellular licensing regime using 734 CMAs, then scaled-up to using 491 Basic Trading Areas (BTAs) and 52 Major Trading Areas (MTAs) in the Personal Communications Service (PCS) proceeding, before adopting 176 Economic Areas (EAs) and 52 Major Economic Areas (MEAs), and then six Economic Area Groupings and 12 Regional Economic Area Groupings across a variety of other wireless services. All of these license areas are significantly larger than the ~74 000 census tracts initially proposed for PALs licensing.¹¹

The regional breakdown to be adopted for the CBRS PALs has been the subject of significant debate, which was ongoing at the time of producing this report. The FCC originally proposed that PALs would be licensed by census-tract, with an average population of ~4400. By contrast, the larger license areas the FCC has used for other services, which range from an average population of ~444 000 per CMA to ~783 000 per PEA, or even more in the case of MTAs and MEAs, are all far larger than the average census tract. However, in October 2017, the FCC requested comment on alternatives that would increase the license size of PALs, including PEAs among other options.¹²

⁷ Some countries (other than the US) have also explored spectrum sharing in the mid-band in connection with 5G (for example the 3.8-4.2GHz band in the UK).

⁸ Some spectrum available for exclusive 5G use depends on coordination of spectrum with existing satellite uses of the spectrum

⁹ See http://wireless.fcc.gov/auctions/default.htm?job=auctions_all

¹⁰ See <https://www.fcc.gov/oet/maps/areas>

¹¹ See <http://wireless.fcc.gov/auctions/default.htm?job=maps>

¹² See https://docs.fcc.gov/public/attachments/FCC-17-134A1_Rcd.pdf

Geographical licensing approach in rest-of-world

Spain and South Korea have both confirmed that mid-band spectrum for 5G will be licensed for 5G use on a nationwide basis. Germany and Sweden will adopt a hybrid approach, with a mix of nationally and regionally available spectrum. However, in both countries, the bulk of available mid-band spectrum (3.4-3.7GHz) will be assigned on a nationwide basis, with another 100MHz (3.7-3.8GHz) available on a regional licensing basis.

A number of our benchmark countries have not yet finalized details regarding the licensing approach they will adopt. However, in several cases, we expect nationwide licenses will be used, based on our understanding of the usual approaches to mobile licensing in these markets.

Examples include Singapore (which is a city-state), France (a four-operator market, where spectrum in the lower part of the C-band has already been assigned in certain areas) and the UK (where nationwide licensing was used in the recent 3.4GHz auction). Current mobile licensing is exclusively on a nationwide basis in both China and Japan, while Russia has used both nationwide and regional licenses.

In the two remaining countries, Australia and Canada, regional licensing is expected. Like the US, Australia and Canada are large geographies which have historically made licenses available on a regional basis.¹³ However, the regions that will be used for the release of mid-band spectrum are likely to be significantly larger than many of those options proposed in the US.

Australia released a consultation on the 3450-3600MHz band in May 2018, specifying 14 geographical regions for assignment (6 'metropolitan areas' and 8 'regional areas'). Canada has not yet confirmed geographical licensing arrangements; however, the regulator has previously defined three different regional-breakdowns for use in spectrum assignment, the most granular of which consists of 172 areas.

The geographical licensing arrangements for the upcoming assignment of 5G spectrum in each of our benchmark countries is summarised in Figure 1.2 below.

¹³ There are a handful of exceptions in Australia, including the multi-band 700MHz and 2600MHz auction in 2013, and the auction of previously un-sold 700MHz lots in 2017.

Figure 1.2: Geographical licensing arrangements for the upcoming assignment of 5G spectrum in benchmark countries [Source: Analysys Mason, 2018]

Country	Geographical licensing arrangement	Further details
Australia	Large regional	Spectrum will be assigned in a total of 14 regions: 6 'Metro areas' and 8 'Regional areas'. The average population per region is ~1.7 million.
Canada	N/d (Likely to be large regional)	Details not yet released. Expected to be regional based on previous auctions, which have either used Tier 2, Tier 3 or Tier 4 'service areas': <ul style="list-style-type: none"> • Tier 2 – 14 provincial and large regional service areas • Tier 3 – 59 smaller regional service areas • Tier 4 – 172 localised service areas The average population of Tier 2, 3 and 4 service areas in 2011 was 2.1 million, 567 thousand, and 195 thousand respectively.
China	N/d (Likely to be national)	Current mobile licenses are nationwide, including recently awarded FDD-LTE 4G licenses, and a fourth basic telecom services license to provide nationwide Internet and data telecommunications services. ¹⁴ The MIIT has designated 3300-3600MHz and 4800-5000MHz for 5G, ¹⁵ and trials are being conducted on a wide area basis. ¹⁶
France	N/d (Likely to be national)	Details not yet released, but likely to be national.
Germany	National and large regional	300MHz (3.4-3.7GHz) for nationwide use. 100MHz (3.7-3.8GHz) awarded on a regional basis. Specific regions yet to be confirmed. In the previous 3.6-3.8GHz (BWA) auction in 2006, Germany was divided into 28 regions.
Japan	N/d (Likely to be national)	Current mobile licenses are nationwide, as well as the licenses in the 3400-3480MHz band. ¹⁷
Russia	N/d	Current mobile licenses are a mixture of nationwide and regional.
Singapore	N/d (Likely to be national)	Licensing is extremely likely to be national: Singapore is a small city-state.
South Korea	National	Confirmed by regulator.
Spain	National	Confirmed by regulator
Sweden	National and regional	300MHz (3.4-3.7GHz) for nationwide use. 100MHz (3.7-3.8GHz) awarded on a regional basis.

¹⁴ http://www.chinadaily.com.cn/business/tech/2015-02/27/content_19672844.htm, <https://www.telegeography.com/products/commsupdate/articles/2018/04/05/china-mobile-handed-fdd-lte-licence/>, and <https://www.reuters.com/article/china-telecoms/china-awards-4th-telecom-license-to-state-owned-broadcaster-idUSL3N18227E>.

¹⁵ See <http://www.gtigroup.org/d/file/Resources/rep/2018-02-23/66c8c8c45897a2017b1cdb7d6df7be6f.pdf>

¹⁶ China's State Centre of Radio Regulation website suggests that the mid-band spectrum is being made available nationally for 5G, but with some restrictions in certain geographical locations where earth stations are operating. See <http://www.srrc.org.cn/search.aspx?s=5g>

¹⁷ See http://www.soumu.go.jp/main_content/000517622.pdf

Country	Geographical licensing arrangement	Further details
		Specific regions yet to be confirmed. We note that municipalities have been used in previous 3.6-3.8GHz auctions; as of end-2017 ¹⁸ , there were 290 municipalities in Sweden with an average population of ~35,000.
UK	N/d (Likely to be national)	Details not yet released, but likely to be national (as was the case in the recent 3.4GHz auction).
US	Regional	See discussion above. Possible license areas include census tracts, counties, PEAs, CMAs (or combinations thereof).

1.3 Conclusions

The majority of the countries assessed in this report are expected to use national licensing in the assignment of mid-band spectrum. These countries include China, France, Japan, Singapore, South Korea, the UK, and Spain, with Germany and Sweden using a mix of national and regional licenses.

In addition to the US, two other large geographies (Australia and Canada) typically use large regional licensing. In Australia, the regulator has proposed 14 regions with an average population of ~1.7m per region, as many people as live in Phoenix, AR or Philadelphia, PA, or the entire state of New Hampshire. In Canada, official details have not yet been released. However, the most granular set of regions previously defined for purposes of spectrum allocation in Canada consists of 172 areas, with an average population of ~195,000 per area. In contrast, each of the US' ~74,000 census tracts contains around 4,400 people (a factor of around 50 less). If the population coverage in Canada corresponded to the combined population of California and Texas, the population coverage of the proposed US census tracts would correspond to less than the population of Hawaii.

In terms of population coverage, the Canadian and Australian licensing regimes for mid-band spectrum are therefore more similar to using larger regions in the CBRS band in the US (such as PEAs, CMAs, counties or some combination thereof), than the much smaller US census tracts.

¹⁸ See http://www.scb.se/en/finding-statistics/statistics-by-subject-area/population/population-composition/population-statistics/#_Keyfigures