



5G SPECTRUM
FOR TERRESTRIAL
NETWORKS:
EXECUTIVE SUMMARY
**Licensing Developments
Worldwide**

GSA



Executive Summary: Introduction

This report provides a snapshot of the global status of national 5G spectrum plans as of 20 January 2020. As national regulators plot their countries' moves towards 5G, there are important choices to be made about which portions of the spectral range should be either dedicated to terrestrial 5G networks and services or at least accessible to 5G networks and services. The report covers spectrum initiatives that are specifically related to 5G networks. As spectrum is increasingly awarded on a technology-neutral basis, the report also tracks spectrum assignments that are or are intended to be technology neutral (and so could be used for 5G). It does not cover spectrum assignments related to 2G or 3G networks, except as far as they might be altered to support new LTE or 5G broadband services.

(Note: all references to countries in this document can be read as also including territories, special administrative regions, disputed territories and dependencies.)

This report reflects a market that is in constant flux and feedback is greatly appreciated to keep it current. Please send comments and information to research@gsacom.com.

Important changes since the last report include:

- Albania: awarded 800 MHz following auction.
- Australia: new five-year spectrum plan.
- Austria: multiband auction approved for April 2020 start.
- Bangladesh: plans for 5G allocations in 2020.
- Belgium: postponed multiband auction; consultation on C-Band spectrum plans.
- Channel Islands: plans announced for tender of spectrum at 700 MHz and 3400–3800 MHz for 5G and FWA services.
- Chile: consultation on the use of 5G for private networks, and consultation on plans for tenders of spectrum due to start in May 2020.
- Colombia: auction of spectrum at 700 MHz and 2500 MHz and publication of new 5G action plan.
- Cyprus: updated multiband auction plans for March 2020.
- Czechia: delay to 700 MHz and 3410–3600 MHz auctions.
- Ecuador: delay to auction timetable.
- El Salvador: auction of AWS spectrum completed.
- Germany: applications open for local/regional licences in the 3700–3800 MHz range; consultation on use of the 24.25–27.5 GHz range for local applications.
- Greece: delayed timetable for 700 MHz and 3.5 GHz auctions.
- Hong Kong: completion of C-Band and 4.9 GHz auctions.
- India: multiband auction approved for March/April 2020; 26 GHz auction to follow.
- Ireland: response to consultation on multiband spectrum auction published.
- Japan: applications opened for local 5G licences.
- Lithuania: public consultation on use of spectrum at 26 GHz.
- Luxembourg: new timetable for 700 MHz and 3400–3800 MHz.

5G Spectrum increasingly becoming available worldwide

40 countries have completed allocations of 5G suitable (dedicated or technology-neutral) spectrum since 2015.

A total of 54 countries have announced plans and approximate dates for allocating 5G-suitable frequencies with time-lines for completion between now and end-2022 (including licences dedicated to 5G and technology-neutral licences that could be used for 5G).



Introduction: cont.

- Malaysia: revised plan for auction of spectrum at 700 MHz, 3.5 GHz and auction/assignment of spectrum at 26/28 GHz.
- Mayotte: consultation on allocation of spectrum at 700 MHz.
- Mexico: auction spectrum plan for 2020 including various bands.
- Middle East: in December 2019 the Arab Spectrum Management Group agreed to release spectrum in the 3300–3800 MHz range (except for four countries that agreed to release 3400–3800 MHz) for mobile broadband services.
- Nepal: Ncell awarded spectrum at 1800 MHz.
- Netherlands: consultation on process for upcoming multiband auction.
- New Zealand: auction of short-term licences for unused C-band spectrum.
- Norway: delayed timetable for multiband auction(s); applications opened for short-term C-Band licences on Svalbard.
- Peru: updated timetable for AWS and 2.3 GHz auction.
- Poland: consultation launched on 2020 auction of spectrum at 3480–3800 MHz.
- Portugal: approved multiband auction to start April 2020.
- Réunion: consultation on allocation of spectrum at 700 MHz and 3400–3800 MHz.
- Romania: delayed timetable for multiband auction.
- Russia: allocated spectrum at 2300 MHz for LTE.
- Slovenia: multiband auction delayed to the end of 2020.
- South Africa: consultation on spectrum plan covering the release of multiple bands.
- Sweden: delayed timetable for multiband auction.
- Taiwan: first phase of multiband auction completed.
- Thailand: multiband auction scheduled for Q1 2020.
- UK: spring 2020 timetable for 700 MHz and 3600–3800 MHz auctions.
- Ukraine: plans for a new C-band licence, refarming of CDMA-used 850 MHz and broadcast-used 700/800 MHz, permission to use 900 MHz for LTE.
- Uruguay: conclusion of auction covering AWS, 1800 MHz and 2.5 GHz spectrum.
- USA: planned auction of spectrum in the 3.7–4.2 GHz range; NPRM on changes to spectrum at 5.9 GHz; launch of auction 103 covering mmWave spectrum; proposals for spectrum sharing in the 3.1–3.55 GHz range.



Frequency range designations and bands

In this report, we consider spectrum in specific bands for which auctions or long-term designations are being considered. These include the new 5G/NR bands defined by 3GPP, which are being defined in the following two frequency ranges (FR) in Table 1.

Table 1: 5G NR frequency ranges

| Frequency range designation | Corresponding frequency range |
|-----------------------------|-------------------------------|
| FR1 | 410–7125 MHz |
| FR2 | 24250–52600 MHz |

FR1 bands at the time of development of this report are defined in Table 2.

Table 2: 5G NR FR1 Bands

| NR operating band | Uplink (UL) operating band | Downlink (DL) operating band | Duplex mode |
|-------------------|----------------------------|------------------------------|-------------|
| n1 | 1920–1980 MHz | 2110–2170 MHz | FDD |
| n2 | 1850–1910 MHz | 1930–1990 MHz | FDD |
| n3 | 1710–1785 MHz | 1805–1880 MHz | FDD |
| n5 | 824–849 MHz | 869–894 MHz | FDD |
| n7 | 2500–2570 MHz | 2620–2690 MHz | FDD |
| n8 | 880–915 MHz | 925–960 MHz | FDD |
| n12 | 699–716 MHz | 729–746 MHz | FDD |
| n14 | 788–798 MHz | 758–768 | FDD |
| n18 | 815–830 MHz | 860–875 MHz | FDD |
| n20 | 832–862 MHz | 791–821 MHz | FDD |
| n25 | 1850–1915 MHz | 1930–1995 MHz | FDD |
| n28 | 703–748 MHz | 758–803 MHz | FDD |
| n30 | 2305–2315 MHz | 2350–2360 MHz | FDD |
| n34 | 2010–2025 MHz | 2010–2025 MHz | TDD |
| n38 | 2570–2620 MHz | 2570–2620 MHz | TDD |
| n39 | 1880–1920 MHz | 1880–1920 MHz | TDD |
| n40 | 2300–2400 MHz | 2300–2400 MHz | TDD |
| n41 | 2496–2690 MHz | 2496–2690 MHz | TDD |
| n48 | 3550–3700 MHz | 3550–3700 MHz | TDD |
| n50 | 1432–1517 MHz | 1432–1517 MHz | TDD |
| n51 | 1427–1432 MHz | 1427–1432 MHz | TDD |
| n65 | 1920–2010 MHz | 2110–2200 MHz | FDD |
| n66 | 1710–1780 MHz | 2110–2200 MHz | FDD |
| n70 | 1695–1710 MHz | 1995–2020 MHz | FDD |
| n71 | 663–698 MHz | 617–652 MHz | FDD |
| n74 | 1427–1470 MHz | 1475–1518 MHz | FDD |
| n75 | N/A | 1432–1517 MHz | SDL |
| n76 | N/A | 1427–1432 MHz | SDL |
| n77 | 3300–4200 MHz | 3300–4200 MHz | TDD |
| n78 | 3300–3800 MHz | 3300–3800 MHz | TDD |
| n79 | 4400–5000 MHz | 4400–5000 MHz | TDD |
| n80 | 1710–1785 MHz | N/A | SUL |
| n81 | 880–915 MHz | N/A | SUL |
| n82 | 832–862 MHz | N/A | SUL |

| | | | |
|-----|---------------|---------------|-----|
| n83 | 703–748 MHz | N/A | SUL |
| n84 | 1920–1980 MHz | N/A | SUL |
| n86 | 1710–1780 MHz | N/A | SUL |
| n90 | 2496–2690 MHz | 2496–2690 MHz | TDD |

FR2 bands at the time of development of this report are defined in Table 3.

Table 3: 5G NR FR2 bands

| NR operating band | Uplink (UL) and downlink (DL) | Duplex mode |
|-------------------|-------------------------------|-------------|
| n257 | 26500–29500 MHz | TDD |
| n258 | 24250–27500 MHz | TDD |
| n259 | 39500–43500 MHz | TDD |
| n260 | 37000–40000 MHz | TDD |
| n261 | 27500–28350 MHz | TDD |

At WRC-2019 in November, delegates identified several new frequency ranges for IMT and IMT-2020 (5G). These encompassed many of the existing 3GPP-bands plus some new spectrum ranges:

- 24.25–27.5 GHz
- 37–43.5 GHz
- 45.5–47 GHz
- 47.2–48.2 GHz
- 66–71 GHz.

Other spectrum bands being considered by national regulators and international bodies, or that have been used in operator trials, that are not yet covered by 3GPP specifications sit within the 71–86 GHz range.



In Europe, 19 countries have already completed auctions of 5G suitable (dedicated or technology-neutral) spectrum. In the Asia-Pacific, allocations have happened in seven countries. In the Americas, six countries have completed allocations, as have six countries in the Middle East, and two in Africa

Global Overview

Worldwide, 40 countries have completed allocations of 5G suitable (dedicated or technology-neutral) spectrum since 2015.

A total of 54 countries have announced plans and approximate dates for allocating 5G-suitable frequencies with timelines for completion between now and end-2022 (including licences dedicated to 5G and technology-neutral licences that could be used for 5G).

In Europe, 19 countries have already completed auctions of 5G suitable (dedicated or technology-neutral) spectrum (Albania, Austria, Croatia, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Norway, Slovakia, Spain, Sweden, Switzerland and the UK).

Twenty-nine countries are known to have 5G-suitable (dedicated or technology-neutral) spectrum auctions/allocations planned (with allocation dates tentatively set) between 2020 and 2022 (Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Guernsey, Greece, Hungary, Jersey, Kosovo, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Ukraine and the UK).

In the Asia-Pacific, allocations have happened in seven countries: Australia, China, Hong Kong, Japan, Philippines, Republic of Korea, and Thailand. There are planned 5G-suitable auctions/allocations confirmed in at least eleven countries in Asia Pacific (Australia, Bangladesh, Hong Kong, India, Japan, Malaysia, Myanmar, New Zealand, Singapore, Taiwan and Thailand) between 2020 and end 2022.

In the Americas, the USA typically issues spectrum on a technology-neutral basis, making any such awards potentially useable for 5G, and it has already allocated 5G-suitable spectrum in sub-1 GHz, sub-6 GHz and mmWave bands. Other countries to have completed 5G-suitable allocations include Canada, Colombia, El Salvador, Mexico and Uruguay. Meanwhile, nine countries (Argentina, Brazil, Canada, Chile, Ecuador, El Salvador, Mexico, Peru and the USA) have announced timetables for future auctions/allocations of spectrum potentially suitable for 5G.

Of the countries in the Middle East and Africa, six countries in the Middle East (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE) have concluded allocations of spectrum suitable for 5G services. Meanwhile, Tanzania has awarded spectrum at 700 MHz for ICT services and Ghana has auctioned spectrum at 800 MHz for mobile services. Allocations are planned in Cyprus, Israel and South Africa as well as in the territories of Mayotte and Réunion.

Licensing activity detail by country

This section summarises, by region and country, the 5G spectrum activity observed by GSA in the course of its research programme. This includes bands being considered for 5G, soon to be auctioned, considered for auction and those already granted to operators. All dates indicated for auctions are correct to the best of our knowledge at the time of publication, but should be treated as provisional or aspirational until all consultations and legal processes have been completed.

In addition to those countries with licensing plans specifically designated for 5G, the information also includes a number of other countries considering, planning or in the process of auctioning bands that could be used for any technology (licensed on a technology-neutral basis), or used to deliver mobile broadband services and hence are potentially useable for 5G but are not explicitly designated for 5G at this stage.

A detailed version of this report is available for download from the GSA web site for GSA Members and Associates. To find out more about becoming a GSA Member or GSA Associate please email info@gsacom.com

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