

**Submission to  
the Telecom Regulatory Authority  
of India (TRAI):**

**Samsung Response to Consultation  
Paper on:**

**Auction of Spectrum in frequency  
bands identified for IMT/5G**

JANUARY 10<sup>TH</sup>, 2022

**SAMSUNG**

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## 1. Executive Summary

Samsung Electronics Co., Ltd (hereinafter Samsung) is pleased to submit a response to the TRAI consultation paper on “**Auction of Spectrum in frequency bands identified for IMT/5G**”<sup>1</sup>. Samsung is grateful for the opportunity to work with the TRAI and to support India be a global wireless leader, to realize the economic and social benefits of mobile communications.

Salient aspects of the Samsung consultation response are summarized below:

- It’s important to **identify/re-farm new bands with optimal and harmonized block size in band below 1 GHz**. It’s equally important to develop a wide band plan for operators to offer large capacity while leveraging propagation characteristics of band below 1 GHz.
- **Maximizing key 5G bands i.e. 3.5 GHz (3300-3670 MHz) and 26/28 GHz (24.25 – 28.5 GHz) as identified by group of secretaries**, are necessary for full-fledged 5G and 5G-Advanced deployments. These bands should be allocated as suggested in 3GPP band plan, taking into account global harmonization and economies of scale.
- TRAI should recommend operators to coordinate for TDD network deployment and **avoid setting up regulatory measures for interference mitigation**.
- TRAI should consider **growing market of private networks using a harmonized spectrum and offer flexible policy** to consider possible licensing mechanism i.e. via both administration and MNOs.

Finally, Samsung would like to thank the TRAI for the opportunity to comment on this consultation, and look forward to working closely with the TRAI for spectrum aspects in a continuous manner.

## 2. Comments and Suggestions

In this section, Samsung provides comments and suggestions for **selected** questions listed in the consultation paper.

### 2.1 Issues related to Quantum of spectrum and band plan

**Q.1 Whether spectrum bands in the frequency range 526-617 MHz, should be put to auction in the forthcoming auction? Kindly justify your response.**

526-617 MHz range as a part of low-band spectrum is well suited for wide area IoT and coverage extension. While this band is yet to be defined by 3GPP and no ecosystem that is presently available, availability of such band for 5G India deployments would give way for 3GPP to consider this band in near future.

**Q.2 If your answer to Q1 above is in affirmative, which band plans and duplexing configuration should be adopted in India? Kindly justify your response.**

Same as Q.1, further we believe that without study of co-existence scenarios, it may be too early to provide exact band plan, however, FDD would be more suitable duplexing mechanism for lower bands. We therefore recommend keeping this range available for all possible 3GPP band plan options before

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<sup>1</sup> Available at <https://www.trai.gov.in/notifications/press-release/trai-releases-consultation-paper-auction-spectrum-frequencies-identified>

deployments are undertaken.

**Q.3 In case your answer to Q1 is in negative, what should be the timelines for adoption of these bands for IMT? Suggestions to make these bands ready for adoption for IMT may also be made along with proper justification.**

Please refer to band plan suggested by Canada government in 600 and 700 MHz band.  
<https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10614.html>

Please also find ECC report on 700 MHz band as mentioned below,  
<https://docdb.cept.org/download/1502>

**Q.4 Do you agree that 600 MHz spectrum band should be put to auction in the forthcoming auction? If yes, which band plan and duplexing configuration should be adopted in India? Kindly justify your response.**

Due to limited availability of spectrum in 700MHz; 600MHz has become an important band to address 5G requirements. 3GPP is working on the extension of existing n71 band (617-652 MHz for UL and 663-698 MHz for DL) to extend the range to 612-703 MHz, to make this a continuous tuning range. The APT wireless group (AWG) has been studying the option of extending the 600 MHz band to utilize additional 5 MHz to the 35 MHz to create a 40 MHz band. We expect that ecosystem would grow in whole band range (612-703 MHz) as soon as 3GPP develops band plan.

**Q.5 For 3300-3670 MHz frequency range, which band plan should be adopted in India? Kindly justify your response.**

Samsung recommends the TRAI to consider 3GPP band plan for 5G NR, esp. n78, taking into account global harmonization.

Please refer [3GPP TS 38.104](#) for details and band as mentioned below:

n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD
n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD

**Q.6 Do you agree that TDD based configuration should be adopted for 24.25 to 28.5 GHz frequency range? Kindly justify your response**

Please find the band plan and duplex mechanism as mentioned in [3GPP TS 38.104](#). 3GPP has developed technology for TDD band and device/network ecosystem is available, therefore, we agree that TDD based configuration should be adopted for high band regime.

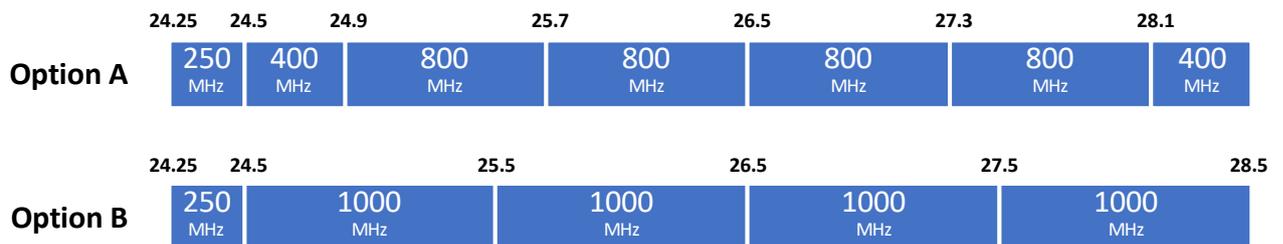
n257	26500 MHz – 29500 MHz	TDD
n258	24250 MHz – 27500 MHz	TDD

The bands n257 and n258 cover this spectrum range. Moreover, there is no study or developments happening in developing FDD mode in frequency range (FR2) at 3GPP.

Samsung strongly recommends the TRAI to adopt TDD band plan for the entire 24.25 to 28.5 GHz frequency range.

**Q.7 In case your response to Q6 is in affirmative, considering that there is an overlap of frequencies in the band plans n257 and n258, how should the band plan(s) along with its frequency range be adopted? Kindly justify your response.**

There are two band plans as mentioned in Q6 covers whole band range from 24.25-28.5 GHz. In this regard, Samsung would like to propose the following two options for a band plan considering four major Indian MNOs.



Currently, 3GPP supports several transmission bandwidths such as 50 MHz, 100 MHz, 200 MHz and 400 MHz in both n257 and n258 bands.

Initial 250 MHz (24.25-24.5 GHz) could be used for local 5G applications. Additionally 400 MHz (24.5-24.9 GHz) should be considered for local 5G as mentioned in option A.

Further details on co-existence for 26//28 GHz could be found in [GSA report](#).

**Q.8 Whether entire available spectrum referred by DoT in each band should be put to auction in the forthcoming auction? Kindly justify your response.**

All spectrum bands in low, mid and high bands are of high importance to provide wide range of use cases. While low-band is good for coverage, mid-band offers a good balance between coverage and capacity and high-band offers very high data rate to enrich user experience. We therefore strongly recommend TRAI to put entire range of spectrum for auction.

**Q.9 Since upon closure of commercial CDMA services in the country, 800 MHz band is being used for provision of LTE services,**

- a. Whether provision for guard band in 800 MHz band needs to be revisited?
- b. Whether there is a need to change the block size for 800 MHz band? If yes, what should be the block size for 800 MHz band and the minimum number of blocks for bidding for existing and new entrants? (Kindly justify your response)

We recommend reconsideration of existing rules for 800 MHz spectrum band and the removal of the provision on guard band. Globally, the 800 MHz band is being used to deploy LTE services mostly under technology neutral conditions. Sub-GHz spectrum is valuable for mobile network coverage and should be allocated efficiently to allow for flexibility in use under technology agnostic conditions. We recommend a uniform block size of 2x5 MHz (UL/DL) in the 800 MHz band to be harmonized

with 700 MHz and 600 MHz plans.

**Q.10 Do you agree that in the upcoming auction, block sizes and minimum quantity for bidding in 700 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands, be kept same as in the last auction? If not, what should be the band-wise block sizes and minimum quantity for bidding? Kindly justify your response.**

Similar to our response to Q.9, we believe 1.25 MHz for 800 MHz band and 200 kHz for 900MHz/1.8 GHz is too narrow for mobile broadband applications. These block sizes are required to be changed to meet the requirement of IMT-2020, and should be considered based on the available spectrum for the bands. Therefore, Samsung recommends block size of 2x5 MHz (UL/DL) in the 800 MHz band to be harmonized with 700 MHz and 600 MHz plans.

**Q.11 In case it is decided to put to auction spectrum in 526-698 MHz bands, what should be the optimal block size and minimum quantity for bidding? Kindly justify your response.**

The block size and minimum quantity for bidding for the 600 MHz band should be 5 MHz. Please also refer to our response in Q.1.

**Q.12 What should be optimal block size and minimum quantity for bidding in 3300-3670 MHz band? Kindly justify your response.**

There is a total available spectrum of 370 MHz (3300-3670 MHz) bandwidth for four MNOs. As per our understanding, 10 MHz block size would be optimal in this band.

Samsung further recommends that TRAI provide a mechanism to allow each MNO to acquire contiguous spectrum of up to 80-100 MHz in this band.

**Q.13 What should be optimal block size and minimum quantity for bidding in 24.25-28.5 GHz? Kindly justify your response.**

We believe 100 MHz would be an optimal block size in this band.

Please refer to Q.7 for possible band plans for this spectrum range. For option A, we recommend 400 MHz as the minimum bidding quantity, while for option B we recommend 1000 MHz as the minimum bidding quantity.

Note that [3GPP TR 37.910](#) has considered 100 MHz to 400 MHz bandwidth (as single carrier component) for evaluation, however, multiple carrier components could be aggregated to support higher bandwidth. ,

## **2.2 Issues related to interference mitigation in TDD bands**

**Q.16 Is there a need to prescribe any measure to mitigate possible interference issues in 3300-3670 MHz and 24.25-28.5 GHz TDD bands or it should be left to the TSPs to manage the interference by mutual coordination and provisioning of guard bands? Kindly provide justification to your response.**

Effective interference measures typically require that TDD networks operating in the same frequency range and within the same area are synchronised. 5G BS using the same TDD band will need to transmit at the same fixed time periods, and all 5G devices need to transmit at different time periods as per available TDD configuration. The chosen approach to synchronisation impacts the use cases that can be addressed in the band. For example, ultra-low latency or uplink centric 5G applications can't be supported in the same band and area.

Samsung recommends leaving this matter as mutual coordination since it is an issue of TDD synchronization between MNOs.

- Q.17 In case your response to the above question is in affirmative,**
- a) whether there is a need to prescribe provisions such as clock synchronization and frame structure to mitigate interference issues, as prescribed for existing TDD bands, for entire frequency holding or adjacent frequencies of different TSPs? If yes, what should be the frame structure? Kindly justify your response.**
  - b) Any other measures to mitigate interference related issues may be made along with detailed justification.**

TDD networks could be deployed with synchronized, partial synchronized and unsynchronized configurations. Synchronized operation avoids any BS-BS and UE-UE interferences, therefore allowing coexistence between adjacent networks without the need for additional guard bands or additional filters. This operating mode simplifies network deployment because no additional interference mitigation is required. Synchronized operation leads to the selection of a compatible frame structure. A common phase clock reference and accuracy/performance constraints that depend on the underlining technology ECC Report 216.

Unsynchronized TDD configuration, while offers flexibility in network deployment, at the same time results in additional guard band, filter requirements or separation distance. Required interference mitigation mechanism for unsynchronized or semi synchronized network could be found in ECC report-216 for 3.5 GHz. ECC report-307 share insight about mitigation measures, separation distance for 24.25 to 27.5 GHz spectrum.

Operators could be recommended to have synchronized network at national level as well as at local levels. The operators may have to coordinate to use different synchronized frame structures to meet the network requirements. TRAI could request MNOs to deploy synchronized TDD network in order to avoid additional mitigation and regulatory measures.

## **2.3 Issues related to Roll-out obligations**

- Q.19 What should be associated roll-out obligations for the allocation of spectrum in 526-698 MHz frequency bands? Should it be focused to enhance rural coverage? Kindly justify your response.**

This band is good for wide area coverage with low capacity. It will find extensive applications in rural and remote low population density areas.

- Q.20 What should be associated roll-out obligations for the allocation of spectrum in 3300-3670 MHz frequency band? Kindly justify your response.**

NAVIC ranging is operational in band between 3400-3425 with FSS earth station, and in this band, co-existence between 5G and NAVIC is possible. Samsung has conducted the relevant study and found 55

km is maximum distance, which can protect FSS from signal coming by 5G base stations. TRAI may recommend protection of all 6-7 earth station based on geographical terrains with the suggested protection distance.

FSS stations operating in band above 3670 MHz should be protected with 15 MHz of guard band and 6-7 km distance to all 5-6 earth stations. Please find additional details in mitigation measures AWG report [[AWG-28-OUT-16](#)].

**Q.21 What should be associated roll-out conditions for the allocation of spectrum in 24.25 to 28.5 GHz frequency range? Kindly justify your response.**

Samsung fully supports the technical conditions defined by 3GPP. We recommend the TRAI to adopt technical conditions defined by 3GPP as roll-out conditions. In conjunction with a matter of unwanted emission limit, Resolution 750 (WRC-19) should also be considered for 5G roll-out in India.

## **2.4 Issues related to spectrum cap**

**Q.24 Keeping in mind the importance of 3300-3670 MHz and 24.25-28.5 GHz bands for 5G, whether spectrum cap per operator specific to each of these bands should be prescribed? If yes, what should be the cap? Kindly justify your response.**

In Samsung view, 100 MHz spectrum should be considered for 3.5 GHz and 800-1200 MHz spectrum should be considered for 26/28 GHz (please refer to our response to Q.7). New spectrum requirements should be considered in the future auctions depending upon applications and market requirements.

It is advisable for TRAI to recommend MNOs to emphasize simultaneous adoption of spectrum in both 3.5GHz and 26/28 GHz for maximum utilization of mid (<6 GHz) and high bands (>6GHz).

## **2.5 Issues related to valuation and reserve price of spectrum**

**Q.37 Whether the auction determined prices of March 2021 auction be taken as the value of spectrum in the respective band for the forthcoming auction in the individual LSA? Should the prices be indexed for the time gap (even if less than one year or just short of one year)? If yes, please indicate the basis/ rate at which the indexation should be done, with reasons.**

Market driven historical price has direct correlation of the then market dynamics. Scarcity of spectrum in requisite bands leads to TSP's compulsion to acquire/retain spectrum for business continuity, etc.

5G era has entirely different dynamics, and is not just about connectivity. The proliferation of 5G creates new businesses, employment opportunities and significantly contribute in the economic growth of the country and hence historical cost method do not have any relevance and therefore TRAI must continuously evaluate the appropriate pricing models in the best socio-economic interest of the country.

**Q.40 Whether the valuation exercise be done every year in view of the Government's intention to have an annual calendar for auction of spectrum? Please support your response with detailed justification.**

The aim of the government is to provide enabling environment to all these who need and can deliver new technologies. Reviewing the valuation on a regular basis will enable government to maximize the socio-economic value of the spectrum.

**Q.46 In your opinion, what could be the possible reasons for the relative lack of interest for**

the spectrum in the 700 MHz band? Could this be attributed to technological reason(s) such as development of network/device ecosystem or availability of substitute spectrum bands or any other reasons(s)?

In our view, unrealistic very high prices could be a potential reason for limited eco system in this band.

**Q.52** Whether the value of spectrum in 24.25 - 28.5 GHz band be derived by relating it to the value of other bands by using technical efficiency factor? If yes, with which spectrum band, should this band be related and what efficiency factor or formula should be used? Please justify your suggestions.

This band can be used for short range and very high capacity and thus requires very high CAPEX and OPEX due to densification. It will be good to take note of other countries experience (such as Korea, USA) on the pricing models where the pricing of mmWave bands are significantly lower than low and mid-bands, on per-unit basis.

**Q.54** Whether international benchmarking by comparing the auction determined price in countries where auctions have been concluded be used for arriving at the value of these new bands? If yes, then what methodology can be followed in this regard? Please explain.  
See response to Q52.

## 2.6 Issues related to spectrum for private cellular networks

**Q.71** Whether some spectrum should be earmarked for localized private captive networks in India? Kindly justify your response.

Optimum utilization and maximization the socio-economic valuation of the spectrum is the fundamental principle of spectrum management. The spectrum allocated for satellite applications can be used for private captive indoor uses as this will not create interference for satellite systems.

**Q.72** Whether In case it is decided to earmark some spectrum for localized private captive networks, whether some quantum of spectrum be earmarked (dedicatedly) from the spectrum frequencies earmarked for IMT services and/or spectrum frequencies earmarked for non-IMT services on location-specific basis (which can coexist with cellular-based private captive networks on shared basis)? Kindly justify your response with reasons.

Yes, Samsung highly recommends earmarking of spectrum within the 3670-4200 MHz mid-band range and within the 28.5-29.5 GHz mmWave band range which are good candidates for captive industrial uses.

**Q.73** In case it is decided to earmark some quantum of spectrum for private captive networks, either on exclusive or shared basis, then

- a) Spectrum under which band(s) (or frequency range) and quantum of spectrum be earmarked for Private Network in each band? Inputs may be provided considering both dedicated and shared spectrum (between geographically distinct users) scenarios.
- b) What should be the eligibility conditions for assignment of such spectrum to private entities?
- c) What should be the assignment methodology, tenure of assignment and its renewal, roll-out obligations?

- c) What should be the pricing mechanism for assignment of spectrum in the band(s) suggested for private entities for localized captive use and what factors should be considered for arriving at valuation of such spectrum?**
  
- e) What should be the block size and spectrum cap for different spectrum band(s) suggested in response to point (a) above.**
  
- f) What should be the broad framework for the process of**
  - (i) filing application(s) by enterprise at single location, enterprise at multiple locations, Group of companies.**
  
  - (ii) payment of spectrum charges,**
  
  - (iii) assignment of frequencies,**
  
  - (iv) monitoring of spectrum utilization,**
  
  - (v) timeline for approvals,**
  
  - (vi) Any other**
  
- g) Any other suggestion on the related issues may also be made with details.**

Spectrum for local area use is an important regulatory topic that is being discussed globally. A few countries have made spectrum available for local use while a number of others are still considering the options. As the market is still at an early stage there is still time to consider the options and it is important to build in regulatory flexibility to accommodate various scenarios and future developments. If TRAI decides to consider spectrum for local area access then Samsung recommends the following;

Consider spectrum within the 3670-4200 MHz mid-band range and within the 28.5-29.5 GHz mmWave band range. Spectrum from within 3670-4200 MHz is being made available within Europe for local area use. There is a healthy ecosystem for equipment within 28.5-29.5 GHz. These ranges are also used for satellite communications and hence it is recommended that these are explored for local use.

Consider designing in flexibility to the local area licensing approach and also how to help create a healthy ecosystem. This can be achieved by allowing a range of entities to apply for local area licenses to serve a range of potential use cases such a distribution centres, ports, manufacturing plants, stadiums, offices, railway stations, airports, outdoor hot zones, etc. It is important that a range of entities can apply for local area licenses such as the mobile operators, building owners, neutral hosts, specific specialised local area network & service providers, etc.

Consider the licensing approach from other regions and countries such as administrative local area licensing with specific licence durations and coverage conditions.

Variations in the geographic size of the local licence is important to consider. In some instances, an applicant may wish to serve a campus, another a factory, while another a large or complete area of a city.

### 3. Summary

Samsung recognises that 5G and 5G Advanced will serve as the basic infrastructure for the growth of Indian economy, generate new business and employment opportunities to the masses, and develop India as a major hub of 5G advances related technology innovation, applications development and exports. Immediate deployment of 5G will serve as the basic tool to achieve the Hon'ble Prime Minister's goal of USD 5 trillion economy by 2025

In order to leverage the full potential of services offered by 5G technology, it's important to maximize the unconstrained availability of spectrum in below and above 6 GHz concurrently. Further, continuously explore possible extension of spectrum in low, mid and high band considering future deployment and usage of 5G and 5G advanced services. Needless to say spectrum is scarce natural resource, therefore it's necessary to maximize spectrum usage for local area applications, wherever, sharing is challenging. Additionally, harmonization of spectrum for local usage is indispensable for growth of private network.

In summary, we believe it will be necessary to allocate at least 100 MHz below 6 GHz coupled with 1000 MHz in 24.25 to 28.5 GHz band spectrum simultaneously to each operator at affordable reserve price and continuously explore new spectrum for IMT-based technologies.

### 4. Acronyms and Abbreviation

3GPP	3 <sup>rd</sup> Generation Partnership Project
eMBB	Enhanced Mobile Broadband
FDD	Frequency Division Duplex
FSS	Fixed Satellite Service
FWA	Fixed Wireless Access
GSA	Global mobile Suppliers Association
IMT	International Mobile Telecommunications
ITU	International Telecommunications Union
mMTC	Massive Machine Type Communications
NR	New Radio
TDD	Time Division Duplex
URLLC	Ultra-reliable and Low Latency Communications
WRC	World Radiocommunication Conferences

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Appendix: 1

## Appendix 1

### Global trends on 5G spectrum

mmWave spectrum bands are being explicitly opened up to enable provision of 5G services.

The 24.25–29.5 GHz range covering the overlapping Bands n257 (26.5–29.5 GHz), n258 (24.25–27.5 GHz) and n261 (27.5–28.35 GHz) has been the most-licensed/deployed 5G mmWave spectrum range to date.

- One hundred and seventy-three operators in 48 countries/territories are investing in 5G (in the form of trials, licences, deployments or operational networks) across the 24.25–29.5 GHz spectrum range.
- Of those, 120 operators are known to have been licensed to deploy 5G in this range.
- Twenty seven operators are understood to be actively deploying 3GPP-compliant 5G networks using this spectrum.

*Figure 1: Use of 5G spectrum between 24.25 GHz and 29.5 GHz, countries/territories plotted by status of most advanced operator activities*

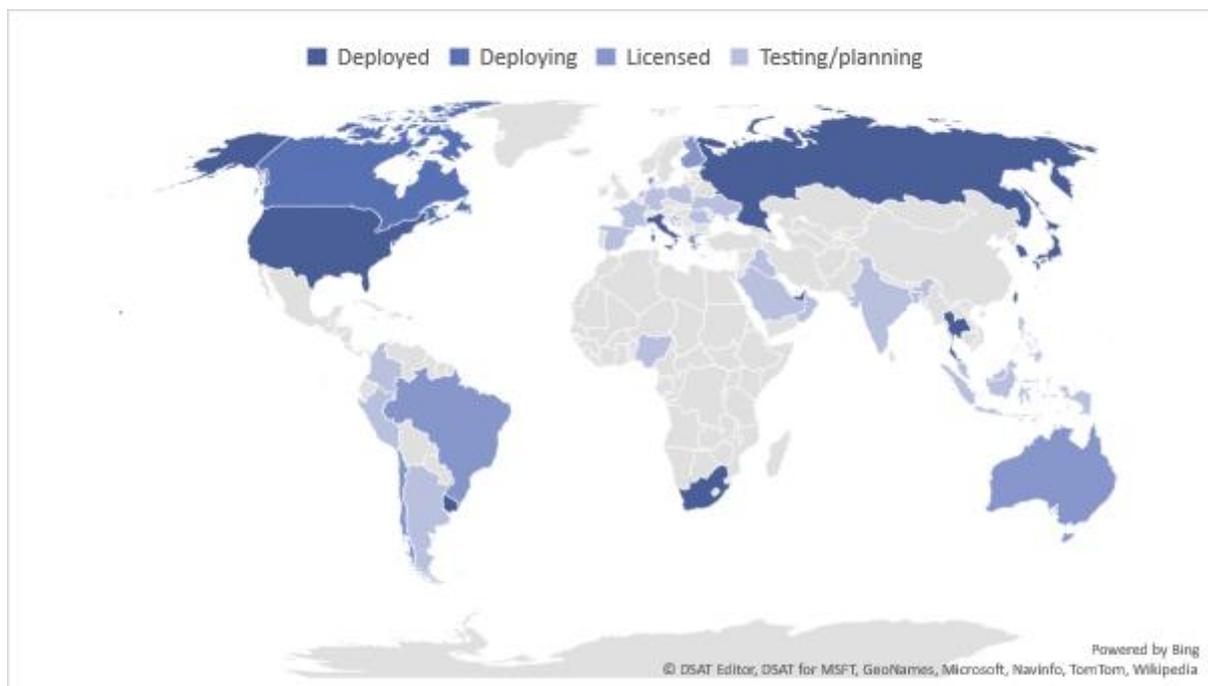
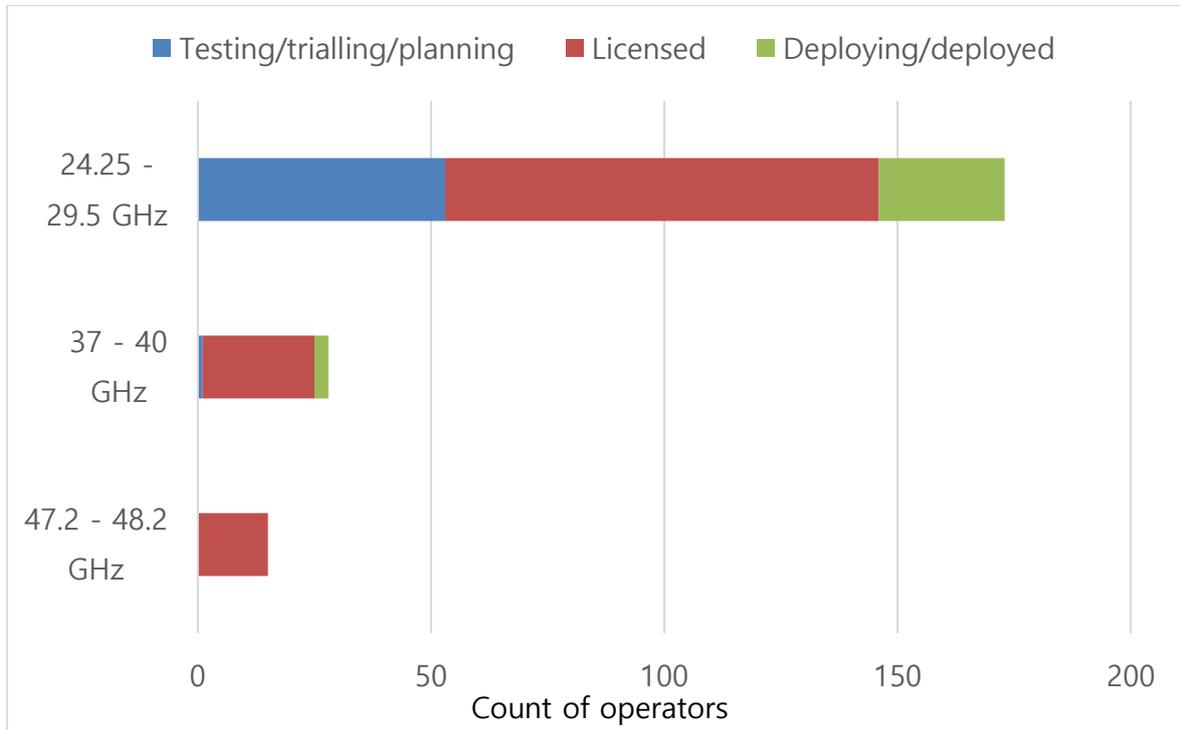


Figure 2: Count and status of operator mmWave investments



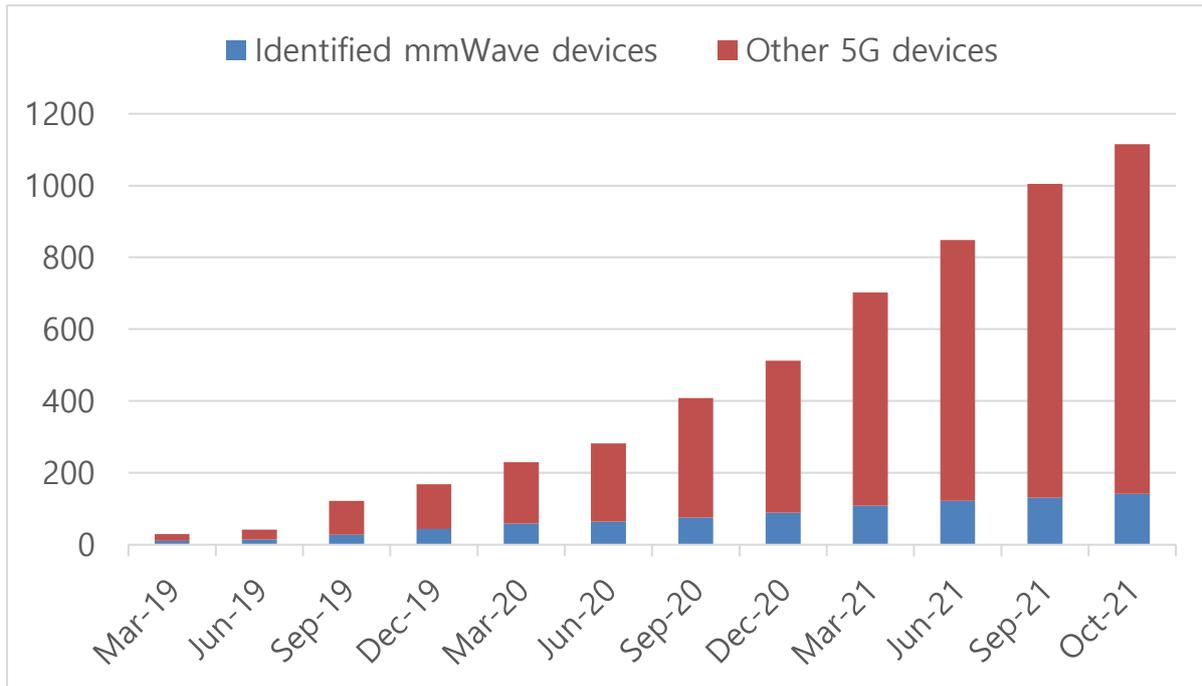
Band n260, covering 37–40 GHz, is also used, with 282 companies in five countries/territories investing in licences for, or have networks using this spectrum. Of those, 27 hold licences. (The majority of those are based in the USA and its territories.) Three operators in the USA have launched 5G using Band n260.

The United States has additionally awarded fifteen operators with licences to use spectrum in band n262, covering 47.2-48.2 MHz.

5G device support for spectrum bands above 24 GHz is growing steadily. GSA’s GAMBoD database includes 142 announced 5G devices that do or will support mmWave spectrum bands (up nearly 27% in 2021). Ninety-two of those are understood to be commercially available (up by 70% in 2021).

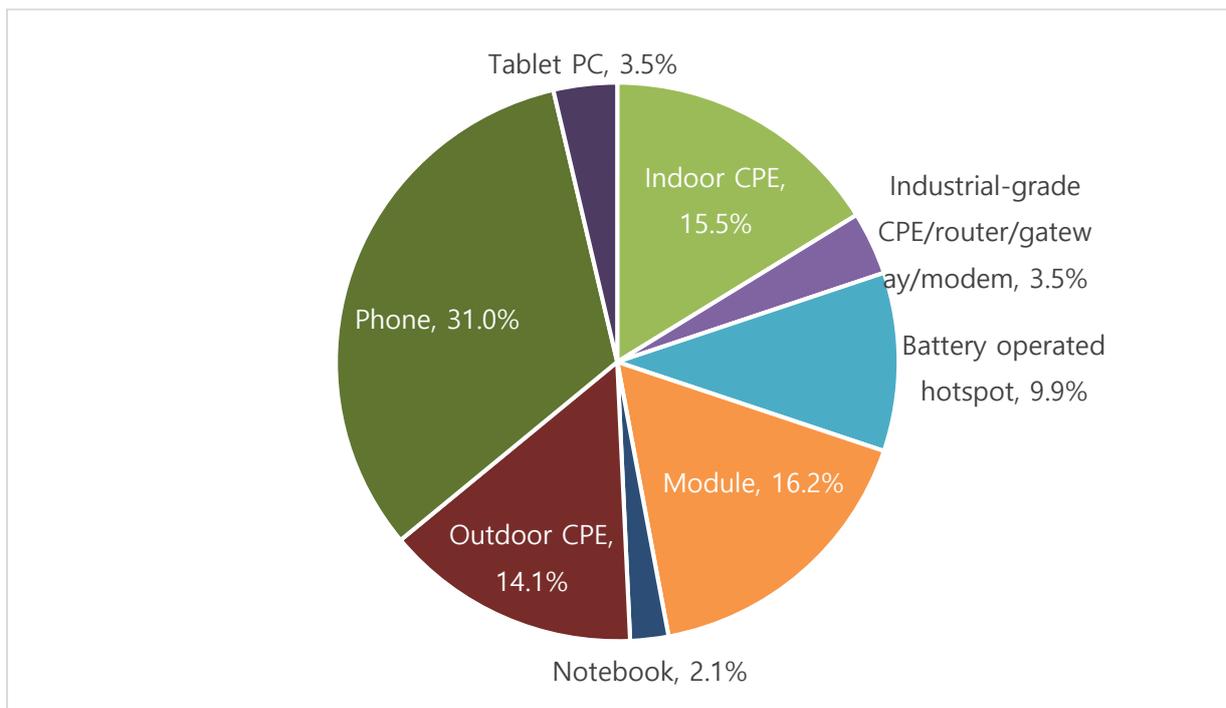
Figure 3: Announced mmWave and other 5G devices

<sup>2</sup> Figures restated since last report to correct an error



5G devices supporting mmWave spectrum have been announced by 57 vendors. Phones (31%) and indoor and outdoor FWA CPE (30%) account for the largest shares of the announced devices by type.

Figure 4: Announced mmWave-supporting models by type



The number of devices identified as supporting specific bands is much lower, as information about spectrum support is not always publicly available, especially for pre-commercial devices. Nonetheless GSA has catalogued 65 announced devices supporting band n261, 57 of which are commercially available, 63 devices announced as supporting band n260 (56 commercially available), 36 announced as supporting n257 (27 commercially available), and 26 announced as supporting n258 (20 of them commercially available).

mmWave spectrum is becoming increasingly important for mobile telecoms and a number of trends will underpin the continued emergence of a 5G market that uses mmWave spectrum:

- Increasing numbers of operators with spectrum assignments in mmWave bands suitable for 5G deployments.
- Further auctions of mmWave spectrum in the coming years.
- Increasing investment in networks using these spectrum bands by operators.
- Commitments to launch compatible devices by device vendors.

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