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Attending to this matter: Subrata Kumar Mitra

Your Reference: Consultation Paper on Auction of Spectrum in frequency bands identified for IMT/5G
Your Date: 2021-11-30

Mr. Syed Tausif Abbas
Advisor (Networks, Spectrum & Licensing)
Telecom Regulatory Authority of India
New Delhi - 110002

Ericsson's Response to TRAI Consultation Paper on "Auction of Spectrum in frequency bands identified for IMT/5G"

Dear Sir,

Ericsson welcomes the opportunity to provide response to TRAI consultation paper No. 8/2021 on "*Auction of Spectrum in frequency bands identified for IMT/5G*". This is a timely consultation to aid the Government of India's vision on improving the digital penetration and broadband experience as per National Digital Communications Policy – 2018 (NDCP- 2018). Given the technology development in connectivity through 5G, the increase in 5G penetration with enhanced speeds will catalyze diverse applications in enhanced Mobile Broadband (eMBB), Ultra Reliable Low Latency Communication (URLLC) and massive Machine Type Communication (mMTC). 5G is expected to transform all sectors of the economy.

Ericsson has gone through the consultation paper and would like to submit our views for your kind consideration. We urge you to consider our suggestions while developing the recommendations. It may be prepared with a view of the potential benefits with increased availability and use of spectrum for Mobile Broadband and Fixed Wireless Access based services for Financial Inclusion, Bridging Digital Divide, Catering to the Urban needs for High Speed, Enterprise/ Business Demands, Broadcasting, Convergence of Networks and Technologies, Technology Evolution & Global Standardization, Development of Eco-System, Exponentially Growing/ Future Needs of Society, People and Government, and most importantly Sustainability.

Yours sincerely,

For Ericsson India Pvt. Limited,

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1 ERICSSON'S RESPONSE

According to the latest forecasts in Ericsson's mobility report[1] (Nov 2021), 5G is on track to become the dominant mobile access technology, by subscriptions globally, by 2027. 5G is also expected to account for around 50 percent of all mobile subscriptions worldwide – covering 75 percent of the world's population and carrying 62 percent of the global smartphone traffic by 2027.

The report also shows that the pace of change is accelerating, with technology playing a crucial role. When we look ahead to 2027, mobile networks will be more integral than ever to how we interact, live and work.

Since 2011, the deployment of 4G LTE networks has been pivotal in generating 5.5 billion new smartphone connections worldwide, contributing to the market availability of more than 20,000 different 4G device models. This report indicates a much earlier technology lifecycle of 5G devices, with 5G handsets today accounting for 23 percent of global volumes, compared to 8 percent of 4G handsets at the corresponding point in its lifecycle.

This is helping to fuel an exponential growth of mobile data traffic. Mobile network data traffic was up 42 percent, year-on-year, in Q3 2021 accounting for approximately 78 exabytes (EB), including traffic generated by Fixed Wireless Access (FWA) services. In Q3 alone, mobile data traffic was more than all mobile traffic ever generated up until the end of 2016. New forecasts reveal that total mobile network data traffic is likely to reach 370EB by the end of 2027.

1.1 5G in India

5G will represent around 39 percent of mobile subscriptions in India at the end of 2027, estimated at about 500 million subscriptions. The number of smartphone subscriptions is expected to be 810 million at the end of 2021 and is projected to grow at a CAGR of 7 percent, reaching over 1.2 billion by 2027. Smartphone subscriptions accounted for 70 percent of total mobile subscriptions in 2021 and are projected to constitute around 94 percent in 2027, driven by rapid smartphone adoption in the country.

4G is expected to remain the dominant technology in India in 2027, however the 4G subscriptions are forecast to drop from 790 million in 2021 to 710 million in 2027, showing an annual average decline of 2 percent. Thus, 4G subscriptions are expected to reduce from 68 percent of mobile subscriptions in 2021 to 55 percent in 2027 as subscribers migrate to 5G.

The reliance on mobile networks to stay connected and work from home has contributed to the average traffic per smartphone increasing to 18.4GB per month in 2021, up from

[1] https://www.ericsson.com/en/press-releases/2/2021/12/ericsson-mobility-report-india-edition

16.1GB per month in 2020. The average traffic per smartphone in the India region is the second highest globally and is projected to grow to around 50GB per month in 2027. Total mobile data traffic in India has grown from 9.4EB per month in 2020 to 12EB per month in 2021 and is projected to increase by more than 4 times to reach 49EB per month in 2027.

5G will serve as a socio-economic multiplier for the country and we are preparing the communication service providers for a seamless introduction of 5G in the country based on our global deployment experience, through various 5G trials with Indian operators we showcased the possibilities with 5G.

Ericsson recently carried out 5G trials with Airtel and Vi where it demonstrated enhanced mobile broadband and FWA use cases with 5G. Ericsson demonstrated blazing speeds of >4Gbps and above 1.5Gbps with 5G during the trial using mmWave and 3.5GHz bands respectively. We showcased the potential of 5G to revolutionize healthcare sector by enabling remote diagnostics. The highlight of the trial with Bharti Airtel was the demonstration of over 200 Mbps throughput on 3GPP-compliant 5G FWA device at distance of over 10 Km from the site. This translated into an inter-site (between two 5G sites) coverage of approximately 20 kms, thus offering the ability to provide high-speed broadband coverage even in the remotest of geographies.

In most of the trials, about 100MHz of spectrum in 3.5GHz and 800MHz were used to demonstrates such high speeds. Hence, access to such amount of spectrum in mid-band and mmWave per operator is key to deliver such speeds, experience, and capability to offer emerging 5G services. Moreover, access to spectrum in sub-GHz bands is also key for extending coverage and capacity along with the mid-band deployments.

According to GSMA's report[2], there will be demand for more spectrum to address the growth of mobile traffic in future. According to the study in the report, there will be an estimated need of about 2,020 MHz in the 2025-2030 time frame in the mid-band itself.

Following are our responses, based on the global 5G deployments and developments, and the potential benefits and growth of mobile traffic in India.

[2] https://www.gsma.com/spectrum/wp-content/uploads/2021/07/Estimating-Mid-Band-Spectrum-Needs.pdf

2 RESPONSE TO QUESTIONS

Questions related to Quantum of Spectrum and Band Plan

Q1. Whether spectrum bands in the frequency range 526-617 MHz should be put to auction in the forthcoming auction?

Response: This portion (526-617 MHz) of the band is identified for IMT in Region 3 and currently being studied for the usage by other services in region 1 under AI 1.5 for WRC-23[3].The outcome of this study during the WRC-23, can lead to harmonized use of this band for IMT.

Ericsson recommends

- that this portion (526-612 MHz) of the band need not to be put for auction in the forthcoming auction but should be considered in subsequent auctions post WRC 23
- to include portion 612-617MHz for forthcoming auction as part of the 600MHz band.

APT region countries are assessing the band plans for "*Extended 600 MHz band",* that ranges from 612-652/663-703MHz (to allow either B1 or B2 options, see response to Q4) in reverse duplex mode to co-exist with the APT700 band.

Q2. If your answer to Q1 above is in affirmative, which band plans and duplexing configuration should be adopted in India? Kindly justify your response.

Response: The portion (612-617MHz) is now considered as part of the extended 600MHz band for APT region's band-plan. Ericsson recommends that this portion (612-617MHz) be included along with the 600MHz band in the forthcoming auction. This increases the availability of 600MHz band for operators to 2x40MHz.

Q3. In case your answer to Q1 is 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.

Response: The entire portion 470-698MHz is identified for IMT in many countries including India.

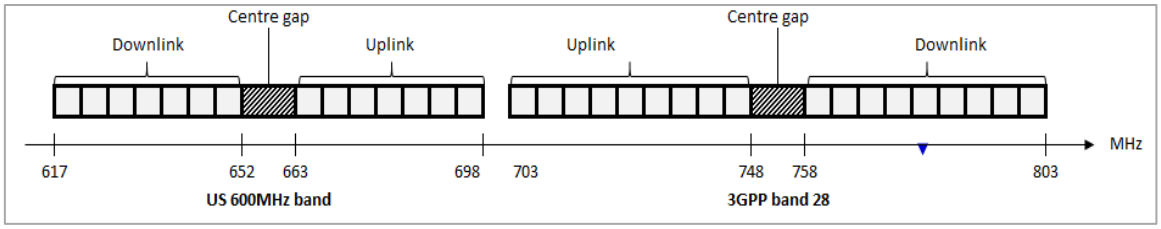
[3] https://www.itu.int/en/ITU-R/study-groups/rcpm/Pages/wrc-23-studies.aspx

Ericsson recommends that the portion of this band (526-612MHz) can be adopted and put up for future auction based on the outcomes and developments of WRC-23 AI 1.5.

Q4. 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?

Response: According to the recent GSA report[4] titled "*Spectrum Positions from 600 MHz"* published in Sep'2021, there are many countries considering deployment of IMT/5G in the *Extended 600 MHz band* (612 - 703 MHz). There are deployments of commercial 5G network based on the US 600 MHz band plan (617-652/ 663–698MHz) and there are around 60 (including pre-commercial) mobile devices supporting n71 as on Dec 2021.

The US600 MHz band-plan for LTE and NR (71/n71) was developed for the US market and is designed to fit with the US 700 MHz bands as shown below:

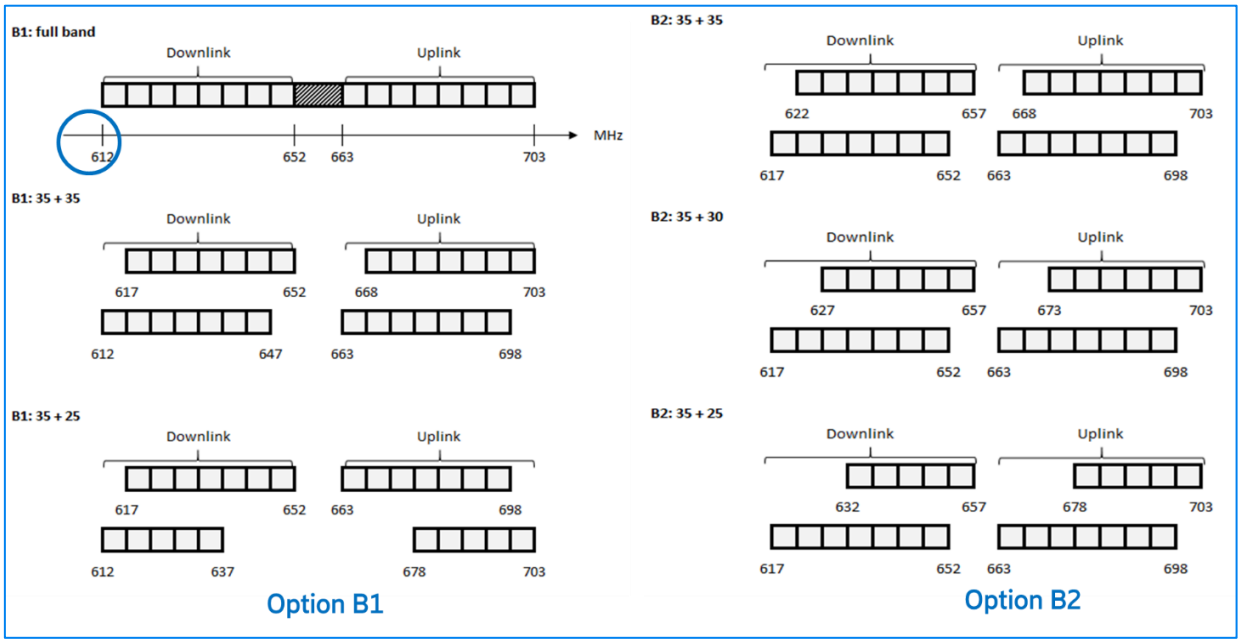


3GPP completed its study report on the technical feasibility (TR 38.860) – "Study on Extended 600 MHz NR band for (Release 17)", that included the study of *extended APT 600 MHz* for NR in FDD mode with reverse duplex operation. According to the study report, the US 600 MHz band 71/n71 in APT region, can make the frequency range 698-703 MHz (5 MHz) unused even though this portion of the spectrum is available for IMT in many countries in region 1 and region 3 including India. There is an opportunity of to have access to additional 2x5 MHz (total of 2x40 MHz) by having a new arrangement that can be leveraged by APT countries.

There are two options of band plans – ***Option B1*** and ***Option B2*** that are being considered by APT countries. The work-item on the extended 600MHz band in 3GPP is expected to begin after the upcoming APT meeting in March'22. Once APT countries conclude their decision on the regulatory framework considering the roaming possibilities with 71/n71; the 3GPP RAN4 specifications for the *extended 600MHz band* is expected to be completed early 2023.

[4] https://gsacom.com/paper/spectrum-positions-from-600-mhz-september-2021/

The figure below represents the two **Options** and the possible duplexer combinations as studied by 3GPP. Both the options allow reusing the n71 duplexer.

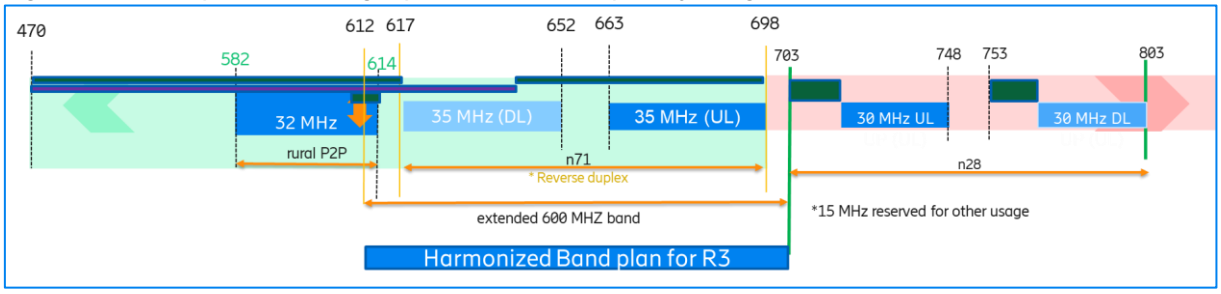


Option B1 – Has single duplex with 40MHz filter as well as two duplex cases, with one of the cases where duplexer reuses the n71 duplexer.

Option B2 – Has three possibilities: with two duplexers. In all the cases, one of the duplexers is same as the n71 duplexer.

India Situation

Figure below depicts the usage/plans for the frequency range



The frequency range 470-698MHz is identified for IMT by India, the lower portion in the extended 600MHz is allocated for a P2P service in rural. Noting the usage of frequency ranges listed in the TRAI consultation paper:

- 526-582 MHz in all the LSAs in coordination with Ministry of information & Broadcasting (MIB). The use will be coordinated with minimum keep out distance from MIB transmitters.
- 582-617 MHz band will be available for IMT/5G and rural point to point links.
- 617-698 MHz in all the LSAs except a few areas/locations.

Ericsson recommends

- the extended 600 MHz band should be put to auction in the forthcoming auction
- the 600MHz band range should start from *612MHz instead of 617MHz, and up to* 703MHz instead of 698MHz. This will maximize the available spectrum utilization for a 2x40MHz arrangement (allowing up to 8 blocks each of 2x5MHz).
- Post auction, the assignment of blocks can be adopted based on the outcome of the 3GPP specifications and APT regulatory agreement which is expected to happen in March'22. This will lead to benefits from economies of scale in India for network and devices

Q5. For 3300-3670 MHz frequency range, which band plan should be adopted in India? Kindly justify your response.

Response: 3GPP Band n78 (TD 3500) 3300-3800 MHz is the most appropriate band for the given range considered for auction. The band n78 is a TDD band and operators can be assigned with adjacent blocks without needing a guard band *(Also see response to Q16)* to efficiently use this band.

NR *operating band*	Uplink (UL) *operating band* BS receive / UE transmit $F_{UL,low}$ – $F_{UL,high}$	Downlink (DL) *operating band* BS transmit / UE receive $F_{DL,low}$ – $F_{DL,high}$	Duplex mode
n77	3300 MHz – 4200 MHz	3300 MHz – 4200 MHz	TDD
n78	3300 MHz – 3800 MHz	3300 MHz – 3800 MHz	TDD

n78 band from 38104 of 3GPP

3GPP Band n78 and n77

Moreover, according to GSA's report[5], there are more than 840 devices that support both n78 and n77 and hence all such devices can operate in this frequency range 3300-3670MHz.

Q6. Do you agree that TDD based configuration should be adopted for 24.25 to 28.5 GHz frequency range?

Response: 3GPP NR Rel-15 onwards have supports FR2 with TDD mode. The 3GPP bands n257 and n258 are applicable for the frequency range 24.25 to 28.5 GHz.

NR *operating band*	Uplink (UL) and Downlink (DL) *operating band* BS transmit/receive, UE transmit/receive $F_{UL,low}$ – $F_{UL,high}$ / $F_{DL,low}$ – $F_{DL,high}$	Duplex mode
n257 (28 GHz)	26500 MHz – 29500 MHz	TDD
n258 (26 GHz)	24250 MHz – 27500 MHz	TDD
n260	37000 MHz – 40000 MHz	TDD
n261	27500 MHz – 28350 MHz	TDD

3GPP Bands FR2

There are no 5G/IMT-2020 technologies that operate in FDD mode. As per the device ecosystem report from GSA, there are more than 50 devices (including Customer Premises Equipment – CPE form factor) that support both n257 and n258 bands.

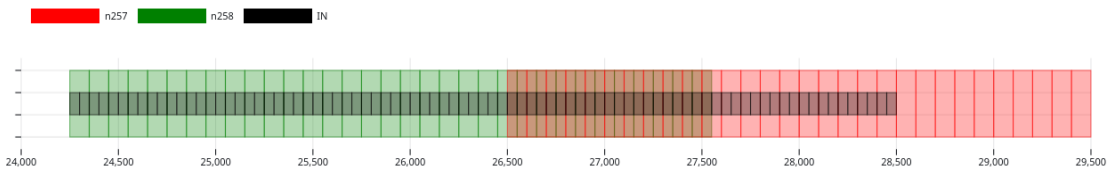
Ericsson recommends adopting TDD configuration for the 24.25 to 28.5GHz frequency range

Q7. 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?

Response: The bands with 100MHz block are depicted in the figure below. There is an overlap of 1000MHz, from 26.5 to 27.5GHz between the two bands n257 and n258.

If the total spectrum assigned to an operator is less than 1000MHz, it is possible to accommodate in any of this band n257 or n258. Based on the blocks that are assigned to the operator, the operator should be allowed to deploy equipment of n257 or n258 appropriately.

[5] GSA 5G year in Review – Webinar Presentation (Dec 2021) https://gsacom.com



3GPP n257 and n258 with 100MHz and 50MHz block unit

Ericsson recommends that based on the continuous blocks assigned to the operator, the operator should be allowed to deploy equipment in n257 or n258 appropriately

Q8. Whether entire available spectrum referred by DoT in each band should be put to auction in the forthcoming auction?

Response: Most of the referred spectrum bands by DoT are already either deployed or being considered for auction by other countries. Based on these global developments, Ericsson recommends that the following bands *Extended 600MHz*, 3.5GHz, and 26/28 GHz (24.25GHz to 28.5GHz) should be put for auction in the forthcoming auction.

Ericsson recommends that all these bands - 3300-3670MHz, 24.25-28.5GHz and the Extended 600MHz band (612-703MHz) should be put for auction.

Questions related to Block Size

Q11. 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?

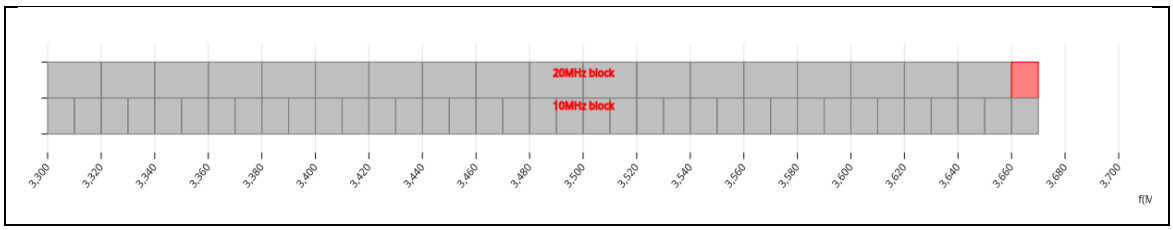
Response: 3GPP supports NR carrier bandwidth as low as 5MHz in the current n71 (US600) band as well as in the study report of band-plan of the extended 600MHz band.

Ericsson recommends that the for the portion of the spectrum that is put for auction in this extended range (612-703MHz); the minimum paired block should be of size 5MHz.

Ericsson suggests that each operator should have access to 2X10MHz of spectrum in 600 MHz band to enable the envisaged 5G services.

Q12. What should be optimal block size and minimum quantity for bidding in 3300-3670 MHz band?

Response: Globally, as of Dec' 2021 report from GSA[6] , there are more than 210 operators who have deployed/planning 5G NR in the C-band n77 and/or n78. 3GPP NR currently supports various channel bandwidth starting from 10MHz up to 100MHz. The supported channel bandwidth for 3GPP NR for the bands n78 and n77 are from 10,15,20,25,30, 40, 50, 60, 70, 80,90 and 100 MHz Availability of 800+ devices supporting NR in this band is also a reason for this band being the most sought band for 5G deployment.



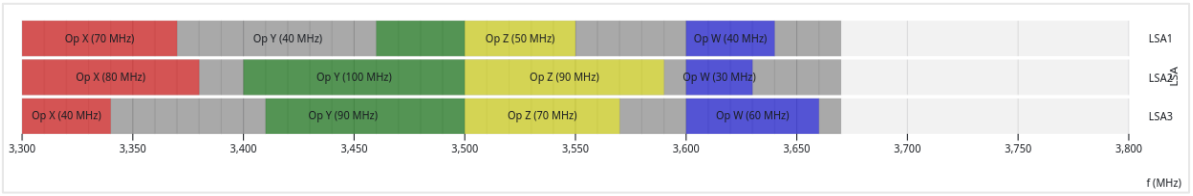
3300-3670 MHz with block sizes of 10MHz and 20MHz

As shown above, if the smallest block is set to 20MHz, one block of 10MHz would be left-over. Hence it is recommended to auction this band with the unit block of size 10MHz.

Ericsson suggests that each operator should have access to around 100MHz of spectrum in 3.5GHz band to enable the envisaged 5G services.

Ericsson further recommends

- multiple unit blocks of 10MHz should be contiguously awarded to the operators for efficient usage of this spectrum band
- that the assignment of the blocks be harmonized across all the LSA for each operator, one such way of assignment across LSA in the range (3300MHz-3400MHz, 3400-3500MHz, 3500-3600MHz and 3600-3670MHz) is depicted below.



Example scenario - Harmonized assignment of the blocks across LSA

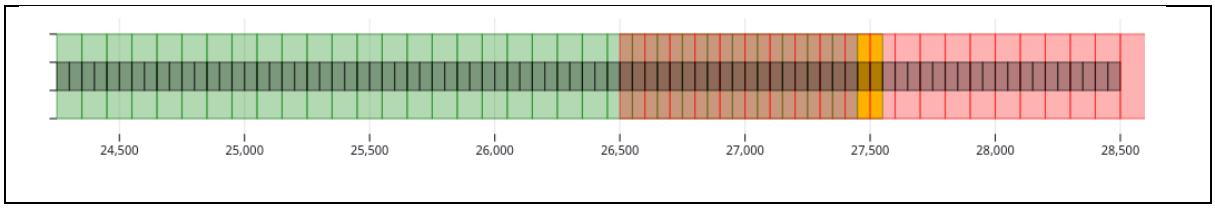
[6] GSA 5G year in Review – Webinar Presentation (Dec 2021) https://gsacom.com

This way of assignment helps to facilitate and mitigate potential interference issues due to TDD synchronization (see response to Q.17) even if all the operators bid for 100MHz in all the LSAs over subsequent auctions.

Q13. What should be optimal block size and minimum quantity for bidding in 24.25-28.5 GHz?

Response: The currently supported channel bandwidth in n258 (26 GHz) and n257(28 GHz) are from 50, 100, 200 to 400MHz.

NR band / SCS / *BS channel bandwidth*					
NR Band	**SCS kHz**	**50 MHz**	**100 MHz**	**200 MHz**	**400 MHz**
n257	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes
n258	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes
n260	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes
n261	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes

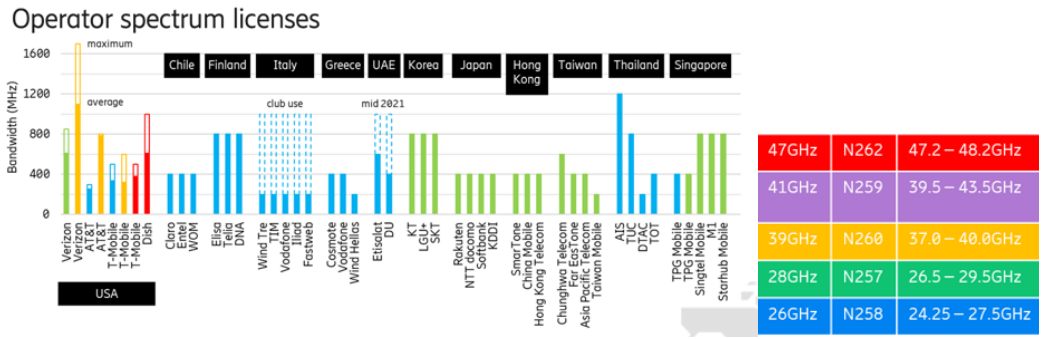


Unit block of 50MHz - 24.25 to 28.5GHz

The figure above depicts the frequency ranges 24.25GHz to 28.5GHz with unit block of size 50MHz. This block size of 50MHz allows to efficiently combine multiple blocks to form a single component carrier up to 400MHz in in either n257 or n258 band, without any block overlapping between 26GHz and 28GHz band.

Based on GSA's report[7] published in Dec 2021, 173 operators in 48 countries/territories are investing in 5G across the 24.25–29.5 GHz spectrum range. Most operators in these countries either are assigned or have secured more than 400MHz in this band.

[7] https://gsacom.com/paper/mmwave-summary-december-2021-spectrum-update/



According to the recent GSA report, there are network infrastructure, chipsets and mobile devices that can support eight 100MHz channels (8CC = 800MHz) in the downlink and two 100MHz (2CC) in the uplink direction. With such bandwidth of 800MHz, operators can roll-out high capacity, high speed FWA services in the 26/28 GHz bands. Hence, with multiple blocks of 50MHz units, operators can deploy multiple carrier components each of 100/200 or 400MHz to deliver high throughput.

For e.g., Eight blocks of 50MHz would be needed to form a single component carrier of 400MHz.

Ericsson suggests that

- each operator should have access to around 1GHz of spectrum in this band to enable the envisaged 5G services.
- the assignment of multiple unit blocks (50MHz); should be contiguously awarded to the operators for efficient usage of this spectrum band

Questions related to Interference mitigation in TDD bands

Q16. 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?

Response As recognized by TRAI in Section 2.53, when there are multiple TDD networks operating in the same band, geographic area in an uncoordinated way, there is a possibility of potential interference between uplink/downlink transmissions. Hence, in such cases, operators employ network synchronization, co-ordinate UL/DL time slot ratios instead of provisioning guard bands.

Ericsson recommends that it should be left to the TSPs to manage this potential interference by mutual coordination after assignment of the spectrum and the type of deployment post auction.

Ericsson does not recommend introducing of any explicit guard bands between operators while assigning the blocks to address this. Also please see detailed response to Q17.

Q.17 In case your response to the above question is 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.

Response: Recently, ITU-R WP5D completed its report ITU-R M. [IMT-2020.TDD.SYNCHRONIZATION] to study the issues of network synchronization when IMT-2020 network is deployed in co-channel and adjacent channel in the 3.5GHz band. Networks can experience cross link interference, (e.g., DL to UL or UL to DL) due to Unsynchronized or semi-synchronized network deployment, usage of different DL/UL time slot ratio and/or unaligned transmission frame structures.

Ericsson does not recommend using solutions such as guard band, stricter RF emission requirements or isolation distance, for mitigating cross-link interference, because this comes with a price of sacrificing the spectrum efficiency and more costly equipment. On the other hand, synchronized operation can avoid cross link interference and wastage of spectrum but requires neighboring operators to coordinate to select a compatible frame structure, and a common phase clock reference (e.g., UTC) with a requirement on accuracy/performance, and a common understanding about the start of the frame with regards to the common phase clock reference.

ECC published a technical report (ECC report 296[8]) - National synchronization regulatory framework options in 3400-3800 MHz: a toolbox for coexistence of MFCNs in synchronized, unsynchronized, and semi-synchronized operation. Interference issues due to unsynchronized operation between operators in the same or adjacent licensed service areas could be solved through consultation and mutual coordination post assignment of the frequency range to operators.

GSMA also published its report[9] - "5G TDD Synchronization - Guidelines and Recommendations for the Coexistence of TDD Networks in the 3.5 GHz range "that provides various guidelines and recommendation for operators' deploying NR in this band.

Given that there are 22 LSA (License service area) and operators are likely to have different among of spectrum across these LSA, it is essential to have synchronized TDD macro networks across the LSAs and other operators.

Ericsson Recommends

- to resolve TDD interference mitigation without prescribing guard band between operators
- to have clock synchronization framework for Macro 5G networks like the existing TDD 4G networks in other TDD bands at national level, especially if there is not sufficient isolation of geographical or frequency between the 5G NR networks in 3.5GHz band
- to allow mutual coordination between the regulator and mobile operators and to agree upon the TDD patterns for the macro network deployment in mid-band. The regulator's involvement is key to also ensure cross-border coordination with neighboring countries if needed in future.
- to allow flexibility for unsynchronized TDD operations between Macro and carefully planned local networks and between local networks. Careful planning of local networks including frequency and/or space separation, antenna directions etc., enables various levels of unsynchronized local networks
- to allow operators to further coordinate to use different synchronized frame structures to meet the network requirements for cases that may need to vary locally to address special usage from users such as verticals or events.
- that bi-lateral agreements between macro network and the local network operator be allowed for interference coordination and acceptable interference levels
- coordination between macro and local network be such that DL slots of the local network does not interfere with the UL slots of Macro network
- that the coordination process for TDD synchronization and TDD patterns between operators be done after the assignment of the frequency blocks to the operators after the auction.

[8] https://docdb.cept.org/download/1381

[9] https://www.gsma.com/spectrum/resources/3-5-ghz-5g-tdd-synchronisation/

Questions related to Private Cellular Network

Q.68 To facilitate the TSPs to meet the demand for Private Cellular Networks, whether any change(s) in the licensing/policy framework, are required to be made.

Response: There is a huge opportunity for communication service providers (TSPs) to address industrial connectivity needs with 3GPP-based cellular technologies. The opportunity encompasses a range of industries, including diverse segments with diverse needs, such as those in the manufacturing, mining, port, energy, and utilities, automotive and transport, public safety, media and entertainment, healthcare, and education industries, among others. Many enterprises in these industries are already TSP customers, with a total TSP share of the global addressable 5G-enabled market across these industries projected to be around USD 700 billion by 2030 according to the 2030 Market Compass Report[10].

As industries become more digitalized, their dependence on connectivity increases and poses uncompromising requirements regarding availability and reliability. Unsurprisingly, there are diverse needs regarding the type of connectivity required. A connectivity solution here will need to cater to various network needs simultaneously as well as cost-efficiently fulfill demanding use cases and services normally part of a public network, such as voice services, access to internet, and track-trace services. Different industries and companies can have different strategies regarding what operations are core to their businesses and should be kept in-house (as opposed to those bought as a service). This will likely be reflected in the way they address connectivity. Consequently, there is a need to cater to industries that would like to own and operate equipment themselves as well as those of the opposite inclination, whose services can be outsourced and provided by either their own private networks or from shared public networks.

Depending on industry strategies regarding what operations are core to their businesses and kept in-house (as opposed to those bought as a service), cellular networks can be deployed in various ways by TSPs. Broadly speaking there are two main network deployment concepts for addressing industrial connectivity needs[11], [12]

- non-public networks (NPNs) in conjunction with public networks (PNs), where network resources are shared between public and non-public users
- standalone non-public networks, where independent standalone networks are deployed for non-public use

Leveraging TSPs' assets like spectrum as well as infrastructure with complementary characteristics can provide major benefits, including improved coverage and availability, Cat-M/NB-IoT access, and low latency requirements demanded by vertical industries. TSPs can leverage their public spectrum assets to provide premium MBB and voice services to industries.

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[10] 5G 2030 industry digitalization potential - Ericsson

[11] https://5g-acia.org/wp-content/uploads/2021/04/WP_5G_NPN_2019_01.pdf

[12] https://www.ericsson.com/en/reports-and-papers/mobility-report/reports

According to the GSA report[13] on private mobile network, manufacturing is an early adopter of local area private mobile networks with 79 identified companies holding suitable licenses or involved in known pilots or deployments of LANs or probable LANs (up from 51 at the start of 2021). It is important to have a favorable policy that encourages multiple stakeholders including TSPs for trials, pilots, and deployments of private networks.

Ericsson suggests that the regulator should facilitate and have policies that enable TSP to reuse the infrastructure deployed for public network to also provide private cellular network services through technologies like network slicing in 5G.

Q.69 To meet the demand for spectrum in globally harmonized IMT bands for private captive networks, whether the TSPs should be permitted to give access spectrum on lease to an enterprise (for localized captive use), for a specific duration and geographic location?

Response: Harmonizing the use of spectrum bands across geographies is essential to achieving mass-market conditions which in turn enable cost-efficient and competitive industrial devices. Many countries have already begun to assign spectrum for 5G wide-area cellular networks, and quick regulatory actions and decisions have proven to be highly positive for all ecosystem parties, benefiting service providers and device makers with the ability to make technology investments as well as consumers with the possibility for earlier enjoyment of new generations of technology. The approaches taken differ widely between regulators, and the allocated bands are in many cases shared with incumbents. Regarding the locally licensed spectrum considered by administrations, these diverse allocations pose challenges to building a device ecosystem for industrial applications. Device chipsets need to be supported not only by an ecosystem of traditional mobile broadband (MBB) devices but also by an ecosystem that includes industrial devices of varying complexity on different spectrum bands.

It can be seen in Appendix A1 of the Ericsson whitepaper[14] that there are many countries considering leasing of spectrum for industrial applications.

Access to spectrum must be predictable over a lengthy period to support uninterrupted operation and major investments in production processes and industrial facilities having a lifecycle of typically 15–20 years. Policies must address such long-term leasing of spectrum access.

Ericsson suggests leasing of spectrum be allowed for TSPs towards usage for private and enterprise applications. The leasing conditions must involve clear geographical boundaries which ensure protection and coordination between the public network and the localized captive use.

[13] https://gsacom.com/press-release/gsa-catalogues-370-private-mobile-networks/

[14] https://www.ericsson.com/en/reports-and-papers/white-papers/5g-spectrum-for-local-industrial-networks

Q.71 Whether some spectrum should be earmarked for localized private captive networks in India?

Response: Ericsson recommends that, if there is plan for locally licensed industry spectrum, regulators and policymakers must find an easy to understand and cost-efficient model for its regulation. If implementing locally licensed spectrum for industry purposes, they must ensure that spectrum utilization is efficient, these requirements include:

- Access to spectrum must be predictable over a long period of time to support uninterrupted operation and major investments in production processes and industrial facilities having a lifecycle of typically 15–20 years.

- Schemes awarding excessive first-mover *advantages should be avoided* so that industries or other players do not block spectrum through spectrum hoarding.

- Local spectrum not yet licensed to industries should be kept available to increase spectrum utilization efficiency for spectrum license holders (such as TSPs), though with a sufficient safety margin to ensure that existing local networks are not subject to interference.

It should be noted that radio network providers and device makers can potentially face challenges with developing solutions for unique frequency bands unless the availability of devices and an ecosystem are factored into the decision of dedicating frequencies for locally licensed spectrum.

Q.72 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)?

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?

d) 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 suggestions on the related issues may also be made with details.

Combined response of Q 72, 73:

In addition to allowing leasing of spectrum by TSPs to private and enterprise usages, if TRAI decides to reserve spectrum for local/private network, then we recommend that 3GPP technologies be used to address the requirements of the private network. This also allows the private networks to leverage the growing ecosystem of devices as well as network deployments in 3GPP supported bands.

3GPP technologies offers possibilities to build solutions for various industries like manufacturing, ports, mining, airports and energy. [See Ericsson private networks - dedicated networks - Ericsson]. Please also see Ericsson's white paper on 5G Spectrum for local industrial networks - https://www.ericsson.com/en/reports-and-papers/white-papers/5g-spectrum-for-local-industrial-networks

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