



## MEMORANDUM

Date	Our reference	Page
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Spectrum Department

# The Swedish Post and Telecom Authority's intents for the assignment of frequencies for 5G, following referral

## Introduction

In its 'Preliminary study prior to future assignment of frequencies for 5G' (PTS-ER-2018:4), which was published on 15 February 2018, the Swedish Post and Telecom Authority (PTS) presented its preliminary assessments in preparation for the assignment of frequencies for 5G. In connection with the publication of this study, stakeholders were invited to contribute additional information and comments on the preliminary assessments made by PTS. The deadline for submitting information and comments was 14 March 2018.

PTS would like to express its gratitude for the information that was submitted. Below is an overview of the stakeholders' comments and the authority's response to them, followed by a presentation of the authority's intents when it comes to the assignment of frequencies for 5G, as a result of comments from the referral.

## Stakeholders' comments

PTS received comments from the following stakeholders: Bahnhof AB, Celestine Hill AB, Ericsson AB, Facebook Sweden Inc, GSA, Hi3G, Huawei Sweden AB, IT-Norrbottnen, North Net Connect AB, Onsala rymdobservatorium, Qualcomm, Svenska rymdaktiebolaget, Tele2 Sverige AB, Telenor AB, Telia Company AB, Teracom AB.

The comments have been published in their entirety on the PTS website: [www.pts.se/5G](http://www.pts.se/5G).

## Bahnhof AB (Bahnhof)

*Bahnhof* recommends a model, 'open spectrum', that implies a lighter form of licensing. According to this model, assignment would be carried out on three

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levels: 1) urban spectrum (limited to Sweden's ten biggest cities), 2) regional spectrum, which corresponds to urban networks, and 3) business development, research and testing purposes. *Bahnhof's* view is that this model would enable access to a greater share of the overall spectrum to new actors than the PTS' proposal.

#### **Celestine Hill Communications AB (Celestine)**

*Celestine* has a licence in Stockholm municipality in the 3.6-3.8 GHz band, comprising 80 MHz. This licence expires on 31 December 2022. *Celestine* supports PTS' proposal for a rapid introduction of 5G and would, as a spectrum holder in the band in question, *Celestine* would like to contribute to that by some kind of collaboration concerning usage of its frequencies after the assignment that is proposed in 2019.

#### **Ericsson AB (Ericsson)**

*Ericsson's* view is that the entire frequency range in the 3.4-3.8 GHz and the 24.25-27.5 GHz bands should be assigned in the form of national licence with at least 80-100 MHz and 400-500 MHz, respectively, per operator. National operators should, however, be to lease out frequency space to meet geographically limited needs. According to *Ericsson* the band needs to be defragmented before any licensing, and it proposes that PTS take on the cost of having existing licence holders move more swiftly out of the frequency range in question. *Ericsson* supports licencing in 2019, and also takes the view that PTS could consider making the entire 3.4-3.8 GHz band available by 2020.

*Ericsson* argues that licencing of only one gigahertz (26.5-27.5 GHz) of the 24.25-27.5 GHz frequency range will not provide sufficient incentives for comprehensive infrastructure investments, and is concerned that licencing without a selection procedure risks hampering effective use of the frequency band.

#### **Facebook Sweden Inc (Facebook)**

*Facebook* recommends that PTS enable the development of fixed services in both the 26.5-27.25 GHz and the 24.25-26.5 GHz bands in future – in particular with the aim of enabling the development of HAPS (high altitude platform stations). *Facebook* believes that a form of licencing that guarantees smaller geographic area licences, which was discussed in PTS' preliminary study, could be an appropriate form for allowing HAPS to become established by a number of regional operators.

#### **Global mobile Suppliers Association (GSA)**

*GSA's* view is that as much spectrum as possible in the 3.4-3.8 GHz should be assigned by means of individual national licences with contiguous frequencies of at least 100 MHz, and it urges PTS to avoid a decision that would increase the risk of geographic fragmentation. Furthermore, defragmentation of the band should be done prior to licencing, and PTS should create incentives for current licence holders to return their licences. *GSA* welcomes licencing in 2019.

*GSA* urges PTS to make the 26 GHz band available at a quicker pace.

#### **Hi3G Access AB (Tre)**

*Tre's* view is that the entire 3.4-3.8 GHz band, or at least large portions of it, should be assigned as national block licences by means of a selection procedure. If part of the band is going to be reserved for other uses, such licencing should be limited to a smaller portion of the frequency band, and the division should be based on frequency and not on geography. *Tre* questions how PTS is going to be able to guarantee that there is no surplus demand with respect to smaller geographic areas. *Tre* also questions the plausibility of reclaiming licences that are not used within 5-8 years.

The size of the licence, in *Tre's* view, should be bigger than 5-10 MHz, and it specifies a need for 80-100 MHz per stakeholder. Licencing should furthermore be as PTS proposes, in 2019. *Tre* believes that PTS should hold off on actively licencing the entire 24.25-27.5 GHz band until the international work is complete.

#### **Huawei Technologies Sweden AB (Huawei)**

*Huawei's* attitude is that the 3.4-3.8 GHz band should be assigned as individual national block licences with contiguous frequencies of at least 100 MHz per licence holder. To enable this, defragmentation of the band should be done prior to licencing. Market-based models such as 'network slicing', or regulatory ones with 'use-it-or-leave-it' conditions, can then be used to give verticals access. *Huawei* recommends that the entire band be made available at the same time and states that commercial realisation of 5G in the band can be carried out in 2019.

With respect to the 26 GHz band, *Huawei* recommends that PTS consider assigning the upper part (26.5-27.5 GHz) as national individual block licences with contiguous spectrums of at least 400-500 MHz per operator. In the upper as well as the lower part of the band, network slicing should be used in response to market demand.

The 3.4-3.8 GHz band should be assigned first, and it should be followed firstly by the upper part of the 26 GHz band and secondly by the lower part of the 26 GHz band.

#### **IT Norrbotten**

*IT-Norrbotten* regards it as important not to assign the entire 3.4-3.8 GHz and 24.25-27.5 GHz frequency bands as national block licences, as that would have anti-competitive effects locally and would lead to large parts of the bands being unused, across large geographic areas, for an extended period into the future. *IT-Norrbotten* instead recommends that parts of the bands be made available without a selection procedure.

For 3.4-3.8 GHz, the recommendation is either to assign licences per transmitter or to use a model like CBRS in the US. *IT-Norrbotten* regards the

following uses of the band as interesting at the regional or local level: 5G-based fixed wireless broadband access, mobile indoor solutions and IoT solutions.

For the 24.25-27.5 GHz band, *IT-Norrbottn* also suggests to make parts of the band, if possible, licence-free with mandatory notification for indoor use.

*IT-Norrbottn* does not believe that a 'sub-leasing market' for unused frequencies from national operators is a good method for achieving cost-efficient use. Limited interest in leasing out and a risk of overpricing are cited as problems.

#### **North net connect AB (North net)**

*North net's* view is that it is appropriate to set aside 100 MHz within 3.4-3.6 GHz for licence-free use indoors and, with limited output power, outdoors.

#### **Onsala rymdobservatorium (Onsala Space Observatory)**

*Onsala Space Observatory* notes that the 3.4-3.8 GHz and 24.25-27.5 GHz frequency ranges are adjacent to frequency bands that are important to its activity. *Onsala Space Observatory* therefore wishes to begin a dialogue with PTS, with the aim of securing a coordination zone.

#### **Svenska rymdaktiebolaget (Swedish Space Corporation, SSC)**

*SSC* adds the information that further to its earlier comments, the introduction of a geographic exclusion zone is one way of achieving protection around the Esrange Space Center and the Salmijärvi Satellite Station.

#### **Telenor AB (Telenor)**

*Telenor* proposes that PTS assign the entire 3.4-3.8 GHz band with national block licences, by means of a selection procedure, as first option. The second option would be to assign national block licences in the 3.4-3.7 GHz band, also by selection procedure, while also assigning a smaller part of the 3.7-3.8 GHz band in smaller geographic areas, without a selection procedure. *Telenor* agrees that the band should be assigned in 2019 and that an appropriate block size is 80-100 MHz.

*Telenor* opposes PTS' proposal to give the opportunity to the other stakeholders to apply for smaller geographic licences in areas where the current licence holder is not using or planning to use its frequencies.

Finally, *Telenor* suggests that PTS wait to begin active work on assigning the 24.25-27.5 GHz band until the international work is complete.

#### **Tele2 Sverige AB (Tele 2)**

*Tele2* suggests in the first instance to assign the entire spectrum of 3.4-3.8 GHz in the form of national block licences. In the second instance, and in the event that PTS decides to maintain the division between areas of high and low demand, respectively, *Tele2* suggests that the entire spectrum of 3.4-3.8 GHz should be made available in the form of national licences in predefined

geographic areas of high demand, and that these should be assigned through a selection procedure. *Tele2* also presents a third and a fourth option.

*Tele2* takes the view that licencing of the entire 3.4-3.8 GHz band should be done at the same time. However, *Tele2* recommends the rejection of PTS's proposal that a licence holder that is not using or planning to use its frequencies should risk losing the licence for smaller geographic areas within the predefined areas to other stakeholders.

*Tele2* suggests that PTS henceforth work on the assumption that a block size of 100 MHz will be applied.

*Tele2* suggests that PTS wait to begin active work on licencing the entire 24.25-27.5 GHz band until international efforts to establish available frequency ranges and lay down technical conditions are completed.

#### **Telia Company (Telia)**

*Telia* considers it important to make licencing possible to carry out in 2019, but finds that the proposal which is not based on using the national licences will lead to an unclear situation and to fragmentation of the band, with reduced possibilities of using it for future IMT 2020/5G services.

Overall, *Telia* supports the proposal to assign that 3.4-3.8 GHz and 24.25-27.5 GHz during 2019 and to access those bands from 2020 onwards (depending on the remaining extant licences). *Telia* also believes that licencing should be in the form of individual block licences. *Telia's* view is that a bandwidth of 100-200 MHz per operator is required.

*Telia* would like to see a discussion about synchronisation, about how to ensure that needs for local licences are not higher than supply, and about how the geographic boundary between areas for selection procedure should be determined. It also points out that the attractiveness of the two different types of licence depends on a number of factors.

#### **Teracom AB (Teracom)**

*Teracom's* opinion is that before the licencing procedure for 5G frequencies can be determined, and the frequency ranges be auctioned for commercial purposes, a detailed review of the need for 5G frequency ranges for PPDR must be carried out.

#### **Qualcomm Europe Inc (Qualcomm)**

*Qualcomm's* view is that PTS should guarantee that every licence holder will have access to 100 MHz in the 3.4-3.8 GHz band, and that the authority should avoid dividing up licences geographically. Further, it suggests that PTS make the entire band available for national licences, with priority for 5G, and that these should be supplemented by 'use-it-or-lease-it' conditions. *Qualcomm* also raises the issue of defragmentation, and wants PTS to create incentives for current licence holders to return their licences. *Qualcomm* supports licencing

with the aim of making spectrum available before 2020, and also supports the proposal that this would be done at the same time for the 3.4-3.8 GHz band and the 26 GHz band.

*Qualcomm* supports licencing of 26.5-27.5 GHz already in 2019, and agrees that assignment should be done by means of national block licences of at least 400 MHz per operator. So-called verticals will then be able to get access to spectrum via e.g. network slicing or the leasing out of spectrum.

Finally, *Qualcomm* brings up the synchronisation between current users and new 5G users in the 3.4-3.8 GHz band.

### **PTS' response to the referral and intents for the assignment of frequencies for 5G**

Below is PTS's response to the comments received, and a presentation of the authority's intents for the assignment of frequencies for 5G as a result of those comments.

#### **The 3.4-3.8 GHz band**

##### Timing of assignment

With respect to the proposed time for assignment of the 3.4-3.8 GHz band for 5G, there was a positive consensus for the assignment of the entire 3.4-3.8 GHz band in 2019.

In its preliminary study PTS proposed that new assignment of the entire 3.4-3.8 GHz band be carried out in 2019, and this assessment remains in place.

##### Opportunities for other stakeholders to apply for licences within five to eight years

PTS proposed in its preliminary study that if a licence holder did not within a given period of time – the suggestion was between five and eight years – use or make plans to use frequencies assigned to it as block licences in predefined geographic areas with a high population density and/or demand, other stakeholders should be allowed to apply for licences covering parts of these geographic areas.

Several of the mobile operators opined that the licences assigned by means of a selection procedure should not be altered in the way proposed by PTS. No other stakeholders expressed views in the matter.

The proposal by PTS is thus without any support in the referral. This, combined with the fact that the proposal would require considerable work on drawing up licence conditions, leads PTS to find proceeding with the proposal unjustified. Instead, PTS intends to continue working on developing other methods to give secondary users access to spectrum, in the best possible way, by means of sharing. Future licences will include conditions on shared use.

### Assignment form

Many comments were made regarding the proposed assignment form, which is based on division of the frequency band and geographical division of the country.

For the assignment of the 3.4-3.5 GHz band it was proposed in the preliminary study that to assign block licences without a selection procedure in smaller geographic areas across the country. For the 3.5-3.8 GHz band, it was proposed that block licences be assigned in two different types of areas; 1) Predefined geographic areas with a high population density and/or high demand; and 2) Smaller geographic areas located outside of the predefined areas. For areas of the first type, it was proposed that assignment be by means of a selection procedure, while for the second type assignment be without a selection procedure.

Some stakeholders argue that a successful rollout of 5G is only possible through the assignment of individual national block licences. Such an assignment form would stimulate the considerable investments required for the introduction of 5G, and would allow for more flexible and less complex implementations. According to some of the comments, local needs for higher capacity, e.g. in industrial facilities close to population centres or in sparsely populated areas, would be met through national networks, and vertical industries would be able to take advantage of network slicing to get direct access to spectrum by means of leasing. Other stakeholders take the view that a conventional and traditional assignment of block licences to a small number of stakeholders ties up an unnecessarily large part of the market. One stakeholder expressed the view that the 3.4-3.8 GHz band should be offered with a lighter form of licencing on three levels: urban, regional and testing spectrums. Such flexible licencing would be aimed at increasing competition, diversity and innovation levels in the market.

The assignment form is a central issue. It is therefore of the utmost importance for PTS to consider all referral comments in order to be able to draw conclusions on this issue.

Many of the comments recommend the assignment of national block licences by means of a selection procedure, but there are also stakeholders who advocate smaller licence areas. PTS' view is that it is important to meet demand and needs with respect to frequencies for national operators as well as for smaller local stakeholders.

After careful deliberation, and with the support of the referral comments received, PTS has determined a future approach to the assignment form. PTS proposes 300 MHz to be assigned as national block licences by means of a selection procedure, and 100 MHz to be assigned in the form of local block

licences. It is the authority's assessment that this assignment form will satisfy the demand for national block licences as well as provide opportunities for smaller local stakeholders to become established.

ASSIGNMENT FORM 3 400-3 800 MHz		
Frequency range (MHz)	Frequency amount (MHz)	Entire country
3 400-3 700	300	National block licences, selection procedure
3 700-3 800	100	Local block licences

With this type of solution, national operators' need to be able freely and at their own pace to build networks across the country would be satisfied in a simple manner. It also, at the same time, affords both national and local operators the opportunity to become established in local areas out of their own interest and without having to participate in selection procedure-based assignment for the entire country. This solution allows smaller local stakeholders to compete in all geographic areas.

The proposed assignment form and frequency use as laid out above, with national block licences in 3.4-3.7 GHz and local licences in 3.7-3.8 GHz, echo the solution for the 3.4-3.8 GHz band chosen by the German regulatory authority<sup>1</sup>. This is positive from an international harmonisation perspective.

Questions concerning block size and how local licences should be assigned if needs exceeds supply will be examined further in connection with the coming assignment process.

#### Defragmentation

A number of stakeholders who are or who represent manufacturers took the view that PTS should consider a national undertaking, together with the stakeholders, to free up and defragment the entire 3.4-3.8 GHz frequency range by 2020 or even earlier.

In this case, defragmentation refers to measures to make the largest possible continuous frequency ranges available throughout the country by the time of

<sup>1</sup>[https://www.bundesnetzagentur.de/DE/Sachgebiete/Telekommunikation/Unternehmen\\_Institutionen/Frequenzen/OeffentlicheNetze/Mobilfunknetze/mobilfunknetze-node.html](https://www.bundesnetzagentur.de/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Frequenzen/OeffentlicheNetze/Mobilfunknetze/mobilfunknetze-node.html)



the planned assignment. This in the context of the fact that there are existing licences in the band with a licence term that extends beyond 2020.

PTS notes that there are considerable differences with respect to the conditions for a defragmentation within the two frequency sub-bands of 3.4-3.6 GHz and 3.6-3.8 GHz.

In March 2018, the Association of Local Authorities (kommunförbundet) in Stockholm County returned the majority of the licences for the 3.4-3.6 GHz band in Stockholm County. This means that on 1 January 2020, there will be assigned licences in a maximum of 68 municipalities, with a joint population making up 24 per cent of Sweden's total population. The licences are currently divided between 16 licence holders. These licences correspond to less than 7 per cent of the population-weighted frequency amount in the 3.4-3.6 GHz band over the remaining licence term, until 1 April 2023. In the proposal for assignment form outlined above, this entire frequency space falls within the frequency range which is intended to be assigned as national block licences. PTS is aware that the remaining licences imply some uncertainty in the event of an assignment. However, these licences make up a relatively small share of the population-weighted frequency amount, and are held by a limited number of stakeholders who, on 1 January 2020, will only have a limited amount of time left of their licence terms. PTS would urge all licence holders who are not using their licences to return these to the authority before the 2019 assignment of frequencies.

The situation in the 3.6-3.8 GHz band is more complex than in the 3.4-3.6 GHz band as there is a large number of assigned licences and licence holders. The majority of these licences, however, belongs to companies controlled by the three mobile operators Tele2, Telenor and Telia. These three operators together control 75 per cent of the assigned licences. Any defragmentation of frequency bands where there are valid licences must be voluntary. This means that without the active participation of these mobile operators, there is very little to be gained from a revision of the plan for defragmenting the band. PTS further notes that no operator has requested a defragmentation of the band. PTS would also urge licence holders in the 3.6-3.8 GHz band who are not using their licences to return them to the authority before the assignment takes place.

In view of the above, PTS' overall assessment is that there is no reason to begin the extensive work of defragmenting the band.

#### About synchronisation

The new licences in the band will be associated with conditions that TDD must be used as the duplex method. For frequency bands with TDD as the duplex method and if there is more than one licence holder, there are significant advantages with introduction of synchronisation between the various licence holders. Synchronisation limits interference between the various licence holders' use and leads to a high level of spectrum efficiency. However,

extensive synchronisation requirements, formulated as licence conditions, can also lead to reduced flexibility with respect to the choice of technique, and furthermore limit the licence holders' possibilities of adapting their frequency use to different and continually varying needs in terms of the division between upstream and downstream capacity.

In the course of the upcoming assignment process, PTS will make proposals for how this trade-off can be made in such a way that an appropriate balance between flexibility for licence holders and technical spectrum efficiency can be achieved.

### **The 26.5-27.5 GHz band**

#### Timing of assignment

Opinions on assignment of 26.5-27.5 GHz diverged, in general. Some stakeholders believed that there was still no need of the frequencies and that it would be better to wait, and assign the entire 24.25-27.5 GHz band later. Others argued that the entire 24.25-27.5 GHz band should be assigned already in 2019.

In the preliminary study, PTS made the assessment that 1 GHz of the 26.5-27.5 GHz frequency range should be opened for assignment in 2019 since that is in accordance to the expressed goal of initially enabling local use of the 24.25-27.5 GHz band as early as in 2020. In the course of the referral, many have raised the point that uncertainty regarding international harmonisation is problematic, as the work to determine available frequency amounts and technical conditions in the band is not yet complete, which is creating considerable uncertainty. PTS also addressed this in the preliminary study.

The option of waiting to begin active work on assigning the entire 24.25-27.5 GHz band until the international work has been completed will of course lead to a later assignment of the band. In view of the responses received, PTS makes the assessment that the best option – despite some risk of a delay – is to begin work on assigning frequencies at a point when the conditions for assignment of the entire band can be determined.

#### Assignment form

It may be noted that the comments concerning the 26.5-27.5 GHz band were fewer overall. Still, different views emerged of the proposed assignment form for the 26.5-27.5 GHz band: some stakeholders prefer national block licences, while others advocate local block licences.

PTS intends to return to this issue at a later stage, when the assignment process begins.