

# The 800 MHz band

Planning and assignment  
proposals



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## Summary

PTS presents through this document proposals for how the 790-862 MHz frequency band ('the 800 MHz band') should be planned and assigned in Sweden. This frequency band has previously been used for terrestrial television broadcasting, but has been released from television broadcasting following a Government decision. PTS is conducting a survey of the interest in being assigned a licence in the 800 MHz band. If it transpires that demand for spectrum in the band exceeds supply, licences in the band will be assigned following an open invitation to apply. PTS proposes that an open invitation to apply should be issued prior to the summer of 2010 and that licences in the band should be assigned during the autumn of 2010.

PTS proposes that the conditions for use of spectrum in the 800 MHz band should be formulated in accordance with the principles of technology and service neutrality. These conditions should comply with the technical conditions produced through European harmonisation. An FDD band plan has been approved for the 800 MHz band, which involves a frequency separation of 1 MHz to channel 60 (782–790 MHz), six paired blocks of  $2 \times 5$  MHz each and a duplex gap of 11 MHz.

PTS proposes that the licences in the 800 MHz band shall be national and shall apply for 15 years. Licences shall be assigned through an auction structured as an SMRA (Simultaneous Multi Round Auction). A spectrum cap of  $2 \times 20$  MHz shall apply at the auction. The provisions on related parties shall prevent operators from taking part in the auction together with their jointly owned network undertakings. The auction will be conducted electronically over the Internet.

PTS proposes technical conditions for the 800 MHz band that are formulated as a spectrum mask, in accordance with the present draft ECC Decision.

In some areas, terrestrial television broadcasting reception for residential customers will be affected by the new systems in the 800 MHz band being put into service. Filters on receivers are the primary measure for diminishing the impact of this issue.

In order to reduce the effects on terrestrial television broadcasting reception, PTS proposes that, in addition to the spectrum mask, a requirement is imposed that only antennas with vertical polarization be used in areas where Channel 60 is used for terrestrial television broadcasting.

## Submitting views

PTS is asking interested parties to submit views on the discussions and proposals presented below. A summary is provided below of the most important proposals, which should make it easier for those who wish to submit views:

1. The point in time of the assignment is proposed to be the autumn of 2010 (Sub-section 3.2)
2. Requirements for coverage and infrastructure roll out (Sub-section 3.3)
3. Technology and service-neutral licence conditions (Sub-section 4.1)
4. The 800 MHz band is planned as an FDD, with six paired channels of  $2 \times 5$  MHz each (Sub-section 4.2)
5. National licences (Sub-section 4.3)
6. The term of the licences is 15 years (Sub-section 4.4)
7. The auction object is a frequency blocks in the form of paired channels of  $2 \times 5$  MHz (Sub-section 5.1.2)
8. The auction shall be structured as an SMRA (Simultaneous Multi-Round Auction), with rules that essentially correspond to those that applied to PTS's auction of licences in the 2.6 GHz band (Sub-section 5.1.3)
9. The spectrum cap at the auction is  $2 \times 20$  MHz (Sub-section 5.2.1)
10. The provisions on related parties are extended beyond groups of companies so that it also refers to companies that hold more than one third of the number of votes in another company (Sub-section 5.2.2)
11. The auction will be conducted electronically via the Internet (Sub-section 5.3.1)
12. Bidding is anonymous (Sub-section 5.3.2)
13. Basic spectrum mask (Sub-section 6.1)
14. Technical conditions for protecting terrestrial television broadcasting reception (Sub-section 6.2)

Responses must be delivered to PTS no later than <u>30 October 2009</u> .
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Responses can be sent by e-mail to [800-bandet@pts.se](mailto:800-bandet@pts.se) or by post to PTS's postal address. Please state File Reference 09-9526 in all communications in this matter.

PTS's postal address is:

PTS  
Box 5398  
SE-102 49 STOCKHOLM, Sweden

PTS intends to publish the responses to this consultation document. It should be clearly indicated whether it is requested that any information contained in the response should be subject to secrecy. PTS will treat such information in accordance with the applicable legislation on public access to information and secrecy.

A party who wishes to submit an anonymous response may do so through an attorney or another representative.

Enquiries regarding the consultation document can be sent to [800-bandet@pts.se](mailto:800-bandet@pts.se) or addressed to Sally Ibrahim, +46 (0)8 678 57 48.

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# 1 Introduction

Through this document, PTS presents proposals for how the 790-862 MHz frequency band ('the 800 MHz band') should be planned and assigned in Sweden. This frequency band had previously been used for terrestrial television broadcasting, but has been released from television broadcasting following the Government decision.

The aim is that market stakeholders and other interested parties should be able to gain access to PTS's proposals and be able to present views at as earlier stage as possible in the process. In this way, PTS will also acquire a valuable information base for its future work. On 23 April 2009, PTS held a hearing regarding the Agency's plans for the 800 MHz band. Following this hearing, a number of written statements of views were submitted to PTS.<sup>1</sup> PTS also held a hearing on 11 September 2009. The following document deals with some of the views presented at these hearings and in the statements of views in more detail.

PTS is conducting a survey of interest, where the Agency requests information from market stakeholders concerning the demands they have for spectrum in the 800 MHz band. If this survey of interest indicates that the demand for spectrum in the 800 MHz band is greater than the supply, licences will, following an open invitation to apply, be granted through an auction in the manner described in this document. If the survey of interest were to indicate that demand for spectrum is less than supply, licences in the 800 MHz band will be assigned in a way that is different to that referred to in this document.

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<sup>1</sup> Presentations and statements of views received are available on PTS's website, [www.pts.se](http://www.pts.se)

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## 2 Background

### 2.1 Use of frequencies in the bands previously used for analogue terrestrial television broadcasting

The following frequency bands for terrestrial television broadcasting were used prior to the switch-off of analogue terrestrial television broadcasting in Sweden:

Frequency bands for terrestrial television broadcasting prior to the switch-off of analogue terrestrial television broadcasting

<i>Frequency range</i>	<i>Designation</i>	<i>Amount of frequencies</i>	<i>Channel number</i>
47–68 MHz	Band I	21 MHz	2–4
174–230 MHz	Band III (VHF)	56 MHz	5–12
470–862 MHz	Band IV/V (UHF)	392 MHz	21–69

'Channel number' refers to the generally accepted numbering of the 7 MHz and 8 MHz channels respectively in Bands I, III, IV and V.

In the spring of 1997, the Riksdag (Swedish Parliament) decided that digital terrestrial television broadcasting would be introduced in Sweden.<sup>2</sup> These broadcasts started in 1999 using DVB-T technology. In May 2003, the Riksdag decided that digital terrestrial television broadcasting should be built out and that analogue terrestrial television broadcasting should cease. Analogue broadcasts were to be switched off in stages and the switch-off be fully implemented no later than 1 February 2008.<sup>3</sup>

Analogue terrestrial television broadcasting was switched off in stages during the period 2005 to 2007. The last analogue broadcasts ceased on 15 October 2007. Sweden had thus completed its transition to terrestrial digital television, as the second country in Europe.<sup>4</sup>

### 2.2 Developments in Sweden after the transition to terrestrial digital television

Following the switch-off of analogue terrestrial television broadcasting, only frequencies in Bands IV and V (470-862 MHz) have been used for digital terrestrial television broadcasting in the five operational DVB-T networks.

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<sup>2</sup> Government Bill 1996/97:67, Report 1996/97:KU17, Riksdag Comm. 1996/97:178

<sup>3</sup> Government Bill 2002/03:72, Report 2002/03:KU33, Riksdag Comm. 2002/03:196

<sup>4</sup> Swedish Government Official Reports –SOU 2008:35, p. 16

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In 2005, the Government decided to give PTS the task<sup>5</sup> of investigating which amount of spectrum can be released in conjunction with the switch-off of analogue terrestrial television broadcasting as well as the areas for which the spectrum can be used.

PTS reported on this assignment on 1 September 2006 in a document<sup>6</sup> where the Agency, among other things, stated that a large amount of spectrum could be released through the switch-off of analogue terrestrial television broadcasting and that there were several realistic ways in which the released frequencies could be used.

On 19 December 2007, the Swedish Government came to a decision about the broadcasting space for digital terrestrial television broadcasting.<sup>7</sup> In summary, this decision entails the following: during the period 2008 to 2014, digital terrestrial television broadcasting shall use the 470–790 MHz frequency band (Band IV and part of Band V). It shall also be possible to deploy digital terrestrial television broadcasting in the 174–230 MHz frequency band (Band III). It shall be possible to allow the use of the 790–862 MHz frequency band for other purposes in accordance with the Electronic Communications Act (2003:389).

The Government also directed PTS to replan Band III and also IV and V so that it could be possible to use these frequency bands in accordance with the above-mentioned decision. PTS reported on this task in two reports in 2008.<sup>8</sup>

## **2.3 International developments**

### **2.3.1 International Telecommunication Union (ITU)**

From 1961 up until 2006, the use of Bands I, III, IV and V for analogue television broadcasting and the coordination of radio transmitters for analogue television broadcasting had been regulated for European Member States by a regional agreement within the International Telecommunication Union (ITU), which was known as 'Stockholm 61' or 'ST61' owing to the fact that it was concluded in Stockholm in 1961.

Between 15 May and 16 June 2006, a regional planning conference was held within the ITU to plan Band III and also Bands IV and V. As of the

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<sup>5</sup> Assignment to investigate the amount of spectrum that can be released in conjunction with the switch-off of analogue terrestrial television broadcasting and what these frequencies can be used for (N2005/8208/ITFoU)

<sup>6</sup> PTS-ER-2006:35, The use of radio spectrum following the switch-off of analogue terrestrial television broadcasting – Report on a Government assignment

<sup>7</sup> *Sändningsutrymme för tv-sändningar* [Broadcasting space for television broadcasting] (Ku2007/455/ME m.fl.)

<sup>8</sup> PTS-ER-2008:16, *Planeringslösning för marksänd digital tv – VHF (delrapport)* [Planning solution for terrestrial digital television – VHF (preliminary report)] and PTS-ER-2008:22, *Planeringslösning för marksänd digital tv – UHF, Slutrapportering av uppdrag RB 2008:5* [Planning solution for terrestrial digital television – UHF, Final report of assignment RB 2008:5]



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conference, the application of the Stockholm 61 Agreement was replaced with a new agreement for the frequency bands, called 'Genève 06' or 'GE06'.

At a global level, frequency bands are planned through decisions approved at the ITU's World Radiocommunications Conferences (WRC). The task of the WRC is to conclude agreements, following a proposal from the ITU Member States, on the revision of ITU's Radio Regulations (ITU-RR) to enable the development of radio use. The most recent World Radiocommunications Conference (WRC 2007) was held between 15 October and 9 November 2007. At WRC 2007, it was decided that the 790-862 MHz frequency band in Region 1 (to which Sweden belongs) should be allocated for the mobile service on a co-primary basis. More detailed information about this allocation is contained in footnotes 5.316, 5.316A and 5.316B.

### **2.3.2 The EU and its Member States**

At an early stage, the European Commission drew attention to the issue of released frequencies following the transition to digital terrestrial television broadcasting, referred to as the 'Digital Dividend'. In a Communication from the Commission in 2003<sup>9</sup>, the Commission stated, among other things, that the switch-off of analogue television broadcasting could release several hundred MHz of commercially attractive frequencies. The European Commission has subsequently issued two further Communications concerning released frequencies following the transition to digital terrestrial television broadcasting.<sup>10</sup> The Commission has, for example, stated that the Member States ought to be flexible when planning the frequencies to be released through the switch-off and ought to allow these frequencies to be used for other electronic communications services, in addition to digital television broadcasting.

In time, the Commission's work concentrated on the opportunities for making the 790–862 MHz frequency band available for electronic communications services other than terrestrial television broadcasting in a harmonised way within the EU.

As a step in the work relating to released frequencies, the Commission has requested opinions from the EU's advisory group for radio spectrum policy, the Radio Spectrum Policy Group (RSPG). Among these opinions, mention may be made of the latest, which was published for public consultation by RSPG on 15 May 2009, and is expected to be approved by the RSPG soon.<sup>11</sup>

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<sup>9</sup> COM(2003) 541, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on the transition from analogue to digital broadcasting (from digital 'switchover' to analogue 'switch-off')

<sup>10</sup> COM(2005) 204 Communication from the Commission to the Council, the European Parliament, the European Economic And Social Committee and the Committee of the Regions on accelerating the transition from analogue to digital broadcasting, COM(2007) 700 Reaping the full benefits of the digital dividend in Europe: A common approach to the use of spectrum released by the digital switchover

<sup>11</sup> RSPG09-272, Draft Radio Spectrum Policy Group Opinion on the Digital Dividend

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An appendix is attached to the draft RSPG opinion stating the position in the various EU Member States (and certain other countries) in 2009 as regards the release of the 800 MHz band for electronic communications services other than terrestrial television broadcasting. The appendix shows that – besides Sweden – Denmark, Norway, Finland, France, Switzerland, Spain, the United Kingdom and Germany have decided that the 800 MHz band should be released and allocated for electronic communications services other than terrestrial television broadcasting. It also shows that several other European countries are deliberating on decisions with the same effect. However, the time horizons for when the band actually becomes available for use differ, often significantly, between countries. This is related, among other things, to how far the country has come in the process of transition to digital terrestrial television broadcasting.

### 2.3.3 CEPT

CEPT is an association of the European regulatory authorities for postal services and telecommunications. Within CEPT, the Electronic Communications Committee (ECC) works on the harmonisation of spectrum at a European level.

According to the EU's Radio Spectrum Decision<sup>12</sup>, the European Commission may grant a mandate to CEPT to conduct technical studies to form the basis of Commission Decisions on technical harmonisation measures. CEPT's work involving the mandate on the 'Digital Dividend' is being conducted by ECC and its sub-groups. CEPT has published a number of reports about released frequencies following the transition to digital terrestrial television broadcasting.<sup>13</sup>

CEPT has submitted CEPT Reports (29, 30 and 31) to the European Commission, which form the basis of the European Commission's proposed technical conditions for the 800 MHz band.<sup>14 15</sup> There is also a draft ECC Decision on the technical conditions for the 800 MHz band, which was

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<sup>12</sup> Decision of 7 March 2002 (676/2002/EC) on a regulatory framework for radio spectrum policy in the European Community

<sup>13</sup> CEPT Report 21 (Compatibility between 'cellular/low power transmitter' networks and 'larger coverage/high power/tower' networks), CEPT Report 22 (Technical Feasibility of Harmonising a Sub-band of Bands IV and V for Fixed/Mobile Applications (including uplinks)), CEPT Report 23 (Technical Options for the Use of a Harmonised Sub-Band in the Band 470 - 862 MHz for Fixed/Mobile Application (including Uplinks)), CEPT Report 24 (Feasibility of fitting new applications/services into 'white spaces' of the digital dividend), CEPT Report 25 (Technical Roadmap proposing relevant technical options and scenarios to optimise the Digital Dividend). All of the material from CEPT can be found on the website of the European Communications Office: <http://www.eco.dk>.

<sup>14</sup> Draft CEPT Report 29, (Guideline on cross border coordination issues between mobile services in one country and broadcasting services in another country), Draft CEPT Report 30 (The identification of common and minimal (least restrictive) technical conditions for 790-862 MHz for the digital dividend in the European Union), Draft CEPT Report 31 (Frequency (channelling) arrangements for the 790-862 MHz band)

<sup>15</sup> It should be noted that these reports were submitted to the European Commission prior to public consultation. CEPT is expected to approve the final reports at the ECC meeting in October 2009.

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approved for public consultation at the ECC meeting in June 2009.<sup>16</sup> ECC is expected to make a decision during its meeting at the end of October 2009.

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<sup>16</sup> Draft ECC Decision of DD MM YYYY 2009 on harmonised conditions for Mobile/Fixed Communications Networks operating in the 790-862 MHz band (ECC/DEC/(09)EE)

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## 3 Points of departure for PTS's proposal

### 3.1 General points of departure

The 800 MHz band (that is, the 790-862 MHz frequency band) is very well suited for the development of future electronic communications systems. The band is relatively wide, which means that services with high data capacity can be provided. Frequencies under 1 GHz have propagation characteristics that make them well suited for achieving wide area coverage and indoor coverage. At the same time, the band is not positioned so low in the frequency spectrum that terminals are difficult to manufacture. As stated above, other European countries have also decided or are considering making a decision about allocating the 800 MHz band for electronic communications services other than terrestrial television broadcasting. This creates good opportunities for equipment for the band to be manufactured in high volumes and at low cost.

Taken together, the 800 MHz band constitutes an extremely valuable, and in some respects unique, asset for the Swedish electronic communications market. For this reason, it is of great importance that PTS formulates the conditions for the assignment and uses of the band in a way that creates the maximum benefit for consumers.

In the assessment of PTS, consumers benefit most from the following principles being observed:

Conditions for use of spectrum are formulated in a way that is as technology and service neutral as possible. This enables licence holders to choose the technology that they wish to deploy and the services that they want to offer.

The assignment is designed so that it enables new stakeholders to enter without excluding existing stakeholders. This promotes competition and an efficient use of spectrum.

PTS considers that the 800 MHz band is so attractive that it is likely that demand for spectrum in the band will exceed supply. PTS is using a survey of interest to request information from market stakeholders about their requirements for spectrum in the 800 MHz band. If it transpires that the demand for spectrum is greater than the supply in the band, the preconditions apply to assign licences in the band through an open application procedure in accordance with Chapter 3, Section 8 of the Electronic Communications Act (2003:389).

When assessing consumer benefit, it is of particular importance that the 800 MHz band has propagation characteristics that make it suitable to achieve coverage for electronic communications services in sparsely populated areas. In

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light of this, PTS believes that there are grounds for considering whether licences in the 800 MHz band should be subject to conditions on coverage and roll out, the purpose of which would be to increase accessibility to electronic communications services in areas where the accessibility is currently inadequate. This issue is dealt with in more detail in Section 3.3 below.

It should be noted that the proposals presented by PTS below have been drawn up without considering the fact that the conditions on coverage and roll out might be relevant for the 800 MHz band. This particularly applies to the sections on the structure of an auction and the technical conditions. In the event of conditions relating to coverage and roll out, this means, among other things, that the assignment can be designed as a combination of an auction and a 'beauty contest' and also that licences must be subject to a requirement that a particular service be provided.

### **3.2 Point in time for the assignment**

In the assessment of PTS, the Agency's planning solution for Bands III, IV and V and ongoing international coordination mean that there are good prospects for completely ceasing terrestrial television broadcasting in the 800 MHz band in the near future.

As reported in Sub-section 2.3 above, there has been rapid progress in Europe in terms of the harmonisation of the 800 MHz band. There is already rather accurate information about the technical conditions that will apply to use in the band. In addition to this, PTS considers that the decisions that have already been made by large EU countries to use the 800 MHz band for electronic communications services other than terrestrial television broadcasting mean that there is great interest on the part of manufacturers in producing equipment for the band.

It is indeed true that not all EU countries have decided to make the 800 MHz band available for electronic communications services other than terrestrial television broadcasting. Reasons for this include the preconditions for coordination in relation to third countries and the fact that different countries are at different stages as regards the switch-off of analogue terrestrial television broadcasting. However, this fact does not change PTS's assessment that the international harmonisation of the 800 MHz band is now at a point where the conditions exist to assign the band.

The 800 MHz band is a very attractive frequency band. It is important that any new stakeholders that want to enter the wireless electronic communications market are able to start operations and to offer services as soon as possible. Existing licence holders in other bands also have an interest in gaining access to more spectrum so that they can develop their networks and the services that they offer to consumers. In addition, account should be taken of the fact that

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Sweden has an interest in retaining the position that the country has as a key player with the field of wireless electronic communications.

In some of the statements of views received by PTS after the hearing in April 2009, the opinion was expressed that PTS ought to put the assignment of the 800 MHz band on hold until more spectrum in Bands IV/V (that is, under 790 MHz) has been made available for services other than broadcasting.

There is currently nothing to suggest that Sweden considers extending the frequencies in Bands IV/V that, according to the Government decision, may be used for services other than broadcasting. Nor is there currently any clear movement in this direction at a European and international level. This issue is not on the agenda at the forthcoming WRC. In the assessment of PTS, spectrum could not realistically be released in Bands IV/V for services other than broadcasting in an internationally harmonised way for a period of at least ten years.

PTS is of the view that there are thus strong reasons to assign licences in the band as soon as possible, taking account of the time required to design and implement the assignment procedure.

**PTS proposes** that an open invitation to apply should be issued prior to the summer of 2010 and that licences in the band should be assigned during the autumn of 2010.

### **3.3 Requirements for coverage and roll out**

PTS's vision is that everyone in Sweden should have access to efficient, affordable and secure communications services. In recent years, the demand for broadband has risen sharply in Sweden and an array of both wired and wireless alternatives have emerged in the market. IT infrastructure with high transmission capacity plays a central role in the development of Swedish society: broadband contributes to, among other things, creating opportunities for economic growth and employment throughout Sweden.

For a number of years, PTS has continuously monitored the development of broadband in Sweden. PTS's geographical mapping of broadband access shows that Sweden generally has good access and a relatively high level of capacity in the access networks. However, there is a group of households and businesses that currently lack the basic prerequisites for broadband access.<sup>17</sup>

There is a risk that, without special initiatives, these households will not be offered broadband in the future by any operator, as the roll out for offering these services to households does not meet commercial requirements regarding profitability.

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<sup>17</sup> See PTS Broadband Survey 2008, PTS-ER-2009:8

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Set against this background, PTS is deliberating on whether conditions for coverage and roll out should be considered in conjunction with the assignment of different frequency bands. This also applies to the assignment of the 800 MHz band.

In order to ensure that during the assignment of the 800 MHz band any conditions regarding coverage and roll out focus on those households that lack the basic prerequisites to receive broadband, PTS is contemplating using the following model when assigning licences in one part of the band: PTS will define population grids (250 x 250m) in accordance with statistics<sup>18</sup> from Statistics Sweden (SCB), where there are households and workplaces that are not considered to have the basic prerequisites for broadband access. Applicants who wish to be assigned the licence can bid for the number of defined SCB grids that they undertake to cover through a combined auction and comparative selection procedure ('beauty contest'). Applicants who undertake to cover all of the defined grids may also submit a supplementary bid in money.

Applicants who have placed a bid for the biggest number of grids will win the licence. When the bids are evaluated, no distinction will be made between how many households and workplaces are found in a respective grid. If several applicants are found to have placed bids for all of the grids, the applicant who made the highest monetary bid will win the licence. The licence is subject to conditions requiring coverage for data communications with a certain lowest service quality (for example concerning a certain minimum bit rate or a certain kind of service) to be provided in the grids that the applicant has undertaken to cover.

The promised coverage shall be provided in conjunction with, or shortly after, networks in the 800 MHz band are being put into service. In order to achieve an efficient utilisation of resources, it should be possible for the coverage requirement to be satisfied in any frequency band; for example, the 800 MHz band, 900 MHz band or 450 MHz band.

A possible requirement for coverage and roll out for a particular amount of spectrum in the band naturally means that the conditions in this part of the band cannot be service-neutral, as PTS will need to impose requirements on a particular minimum service level being offered to end users.

**PTS is considering** attaching conditions on coverage and roll out to licences in one part of the 800 MHz band. **PTS requests** views on how possible requirements on coverage and roll out should be formulated when assigning the 800 MHz band and how such an assignment should be implemented. The following questions are of particular interest:

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<sup>18</sup> PTS-ER-2009:8, p. 140ff.

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- How should a possible requirement for coverage and roll out be designed to ensure that accessibility to broadband actually increases? Will this be achieved with the combined auction and 'beauty contest' proposed above?
  - What requirements ought to be imposed as regards lowest service quality?
  - How much spectrum in the 800 MHz band ought to be subject to requirements for coverage and roll out?
  - Should it be possible for the requirement to be satisfied in optional frequency bands (that is, not just in the 800 MHz band)?
  - What is the earliest point at which a requirement for coverage and roll out should be satisfied (depending on how it is formulated)?
  - If a requirement for coverage and roll out comes into question in the 800 MHz-MH band, should it, in that case, affect the formulation of the spectrum cap?

### **3.4 Assignment for terrestrial television broadcasting?**

In one of the written statement of views received by PTS following the hearing in April 2009, a question was raised as to whether PTS's future assignment of the 800 MHz band may also include the potential to assign the band for terrestrial broadcasting (including DVB-T broadcasts).

The Government decision of 19 December 2007, which is reported above, specifies the broadcasting space that may be granted for broadcasts that require licences under the Radio and Television Act (1996:844) (RTVL). The decision states that this broadcasting space ends at 790 MHz. It is also indicated that the intention is that the 790-862 MHz frequency band should be used for purposes other than television and allocated by PTS in accordance with the provisions of LEK.

The second paragraph of Chapter 3, Section 6 of LEK prescribes that PTS can only assign a licence to use a radio transmitter for broadcasting (including traditional terrestrial television broadcasting) if there is a broadcasting licence under RTVL. The Government decision dated 19 December 2007 is to be accepted as establishing that broadcasting licences that have been or may be granted by the Radio and Television Authority or the Government under RTVL may only involve broadcasts in the frequency bands under 790 MHz. There are consequently no possibility according to the current legislation to assign the 800 MHz band for terrestrial broadcasting. In addition, according to Chapter 3, Section 8, third paragraph, item 1 of LEK, PTS may not assign spectrum, by means of an open invitation to apply, for such use as referred to



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in Chapter 1, Section 1, third paragraph of the Fundamental Law on Freedom of Expression (YGL) (i.e. terrestrial broadcasting).

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## 4 Basic licence conditions and band plan

### 4.1 Technology and service neutrality

PTS's Spectrum Policy<sup>19</sup> states that licences to use radio transmitters are required to be as technology and service-neutral as possible. A 'technology neutral licence' means that only the technical requirements that are required to ensure coexistence between different users should be imposed (such as, for instance, emission limits within and outside the frequency band and geographical area to which the licence applies) in order to avoid the occurrence of harmful interference. In practice, the restrictions and requirements that are necessary can differ significantly between different frequency bands; for example, depending on how great the need for protection is in adjacent bands. Technology and service neutrality should therefore be regarded as a relative term, where the aim is to achieve as much freedom as possible for parties who have rights to use spectrum.

Technology and service-neutral licences give the licence holder the flexibility to choose which service is to be provided and which technology is to be used. Consequently, the licence holder can decide when the deployment is to take place and which technology is to be used, and also has the potential to upgrade its network or completely change the technology when new technology becomes available. This results in the introduction of new technology, which encourages more efficient spectrum use, at the same time as enabling networks to be developed and upgraded when this is socio-economically optimal.

PTS's ambition to have technology and service neutral licences corresponds to a clear international move in this direction. Here, particular mention may be made of RSPG's statement of views<sup>20</sup> concerning wireless access to electronic communications services (Wireless Access Policy for Electronic Communications Services – WAPECS). WAPECS means that frequency bands are defined in the EU in which electronic communications networks and electronic communications services can be provided on technology and service neutral conditions. The aim is to achieve a move towards a more flexible regime where a wide range of wireless services can be offered.

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<sup>19</sup> PTS-ER-2006:35

<sup>20</sup> RSPG05-102 Radio Spectrum Policy Group Opinion on Wireless Access Policy for Electronic Communications Services (WAPECS) – A more flexible spectrum management approach

The 470–862 MHz band is among those frequency bands that have been identified as feasible for the introduction of WAPECS at a first stage.<sup>21</sup>

In light of that stated above, **PTS proposes** that the conditions for use of spectrum in the 800 MHz band shall be designed according to the principles of technology and service neutrality. PTS will, in all essential respects, follow the technical conditions produced through the European harmonisation work. These are also based on the principle of minimum requirements that are imposed to protect other users from harmful interference.

## 4.2 Band plan – FDD/TDD

A basic choice that must be made when assigning the 800 MHz band is whether the frequency band should be planned using paired blocks for FDD<sup>22</sup> or unpaired blocks for, for instance, TDD.<sup>23</sup> CEPT Report 31 describes the various conceivable band plans for the 800 MHz band.

CEPT Report 31 specifies a band plan with 2 x 30 MHz and a duplex gap of 11 MHz as a preferred option ('Preferred Harmonised Frequency Arrangement'). Frequency blocks are designed as six duplex blocks of 2 x 5 MHz with reverse duplex direction. 'Reverse duplex direction' means that the uplink (the connection from terminal to base station) is located in the lower part of the band, in contrast to what is normally the case when planning FDD spectrum. The downlink band starts at 791 MHz, which means a frequency separation of 1 MHz to Channel 60 in Band V for terrestrial television broadcasting.

790-791	791-796	796-801	801-806	806-811	811-816	816-821	821 - 832	832-837	837-842	842-847	847-852	852-857	857-862
Guard band	<b>Downlink</b>						Duplex gap	<b>Uplink</b>					
1 MHz	30 MHz (6 blocks of 5 MHz)						11 MHz	30 MHz (6 blocks of 5 MHz)					

FDD arrangement in the 800 MHz band (frequencies expressed in MHz)

CEPT Report 31 also specifies an alternative for administrations that do not wish to implement the preferred option, with frequency blocks designed as 13 unpaired blocks of 5 MHz each. The unpaired blocks could possibly be used

<sup>21</sup> See also Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions 'Rapid access to spectrum for wireless electronic communications services through more flexibility', (COM(2007) 50), CEPT Report 19, Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS, 21 December 2007

<sup>22</sup> FDD: Frequency Division Duplex. The communication from base station to terminal (downlink) and the communication from terminal to base station (uplink) takes place in separate frequency channels

<sup>23</sup> TDD: Time Division Duplex. Uplink and downlink are found in the same frequency channel, but separated in different time slots.

for TDD. Frequency blocks start at 797 MHz, which involves a guard band of 7 MHz to Channel 60 in Band V for terrestrial television broadcasting.

790-797	797-802	802-807	807-812	812-817	817-822	822-827	827-832	832-837	837-842	842-847	847-852	852-857	857-862
<b>Guard band</b>	<b>Unpaired blocks</b>												
<b>7 MHz</b>	<b>65 MHz (13 blocks of 5 MHz)</b>												

Arrangement with unpaired blocks in the 800 MHz band (frequencies expressed in MHz)

CEPT Report 31<sup>24</sup> also discusses mixing FDD and TDD in the 800 MHz band. The report concludes that FDD and TDD should not be mixed in the band, as this causes a drastic reduction of spectrum efficiency.

It would actually be possible to structure the assignment procedure so that the market (bidders) was allowed to decide on whether FDD or unpaired blocks should be used in the 800 MHz band. However, this type of assignment procedure increases both the complexity and cost. Furthermore, PTS assesses that equipment manufacturers at this phase will be focussing on the use of FDD in the band. At the hearings conducted by PTS, there did not appear to be any demand for the assignment of the 800 MHz band in unpaired blocks.

In light of that stated above, **PTS proposes** that the band plan for the 800 MHz band shall be designed in accordance with CEPT's preferred option; that is, frequency separation by 1 MHz to Channel 60, FDD use with  $2 \times 30$  MHz, six paired blocks of  $2 \times 5$  MHz each, together with a duplex gap of 11 MHz.

### 4.3 The geographical delimitation of licences

When assigning the 800 MHz band, PTS may choose to assign either national licences (for use throughout Sweden) or regional licences.

The 800 MHz band is located quite low in the frequency spectrum and thereby has good propagation characteristics, which mean that, in comparison with higher frequency bands, fewer base stations are required to achieve the same area coverage. The 800 MHz band is suitable for building national networks for wireless electronic communications services; for example, wireless broadband or mobile telephony. Assigning national licences provides licence holders with the opportunity to build national networks and offer the same services throughout Sweden, which benefits the consumer. Indeed, the larger the area for which a service is offered, the greater the likelihood of

<sup>24</sup> CEPT Report 31, p. 22

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international roaming; that is, the potential to use corresponding services in other countries as well.

As a main rule, national licences are more efficient to assign in terms of frequency than regional licences, as regional licences would need to have technical conditions for protection between licence holders. This increasingly applies to the low frequency bands such as, for instance, the 800 MHz band, as the signal reaches further in comparison with the high frequency bands.

Another argument against regional licences is that during 2007 PTS assigned municipal licences in the 3.6–3.8 GHz frequency band through an auction of spectrum. This auction resulted in 402 licences being assigned from a total of 1160 licences; that is, four in each municipality. One stakeholder purchased a combination of municipal licences corresponding to a national licence. This indicates that the demand for regional licences is limited. The assignment of the remaining regional licences in the 3.6-3.8 GHz band is planned to take place at the end of 2009. The assignment of the 800 MHz band is planned to take place in the autumn of 2010. If this frequency band is assigned in the form of national licences, both national and regional licences will be offered within the timeframe of one year, which ought to satisfy market demand for licences with different characteristics.

When assigning licences in the 2.6 GHz band, the assignment of regional licences in Norway compared with the assignment of national licences in Sweden produced a result indicating that national licences were valued more highly by the market.<sup>25</sup> This suggests that national licences create more benefit for consumers. In addition to this, all of the Norwegian regional licences in the 2.6 GHz band have been converted into national licences at the request of the licence holders.<sup>26</sup> PTS considers overall that an assignment of national licences in the 800 MHz band is most effective from a technical and economic perspective.

Consequently, **PTS proposes** that national licences should be assigned in the 800 MHz band.

#### 4.4 The term of licences

It is prescribed by Chapter 3, Section 12 of LEK that licences to use radio transmitters must be granted for a fixed period. The provision indicates the factors that should, in particular, be considered when determining the term of a licence:

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[http://www.npt.no/portal/page/portal/PG\\_NPT\\_NO\\_NO/PAG\\_NPT\\_NO\\_HOME/PAG\\_RESSU\\_RSER\\_TEKST?p\\_d\\_i=-121&p\\_d\\_c=&p\\_d\\_v=104880](http://www.npt.no/portal/page/portal/PG_NPT_NO_NO/PAG_NPT_NO_HOME/PAG_RESSU_RSER_TEKST?p_d_i=-121&p_d_c=&p_d_v=104880)

<sup>26</sup> <http://www.npt.no/ikbViewer/Content/49001/Oversikt%20over%20tildelte%20spektrumstillatelse-20090812.pdf>

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1. future changes in radio use,
  2. the period when the transmitter is intended to be used,
  3. the technological development that may be expected,
  4. the period of time that is required to achieve a reasonable financial return on the equipment, and
  5. such licence as, according to the second paragraph of Section 6, constitutes a precondition for a licence to use a radio transmitter.

PTS determined the term of the licence to be 15 years in previous decisions regarding the granting of licences to use radio transmitters of the kind involved here (that is, block licences for electronic communications services).<sup>27</sup> PTS considers that this licence period affords the licence holder a reasonable time for a return on its investment balanced against the interest of being able to reconsider or replan the use of the frequencies in the future. PTS does not see any reason to deviate from this assessment for the 800 MHz band.

For this reason, **PTS proposes** that the term of licences in the 800 MHz band shall be determined to be 15 years.

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<sup>27</sup> See, for example, decision on licence in the 450 MHz band (file re. 05-1337), decision on licence in the 3.7 GHz band (file ref. 07-9177), decision on licence in the 1900 MHz band (file ref. 08-418) and decision on licence in the 2.6 GHz band (file ref. 08-417)

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## 5 Assignment procedure

### 5.1 Auction design

#### 5.1.1 Why have an auction?

According to Chapter 3, Section 8, third paragraph of LEK, PTS can, by an open invitation to apply, assign licences either by means of a comparative selection procedure ('beauty contest'), by a tender procedure, which is determined by the price applicants are willing to pay for a licence (auction), or by a combination of both of these procedures. The provision contained in LEK implements Article 7.3 of the Authorisation Directive<sup>28</sup>, which states that if there is a limitation in respect of the number of licences, licences shall be granted on the basis of objective, transparent, non-discriminatory and proportionate selection criteria.

PTS has stated in the Agency's Spectrum Policy that an auction should be applied in the first instance when considering an open invitation. PTS has held auctions to assign licences to use radio transmitters on several previous occasions. The experience from these auctions has, in general, been positive.

In the following, PTS reports on some general considerations regarding the structure of the auction. PTS has issued Regulations (PTSFS 2008:1) regarding spectrum auctions. These Regulations include generic rules on spectrum auctions. On the basis of these Regulations, PTS will in the open invitation to apply determine the more detailed rules that should apply for the auction of the 800 MHz band. A draft open invitation, which consequently contains full rules for the auction, will be circulated for consultation to the market for views.

#### 5.1.2 Size of blocks

As stated above in Sub-section 4.2, PTS proposes that the band plan for the 800 MHz band is determined in accordance with the FDD arrangement proposed by CEPT, which means that there are six paired blocks of  $2 \times 5$  MHz each in the band. The issue then arises as to whether the auction should be structured so that bidders are given the opportunity to bid on their own combinations of blocks of  $2 \times 5$  MHz, or if PTS should divide the band into objects at the auction that each comprise more than one block of  $2 \times 5$  MHz (e.g. three blocks of  $2 \times 10$  MHz).

By assigning the 800 MHz band in frequency blocks of  $2 \times 5$  MHz, this assignment becomes flexible, and the willingness of different stakeholders to pay at the auction determines the extent of the licence. Future wireless systems and technologies that are considered for use in the 800 MHz band may use

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<sup>28</sup> Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services

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blocks that are broader than  $2 \times 5$  MHz. As the amount of spectrum available in the band is  $2 \times 30$  MHz, there are several different combinations, depending on how many stakeholders win licences. It may be noted in this context that there are five operators in Sweden that run national networks for mobile telephony.

One of the disadvantages of an assignment in frequency blocks of  $2 \times 5$  MHz is that the complexity of the auction will increase slightly compared with using larger but fewer frequency blocks. Furthermore, there is a risk that a bidder who wishes to gain access to contiguous large frequency blocks will have been assigned non-contiguous frequency blocks when the auction is concluded. However, experience from the PTS auction of the 2.6 GHz band in 2008 suggests that there is only a limited risk of this happening and that this can be reduced by the way in which the auction is designed (see more below regarding the format of the auction).

For this reason, **PTS proposes** that the auction is structured so that bidders can bid for one or more frequency blocks of  $2 \times 5$  MHz, up to the spectrum cap determined (see below in Sub-section 5.2).

### 5.1.3 Format of the auction

The auction formats that PTS has considered for the assignment of the 800 MHz band are as follows:

- *Single round, sealed bid* auction: In a single round auction, bidders submit sealed bids that are then opened and the winner chosen.
- *Simultaneous multi round auction (SMRA)*: Bidders can raise (and switch) bids in bidding round after bidding round until the bids are no longer raised, whereupon the bidders with the standing highest bids win. The bids placed for frequency blocks may differ between blocks.
- *Clock auction*: The same price applies to all frequency blocks in a bidding round. At the first phase of the auction, the bidders may state in each bidding round how many frequency blocks they are bidding for at the price in question. PTS increases the price until demand equals supply and the number of frequency blocks that each bidder has won are then determined. Where the bidders are positioned in the band is either determined by PTS or at a second phase of the auction; for example, by means of a sealed bidding round.

The above-mentioned are the forms of spectrum auction that have been tested internationally.<sup>29</sup>

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<sup>29</sup> A-focus & DotEcon, The use of auctions in spectrum assignment – A report for PTS, 2004, p. 14ff.



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Single-round, sealed bid auctions are easy and inexpensive to implement, both for bidders and PTS. However, one of the disadvantages of a single round, sealed bid auction is that bidders are unable to observe the behaviour of other bidders and adapt themselves accordingly. The bidders may also perceive bidding to be random. The advantages of a single round, sealed bid auction are limited in the 800 MHz band, as the band is very attractive and may be considered to have an economic importance that far exceeds the costs for an auction. PTS considers that it is more important that the format of the auction enables an effective assignment than the auction being as fast and inexpensive as possible.

A clock auction is not an appropriate form of auction unless the frequency blocks are of equal value, as the bidders do not know which frequency block they may win when placing their bids at the first phase of the auction. In that case, a rational bidder will not risk offering more than the value of the lowest value block during the first phase of the auction. If there were one or more blocks that the bidder did not want to have, it would be not reasonable for him to place a bid at all during the first phase of the auction. There is otherwise a risk of the bidder eventually being assigned a block that the bidder does not even want, or at a significantly higher price than it is worth to the bidder.

Frequency blocks in the 800 MHz band have different properties, primarily as regards limitations to the use of the lowest block owing to the protection for terrestrial television broadcasting (see Sub-section 6.2). In addition, it is also likely that the other blocks could be affected, in partially different ways, by interference and claims for protection from neighbouring countries, particularly with respect to future terrestrial television broadcasting in the band and radio navigation services (see Sub-section 6.3.1). Consequently, PTS considers that blocks probably have such different characteristics that a clock auction is a less appropriate form of auction than an SMRA.

As stated above, frequency blocks in the 800 MHz band differ to some extent, but can still be regarded essentially as both a substitute for and a complement to each other. In such cases, SMRA is an appropriate auction format. An SMRA affords the bidders the opportunity of responding to and adapting themselves to each other's bidding, which creates the preconditions for achieving an effective outcome. The value of the 800 MHz band is also so high that it justifies a form of auction that is more complicated and time-consuming. PTS therefore considers that SMRA is an appropriate form of auction for the 800 MHz band.

The rule concerning the right to switch bids between frequency blocks which was used to good effect in, for instance, the Swedish 3.7 GHz and 2.6 GHz auctions and the Norwegian 3.5 GHz and 2.6 GHz auctions, should also be used in this case. This rule increases the likelihood of an auction outcome with contiguous frequency blocks and equal prices for blocks of equal value.

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One conceivable alternative would be to introduce combinatorial bidding; that is, the possibility to place bids in a combination of frequency blocks in order to increase the likelihood of the bidders being assigned contiguous frequency blocks. However, experience from the Swedish and Norwegian 2.6 GHz auctions, where the outcome of these auctions was that the bidders were assigned contiguous frequency blocks, suggests that this is unnecessary. An SMRA in the 800 MHz auction is also significantly less complicated for bidders, as there are only six frequency blocks to bid for compared with the 15 frequency blocks in the 2.6 GHz band. There is a risk that a combinatorial auction could become very complicated for PTS and bidders, and so far there is only limited international experience of using combinatorial bidding at spectrum auctions.<sup>30</sup>

PTS wishes to emphasise that using an auction design in the 800 MHz band that is linked to previous SMRA-type auctions that have been conducted by PTS in the 3.7 GHz band and the 2.6 GHz band results in the bidders being able to reuse their knowledge and experience. This reduces costs both for bidders and PTS.

Owing to that stated above, **PTS proposes** that the auction of the 800 MHz band shall be structured as an SMRA with the potential to switch bids. The rules at the auction shall essentially correspond to the rules that applied at PTS's auction of the 2.6 GHz band.

## **5.2 Spectrum cap and provisions on related parties**

### **5.2.1 Spectrum cap**

A 'spectrum cap' means the largest amount of spectrum that a bidder can be assigned at an auction. The aim of introducing a spectrum cap is to ensure that the available spectrum is assigned to at least two bidders and that one bidder cannot be assigned so much spectrum that competition is distorted. Without a spectrum cap for the present assignment of the 800 MHz band, there is a risk of a licence holder being assigned all or virtually all of the frequencies available. An outcome of this type could possibly distort competition.

Setting a low spectrum cap (e.g.  $2 \times 10$  MHz) may on the other hand unnecessarily limit the freedom of action for stakeholders. PTS should not prevent licence holders from developing business plans that are based on offering broadband services with high data capacity.

PTS considers that a spectrum cap should be implemented at the auction in the 800 MHz band to prevent an outcome where one bidder is assigned all of the frequency blocks in the band. However, the spectrum cap should be set high enough so that it does not limit the freedom of action for market stakeholders

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<sup>30</sup> A-focus & DotEcon, *ibid.* p. 19 ff.

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and the future use of the band. In light of the foregoing, PTS' assessment is that a suitable spectrum cap is  $2 \times 20$  MHz.

**PTS proposes** that a spectrum cap shall be set at  $2 \times 20$  MHz. Consequently, it shall not be possible for one and the same bidder at an auction to be assigned more spectrum than  $2 \times 20$  MHz in total in the 800 MHz band.

### 5.2.2 Provisions on related parties

It is a precondition of the rule concerning a spectrum cap in the 800 MHz band that some kind of definition is provided of which legal persons (undertakings) are considered to be 'related'. In a circle of undertakings that are related, only one of these may participate at the auction. It would otherwise be easy to circumvent the spectrum cap by two or more undertakings, which are controlled by the same interest, participating as bidders.

The most natural way of determining a circle of related undertakings among legal persons is the concept of a 'group of companies'. A 'group of companies' is defined by Chapter 1, Section 4 of the Annual Accounts Act. According to the definition contained in the Annual Accounts Act, a 'group of companies' is characterised by one company (the parent company) having full control over all of the subsidiaries in the group as it, directly or indirectly, holds more than 50 per cent of the votes in such company.

PTS used the concept of 'group of companies' as provisions on related parties when assigning the 2.6 GHz band.

In recent years, the Swedish market for mobile telephony and wireless broadband has moved towards the major enterprises, which are operators of wireless electronic communications networks, cooperating with others in different constellations regarding the deployment and operation of networks. TeliaSonera and Tele2 are cooperating on the deployment and operation of the UMTS network through the network undertaking SUNAB. Telenor and Hi3G (3) are cooperating on the deployment and operation of the UMTS network through the network undertaking 3GIS. Telenor and Tele2 have also recently announced that they are cooperating on the future deployment of the LTE network through the network undertaking Net4Mobility.

PTS considers that if these major operators were allowed to participate in the auction of the 800 MHz band together with their network undertakings, this might lead to a distortion of competition. As these network undertakings are owned 50/50, they do not form part of the operators' respective groups of companies. Consequently, the provisions on related parties must be extended beyond the concept of 'group of companies'.

**PTS proposes** that the provisions on related parties at the auction of the 800 MHz band shall be formulated as follows:

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1. All companies that form part of the same group of companies are deemed to be related.
  2. If a company or a group holds at least one third of the number of votes in another company, it is considered that this company (and any of its subsidiaries) is deemed to be related to the owning undertaking and similarly all companies in the owning group.

These provisions on related parties ensure that jointly owned network undertakings are deemed to be related to their owning operators. It should be noted that two operators that own a joint network undertaking 50/50 are not deemed to be related to each other.

### **5.3 Certain other rules for the auction**

#### **5.3.1 Electronic auction via the Internet**

PTS conducted SMRA-type auctions in the 3.7 GHz band and the 2.6 GHz band through an electronic auction system via the Internet. This procedure had several advantages. The procedure is clear for bidders and increases confidence that all of the auction rules are being complied with. Bidding via the Internet can be implemented with good security and also reduces the costs for bidders, as they can bid from a location that they have chosen and do not have to travel. One disadvantage of the electronic auction system is that it entails certain implementation costs for the Agency. These costs are partly covered by the administrative charges that the bidders have to pay. However, these costs are considered to be significantly lower than the value of a licence in the 800 MHz band.

For this reason, **PTS proposes** that the auction of the 800 MHz band is conducted via the Internet.

#### **5.3.2 Anonymous bidding, etc.**

At an electronic auction, it is possible to disidentify the bidding; that is, keep secret from the bidders and others who the bidder is, how many bidders there are and from which bidder the lowest bids have come. The reason for disidentification is to make it difficult for bidders to collude or engage in other strategic behaviour at the auction; for example, strong bidders 'intimidating' weaker bidders.<sup>31</sup> The advantages of openness as regards the identity of the bidders could possibly be that it simplifies the administration and the bidders' choice of strategy. PTS considers that there are strong reasons to apply anonymous bidding at the auction of the 800 MHz band, as was the case at the 2.6 GHz auction.

**PTS proposes** that bidding at the auction of the 800 MHz band shall be anonymous.

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<sup>31</sup> Cramton, Peter and Schwartz, Jesse A (2000): Collusive Bidding: Lessons from the FCC Spectrum Auctions, *Journal of Regulatory Economics*, 17, 229-252

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Experiences from previous auctions that have been conducted suggest that the information policy at the auction (that is, information that is released to bidders and information that is kept secret) is of great importance to enable bidders to make effective bids. PTS will carefully consider the formulation of the information policy for the 800 MHz auction.

More detailed rules for the auction will be determined in the open invitation to apply. A draft open invitation will be published and circulated for consultation to the market for views (see also Section 7 below).

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## 6 Technical licence conditions, etc.

### 6.1 Basic spectrum mask

CEPT Report 30 describes how common technical conditions for the 790-862 MHz frequency band have been produced. These technical conditions are based on the concept of a spectrum mask (Block Edge Mask (BEM)); that is, the licence holder is at liberty to choose technology, but must limit the emissions from its use at the borders of the frequency blocks of other licence holders so that harmful interference does not arise. In the 800 MHz band, there are conditions for the protection of reception of terrestrial television broadcasting under 790 MHz.

The technical conditions, together with the band plans, are contained in the draft ECC Decision for the 800 MHz band. PTS intends to follow the European harmonised conditions when determining the technical conditions for the 800 MHz band in Sweden.

The European Commission has indicated an intention to draw up a proposed decision on the binding harmonisation of the 800 MHz band within the European Union in accordance with the procedure described in the EU's Radio Spectrum Decision.<sup>32</sup> If such a decision were to be approved by the European Commission, Sweden, as a member state of the EU, would be obligated to implement this. The technical reports produced within CEPT will form the basis of any decisions made by the European Commission.

**PTS proposes** that technical conditions for licences in the 800 MHz band shall be formulated as a spectrum mask in accordance with that identified in the draft ECC Decision. PTS proposes however that the in-block limitations on radiated power, at antenna heights greater than 50 m, shall be set at a higher value than what is proposed in the Draft ECC Decision, in order to facilitate deployment in sparsely populated areas.

The basic spectrum mask for FDD use can be described as follows, in the version identified in the current draft ECC Decision:

The following applies in the downlink band: radiated power from a base station transmitter and repeater (per antenna) within the 791–832 MHz frequency band may, within 0 to 10 MHz outside each frequency block, not exceed the values shown in the table below.

Frequency offset from block edge ( $ \Delta F $ ) in MHz	Maximum radiated power (EIRP) (per antenna)
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<sup>32</sup> Decision No 676/2002/EC of the European Parliament and of the Council on a regulatory framework for radio spectrum policy in the European Community

$0 <  \Delta F  < 5$	+22 dBm/5MHz
$5 <  \Delta F  < 10$	+18 dBm/5MHz

$|\Delta F| = 0$  corresponds to the upper or lower limits for the frequency block assigned for transmissions from base station or repeater

As regards the 791–832 MHz frequency band, the radiated power from a base station transmitter and repeater (per antenna) in the downlink direction, more than 10 MHz outside an assigned frequency block, may not exceed 9 dBm/1 MHz EIRP. The radiated power from a base station transmitter and repeater (per antenna) in the downlink direction may not exceed 17.4 dBm/1 MHz EIRP in the 790–791 MHz frequency band.

The above-mentioned restrictions apply per antenna for between one and four antennae. This means that a system with several antennae (e.g. MIMO systems<sup>33</sup>) may generate an aggregate radiated power that exceeds the limit per antenna.

The radiated power from a base station transmitter and repeater in the downlink direction may not exceed -49.5 dBm/5 MHz EIRP in the 832-862 MHz frequency band.

The Draft ECC Decision contains a statement to the effect that the license holder's radiated power in-block should be limited to a value between 56 dBm/5 MHz and 64 dBm/5 MHz, but that this value may be relaxed e.g. for deployment in rural areas. In order to provide a predictable interference environment for licence holders, PTS proposes a value for the highest in-block radiated. However, PTS also proposes that this value should be made dependent on antenna height, in order to facilitate deployment in sparsely populated areas.

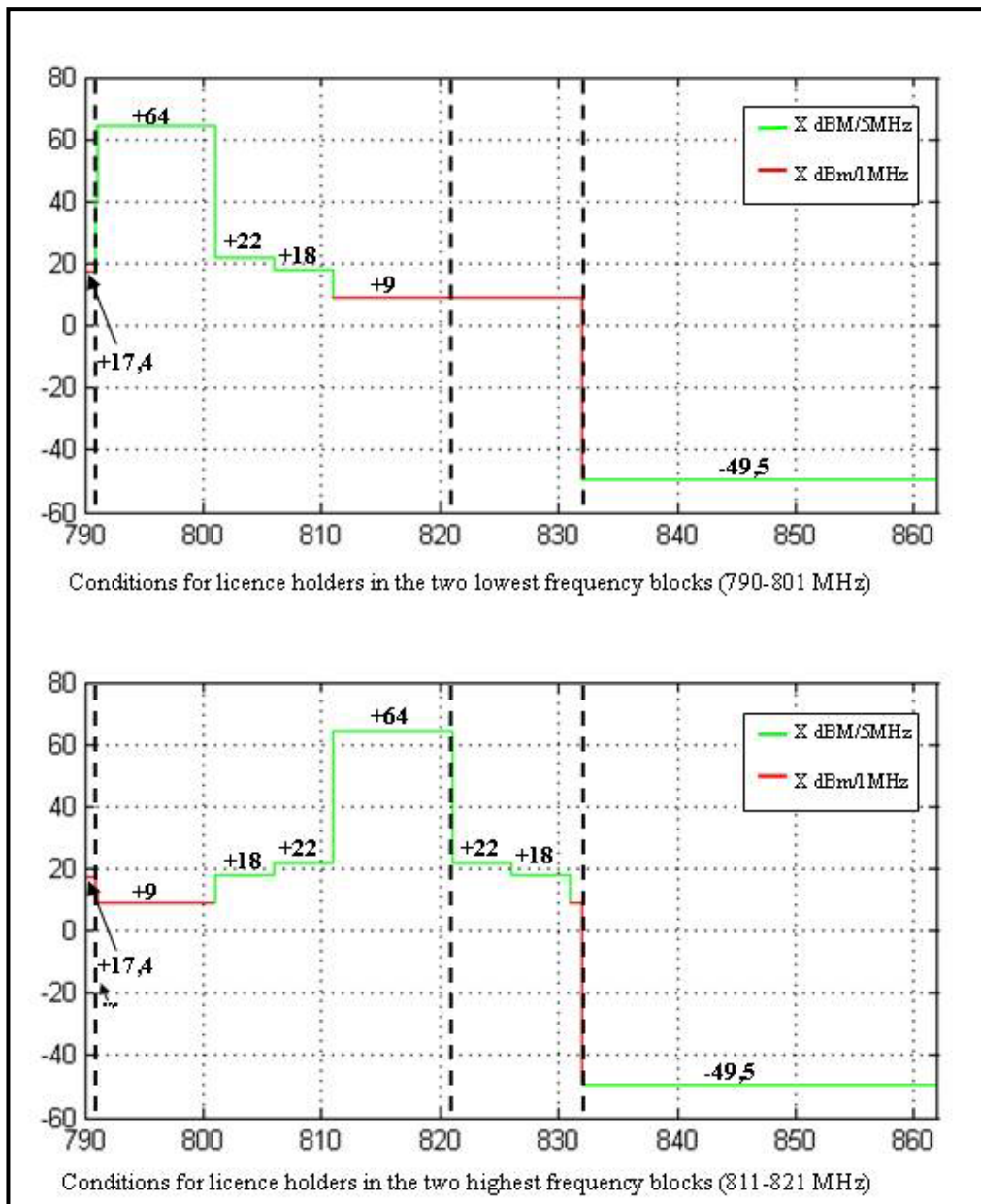
PTS therefore proposes that, if the height of an antenna is less than 50 m above the average level of the ground, the radiated power from a base station transmitter and repeater in the downlink direction may not exceed 64 dBm/5 MHz EIRP.<sup>34</sup> If the height of an antenna is more than 50 m above the average level of the ground, the radiated power from a base station transmitter and repeater in the downlink direction may not exceed 67 dBm/5 MHz EIRP.

As PTS proposes that the 800 MHz band should be assigned in accordance with the band plan applicable for FDD use, the technical conditions for TDD use are not described here. These are available in CEPT Report 30 and the draft ECC Decision.

<sup>33</sup> MIMO: Multiple Input Multiple Output

<sup>34</sup> Equivalent Isotropically Radiated Power

Examples of how the above-mentioned conditions should be interpreted for an individual licence holder can be found in the illustration below for those cases where a licence holder has been assigned the two lowest and the two highest  $2 \times 5$  MHz blocks respectively. The conditions for emissions outside own frequency blocks in the 790–832 MHz frequency band apply per antenna for between one and four antennae, while the conditions for emissions in own frequency blocks and also in the uplink band apply to the aggregate radiated power from a base station.





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## **6.2 Conditions for protecting terrestrial television broadcasting reception**

As stated above in Sub-section 3.2, terrestrial television broadcasting will be available in the frequency band under 790 MHz, at least in the medium term. The introduction of the new systems in the 800 MHz band therefore gives rise to the issue of how existing terrestrial television broadcasting reception should be protected against the effects of these new systems.

The spectrum masks produced within CEPT provide a certain amount of protection for terrestrial television broadcasting reception under 790 MHz. However, it is pointed out that some effects may occur and that special measures may need to be taken at a national level.

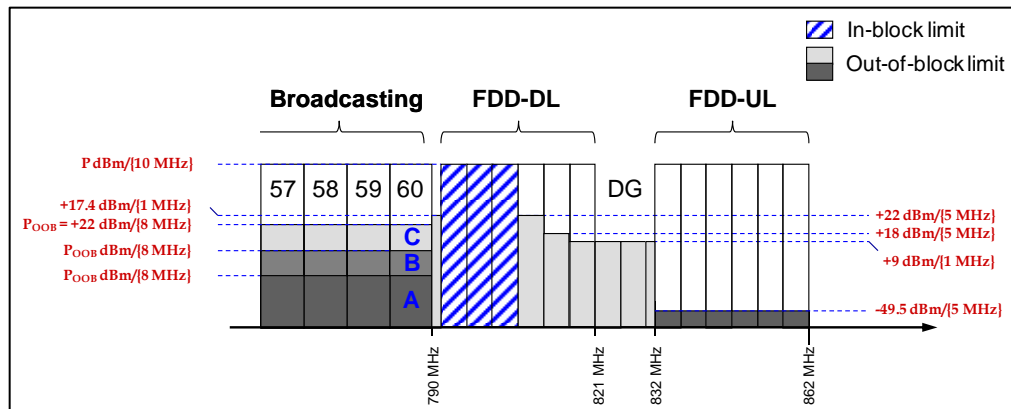
### **6.2.1 Conditions in the spectrum mask for protecting terrestrial television broadcasting reception**

In the draft ECC Decision for the 800 MHz band, three options (A, B and C; see illustration below) are provided for radiated power (EIRP) under 790 MHz from base station and repeater in the 800 MHz band in the downlink direction. These levels may be combined in the spectrum mask, depending on the protection that is to be achieved for terrestrial television broadcasting reception. Option A represents the major limitation of radiated power in the 470–790 MHz frequency band and is intended to be used when terrestrial television broadcasting reception must be protected. Option B involves less protection for television reception than would apply under Option A. Option C is the baseline for those areas where terrestrial television broadcasting reception does not need protection.

PTS considers that there are reasons to protect terrestrial television broadcasting reception throughout Sweden and within the entire 470–782 MHz frequency band so that terrestrial television broadcasting can be replanned in the future. For this reason, Option A should apply to this frequency band. In the 782–790 MHz frequency band (Channel 60), however, if the conditions under Option A were to apply throughout Sweden, this would entail increased costs for the deployment of infrastructure and for putting into service new systems in the 800 MHz band. PTS therefore considers that Option C should apply in geographical areas where terrestrial television broadcasting reception in Channel 60 does not need protection. Option A shall apply to areas where terrestrial television broadcasting reception in Channel 60 must be protected.

Appendix 1 shows the areas in Sweden where Channel 60 has been planned for terrestrial television broadcasting in the current situation. When the final licence conditions are determined for use in the 800 MHz band, PTS will specify the geographical areas where measures must be taken to protect terrestrial television broadcasting reception in Channel 60.

The following illustration describes the three options A, B and C:



P<sub>OOB</sub> means permitted radiated power (EIRP) under 790 MHz from base station and repeater in the 800 MHz band in the downlink direction.

**PTS proposes** that the spectrum mask be designed as follows:

In geographical areas where terrestrial television broadcasting reception in Channel 60 (782-790 MHz) must be protected, the licence holder shall limit the radiated power in Channels 21–60 (470–790 MHz) to the level prescribed by Option A of the spectrum mask decided by the ECC.

In other geographical areas, the licence holder shall limit the radiated power in Channel 60 to the level prescribed by Option C of the spectrum mask in the draft ECC Decision. In Channels 21-59, the emission is limited to the level prescribed by Option A of the spectrum mask in the draft ECC Decision.

The spectrum mask for protecting terrestrial television broadcasting reception is described below:

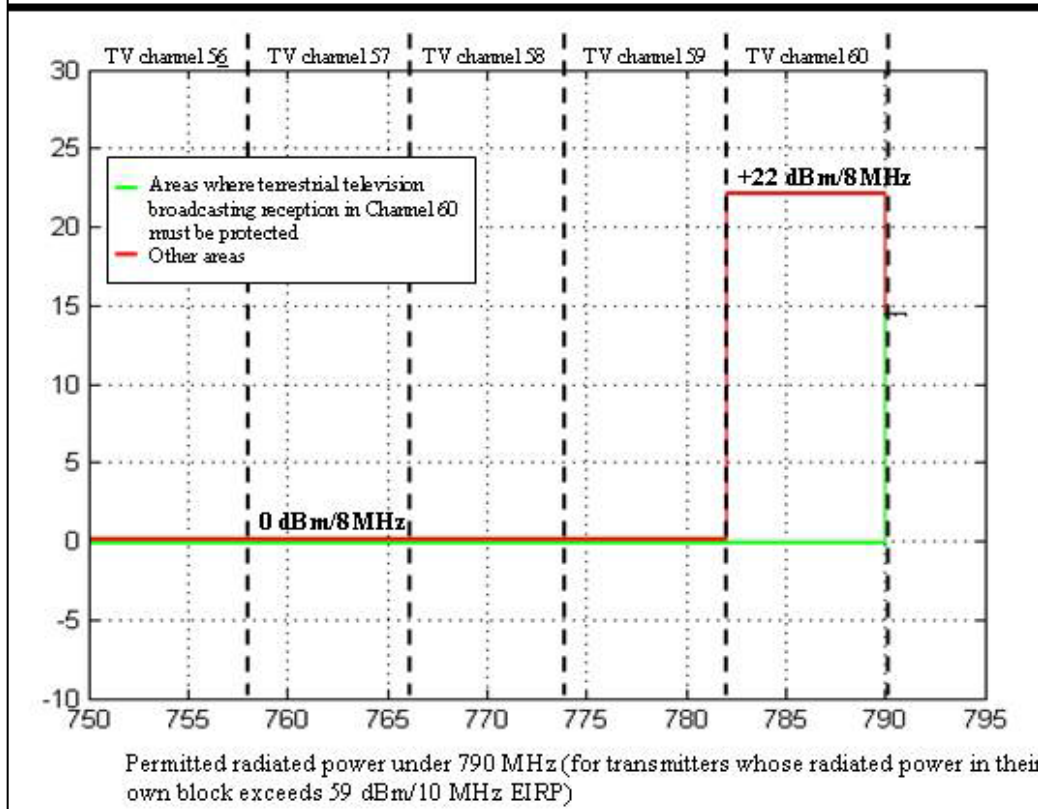
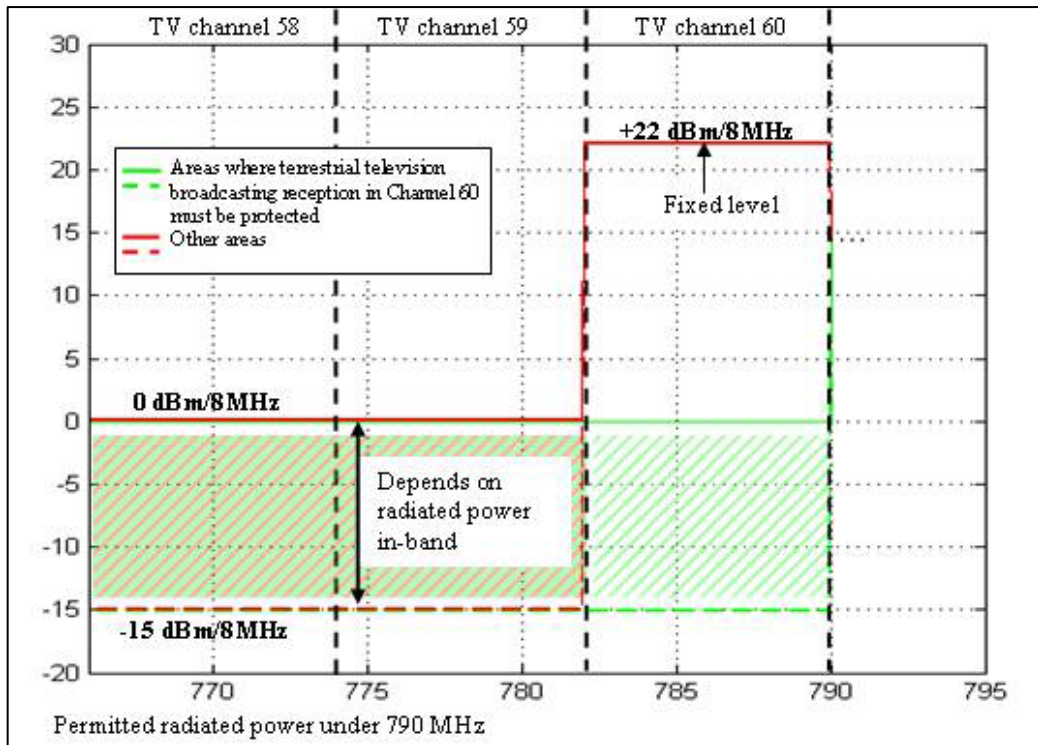
The radiated power from base station transmitter and repeater in the downlink direction may not exceed the values prescribed by Option A (that is, the value specified in the table below) in the 470–782 MHz frequency band and the 782–790 MHz frequency band in geographical areas where terrestrial television broadcasting reception in Channel 60 must be protected.

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The base station's radiated power (P) (EIRP) in its own block	Maximum radiated power (EIRP) in the 470-782 MHz frequency band (and also the 782-790 MHz frequency band in geographical areas where terrestrial television broadcasting reception in Channel 60 must be protected)
$P \geq 59$ dBm/10MHz	0 dBm/8 MHz
$44 \leq P < 59$ dBm/10 MHz	(P-59) dBm/8 MHz
$P < 44$ dBm/10 MHz	-15 dBm/8 MHz

In other geographical areas, the radiated power from base station transmitters and repeaters in a downlink direction in the 782–790 MHz frequency band must not exceed the value prescribed by Option C; that is, 22 dBm/8 MHz.

In order for an operator to be able to satisfy the conditions that apply under the spectrum mask, it is highly likely that extra filters must be installed at base stations in areas where terrestrial television broadcasting reception in Channel 60 must be protected. This is of particular importance for the lowest frequency block.



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### 6.2.2 Further measures for protecting terrestrial television broadcasting reception

PTS has brought in consultants to conduct two studies of the risk of harmful interference to terrestrial television broadcasting reception from new systems in the 800 MHz band. The first study is directed at interference from adjacent frequency bands<sup>35</sup> and the second study is directed at the risk of television receivers being overloaded.<sup>36</sup> 'Overloading' means that the signals from an adjacent base station in the 800 MHz band are so strong that a television receiver cannot receive wanted signals from terrestrial television broadcasting.

In summary, the studies indicate that unless further requirements are imposed in the licence conditions for the 800 MHz band, in addition to those referred to above, terrestrial television broadcasting may be affected in the following ways:

- The scale of the effect on television reception as a consequence of overloading of the receiver may amount to approximately 5 000 households (from all blocks in the 800 MHz band throughout Sweden and in all channels (21-60)).
- The scale of the effect from use in the 800 MHz band on reception in Channel 60 may amount to approximately 10 000 households (primarily from the lowest block in the 800 MHz band in geographical areas where Channel 60 is used for terrestrial television broadcasting reception).
- The scale of the effect from use in the 800 MHz band on reception of Channels 21-59 may amount to approximately 15 000 households.

In these studies, the point of departure has been receivers with average characteristics and reception using a fixed roof-mounted antenna. Regard has been taken of the fact that only a certain percentage of households in Sweden receive terrestrial television broadcasting.

PTS considers that filters installed on television receivers are the most important measure to address the problem of the overloading of television receivers and interference in reception of Channels 21-59 owing to new systems in the 800 MHz band. PTS does not propose anything other than that this measure is taken by those households that receive terrestrial television broadcasting and whose reception is expected to be affected (approximately 20 000 households). In the assessment of PTS, the cost of the filters will be quite low (a figure of SEK 250 per filter was mentioned in one study).<sup>37</sup> As other

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<sup>35</sup> Progira Radio Communications AB, Interference from future mobile network services in frequency band 790 – 862 MHz to digital tv in frequencies below 790 MHz, report dated 5 February 2009

<sup>36</sup> HiQ Stockholm AB, *Analys av överstyrning av DVB-T mottagare med anledning av tilldelning av frekvenser i 800 MHz-bandet* [Analysis of overloading of DVB-T receivers as a result of the assignment of frequencies in the 800 MHz band], June 2009

<sup>37</sup> HiQ, *ibid.*, p 16

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European countries are also considered to be interested in a corresponding solution, it is likely that filters will be manufactured for the European market.

It is also expected that for low antennae heights, the above-mentioned limit on radiated power within one's own block will reduce the risk of the overloading of television receivers to some extent.

In areas where Channel 60 is used for terrestrial television broadcasting reception, filters that are installed will probably filter out reception of Channel 60, as the frequency separation between the lower frequency block in the 800 MHz band and Channel 60 is only 1 MHz. This may affect around 10 000 households. It is unclear whether there will be a market for more advanced and expensive filters that can filter out the reception of the 800 MHz band while not affecting terrestrial television broadcasting reception in Channel 60.

PTS therefore considers that there is a need for further measures to reduce the effects from new systems in the 800 MHz band on terrestrial television broadcasting reception in Channel 60. There will be a reduction in the number of receivers affected if there is a requirement stipulating that only antennae with vertical polarization may be used in areas where television reception in Channel 60 must be protected. Studies conducted suggest that the effects reduce by at least 50 per cent. This requirement shall apply to all frequency blocks in the 800 MHz band. This condition will entail certain losses in capacity for those base stations where only antennae with vertical polarization may be used.

Even if conditions on vertical polarization are applied, there will remain a small group of households that will not be able to receive terrestrial television broadcasting in Channel 60. The consequence for a large proportion of these household is that they will not be able to receive the full range of television programmes offered by Boxer TV-Access. Only a small group of households will also encounter difficulties in receiving SVT's public service digital terrestrial broadcasts. However, no household will completely lose the possibility of receiving television.

PTS is authorised to grant exemptions from licence conditions, or subsequently amend licence conditions, if licence holders can prove that they can achieve an equivalent protection of terrestrial television broadcasting with less extensive measures.

PTS points out that when new systems are put into service in the 800 MHz band, there may be a need for various information activities aimed at television viewers.

<p><b>PTS proposes</b> the following measures for protecting terrestrial television broadcasting reception, in addition to conditions in the spectrum mask:</p>
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- Filters on television receivers are the primary measure to address problems related to interference and overloading. This measure shall be taken by the households affected themselves.
  
  - In areas where Channel 60 is used for broadcasting terrestrial television broadcasting, a requirement shall be imposed that only antennae with vertical polarization are used. This condition shall apply to all frequency blocks in the 800 MHz band.

### **6.3 Certain further factors of importance for use of the 800 MHz band**

#### **6.3.1 Use of the 800 MHz band in Sweden's neighbouring countries**

Denmark, Norway and Finland have already decided to not use the 800 MHz band for terrestrial television broadcasting in the future. However, pending all of Sweden's neighbouring countries making the 800 MHz band available for electronic communications services other than television, Swedish use of the 800 MHz band may be affected by its neighbouring countries' transmissions of terrestrial television broadcasting over 790 MHz.

The GE06 Agreement specifies the rights that each State has to utilise frequencies in Bands IV/V for broadcasting and the obligations there are to protect the reception of other States. These rights not only apply to existing transmitters but also to new transmitters that are put into use, particularly in such areas that are expressly planned for the future use of broadcasting transmitters ('allotments').

Interference from and the protection of the neighbouring countries' use of terrestrial television broadcasting can consequently vary for use in the 800 MHz band, depending on which frequency block in the 800 MHz band is used and the part of Sweden in which this occurs.<sup>38</sup>

An illustration of coverage areas for existing frequency rights in the closest neighbouring countries is provided in Appendix 2.

Parts of the 800 MHz band in, for example, Russia are used for aeronautical radionavigation systems.<sup>39</sup> No particular regard has been taken of the protection of and interference from such systems when producing the technical conditions for the 800 MHz band within CEPT. It is possible that future coordination agreements with, for instance, Russia will entail restrictions in the use of the 800 MHz band in Sweden. Based on the information available, PTS considers that any restrictions as a consequence of coordination in relation to Russia may be less intrusive in the upper frequency blocks in the 800 MHz band.

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<sup>38</sup> See also CEPT Report 29

<sup>39</sup> See ITU-RR, footnote 5.312

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### **6.3.2 Possible future use of short range devices in the 800 MHz band**

CEPT Report 30 and the draft ECC Decision contain the spectrum mask specified and highest power for any future use of short range devices in the duplex gap that arises in the 821–832 MHz frequency band, when using the FDD band plan.

In the current situation, no decision has been taken concerning the future use of these frequencies and it is unclear what demand there is for the use of short range devices in this band. However, one possibility is that some form of exemption from the licence obligation in the duplex gap could be introduced in the future.

Any use of short range devices in the duplex gap may affect the interference situation in the 800 MHz band. In particular, this should be the case in those frequency blocks that lie closest to the duplex gap; that is, the lowest and uppermost frequency block according to the FDD band plan.



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## 7 Further work

On the basis of this document, the survey of interest and the responses received, PTS intends to continue to work on planning the 800 MHz band and designing the procedure for the assignment of licences in the band.

PTS plans to announce a draft decision to limit the number of licences in the 800 MHz band, together with an open invitation to apply during the spring of 2010. Market stakeholders will be afforded an opportunity to express their views on the proposal. This will, for instance, include the detailed rules for an auction.

It is intended to make decisions on limiting the number of licences in the 800 MHz band together with the open invitation to apply prior to the summer of 2010. An auction can then be initiated during the autumn of 2010. Licences in the 800 MHz band will be assigned when the auction is completed.

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Government Bill 1996/97:67, Report 1996/97:KU17, Riksdag Communication 1996/97:178

Government Bill 2002/03:72, Report 2002/03:KU33, Riksdag Communication 2002/03:196

*Sändningsutrymme för tv-sändningar* [Broadcasting space for television broadcasting] (Ku2007/455/ME and others)

Swedish Government Official Reports – SOU 2008:35

Assignment to investigate the amount of spectrum that can be released in conjunction with the switch-off of analogue terrestrial television broadcasting and what this frequency scope can be used for (N2005/8208/ITFoU)

EU material

Decision No 676/2002/EC of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community

COM(2003) 541, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on the transition from analogue to digital broadcasting (from digital 'switchover' to analogue 'switch-off')

COM(2005) 204 Communication from the Commission to the Council, the European Parliament, the European Economic And Social Committee and the Committee of the Regions on accelerating the transition from analogue to digital broadcasting

RSPG05-102 Radio Spectrum Policy Group Opinion on Wireless Access Policy for Electronic Communications Services (WAPECS) – A more flexible spectrum management approach

Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions 'Rapid access to spectrum for wireless electronic communications services through more flexibility', (COM(2007) 50)

COM(2007) 700 Reaping the full benefits of the digital dividend in Europe: A common approach to the use of spectrum released by the digital switchover

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RSPG09-272, Draft Radio Spectrum Policy Group Opinion on the Digital Dividend

CEPT material

CEPT Report 19, Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS, 21 December 2007

CEPT Report 21 (Compatibility between 'cellular/low power transmitter' networks and 'larger coverage/high power/tower' networks), CEPT Report 22 (Technical Feasibility of Harmonising a Sub-band of Bands IV and V for Fixed/Mobile Applications (including uplinks))

CEPT Report 23 (Technical Options for the Use of a Harmonised Sub-Band in the Band 470 - 862 MHz for Fixed/Mobile Application (including Uplinks))

CEPT Report 24 (Feasibility of fitting new applications/services into "white spaces" of the digital dividend)

CEPT Report 25 (Technical Roadmap proposing relevant technical options and scenarios to optimise the Digital Dividend)

CEPT Report 29, (Guideline on cross border coordination issues between mobile services in one country and broadcasting services in another country)

CEPT Report 30 (The identification of common and minimal (least restrictive) technical conditions for 790-862 MHz for the digital dividend in the European Union)

CEPT Report 31 (Frequency (channelling) arrangements for the 790-862 MHz band)

PTS reports

*All of the reports listed below are available on PTS's website, [www.pts.se](http://www.pts.se).*

A-focus & DotEcon, The use of auctions in spectrum assignment – A report for PTS, 2004

PTS-ER-2006:35, The use of radio spectrum following the switch-off of analogue terrestrial television broadcasting – Report on a Government assignment

PTS-ER-2008:16, *Planeringslösning för marksänd digital tv – VHF (delrapport)* [Planning solution for terrestrial digital television – VHF (preliminary report)] and PTS-ER-2008:22, *Planeringslösning för marksänd digital tv – UHF*,

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*Slutrapportering av uppdrag RB 2008:5 [Planning solution for terrestrial digital television – UHF, Final report of assignment RB 2008:5]*

Progira Radio Communications AB, Interference from future mobile network services in frequency band 790 – 862 MHz to digital tv in frequencies below 790 MHz, report on 5 February 2009

HiQ Stockholm AB, *Analys av överstyrning av DVB-T mottagare med anledning av tilldelning av frekvenser i 800 MHz-bandet* [Analysis of overloading of DVB-T receivers as a result of the assignment of frequencies in the 800 MHz band], June 2009

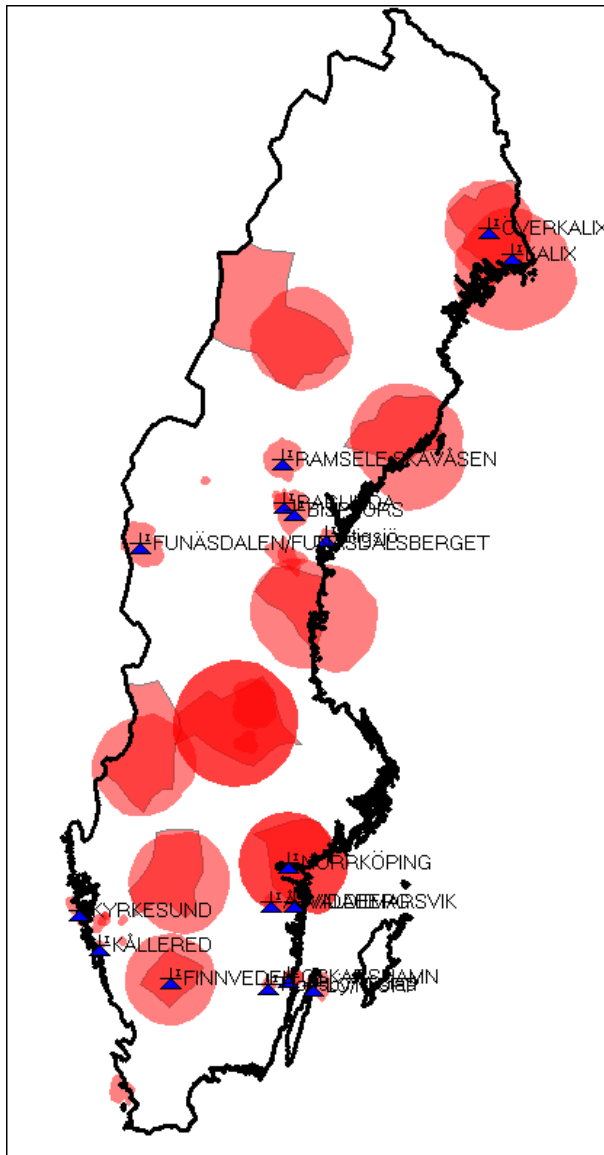
Other

Cramton, Peter and Schwartz, Jesse A (2000): Collusive Bidding: Lessons from the FCC Spectrum Auctions, *Journal of Regulatory Economics*, 17, 229-252

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## Appendix 1

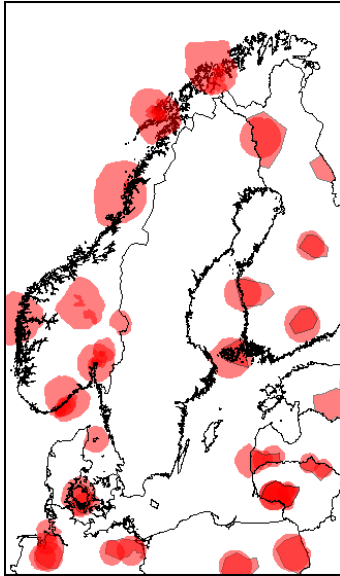
Areas where television channel 60 is planned in the current situation for use of terrestrial television broadcasting in Sweden



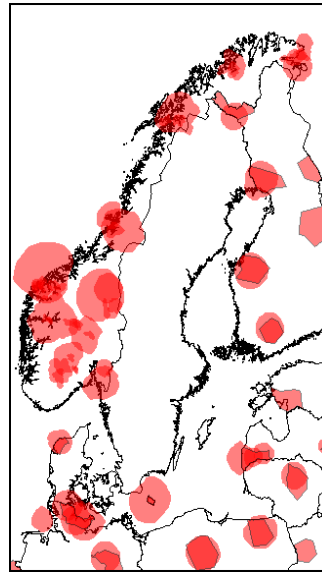
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## Appendix 2

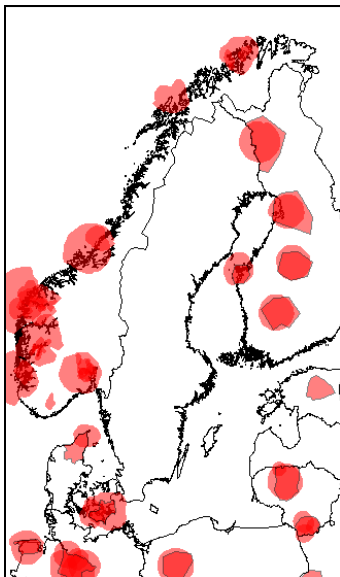
Illustration of the coverage areas for existing frequency rights for television channels 61–69 in the closest neighbouring countries. It should be noted that these maps do not necessarily give a picture of the interference that is created from terrestrial television broadcasting in the 800 MHz band in relation to the new systems in the 800 MHz band in Sweden.



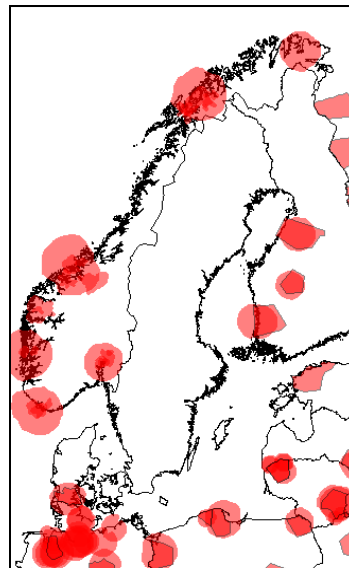
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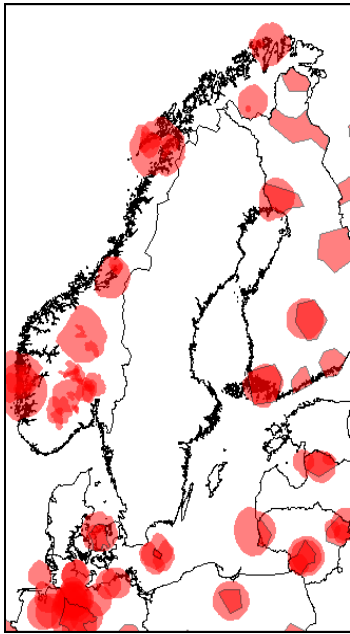
Channel 62



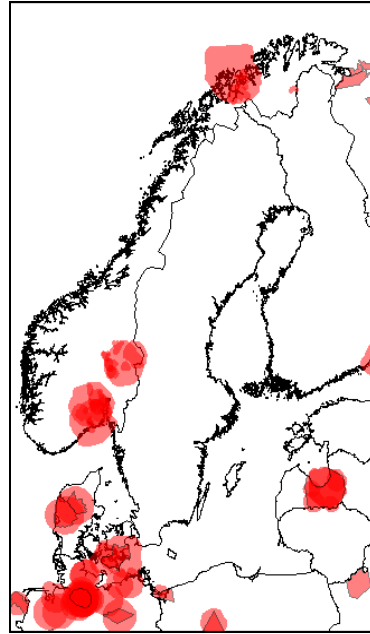
Channel 63



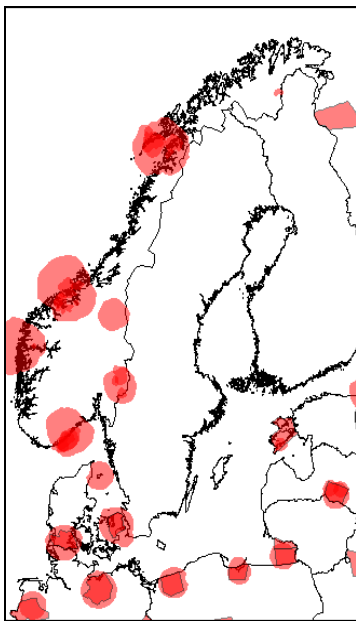
Channel 64



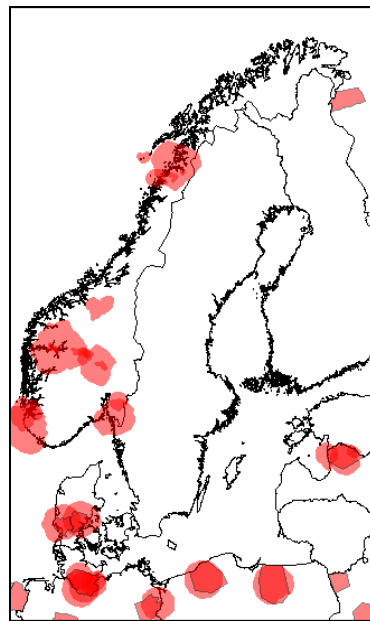
Channel 65



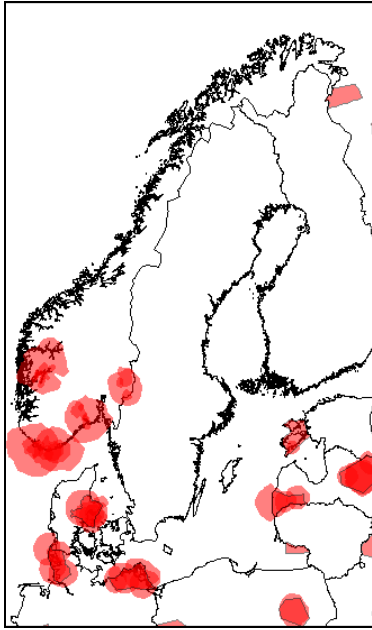
Channel 66



Channel 67



Channel 68



Channel 69