Spectrum Aggregation Limits in Auctions with Spectrum below 1 GHz: the European Experience

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Executive Summary

Several recent commenters have suggested that spectrum aggregation limits in European spectrum auctions have led to disappointing results. In the report "The case for inclusive spectrum auction rules – How failed international experiments with auction bidding restrictions reveal the strength of inclusive rules that put consumers and innovation first,"[1] Mobile Future claims, with reference to international experience with spectrum auctions and especially various spectrum auctions from several European countries, that…

1. "…the restrictions imposed in the Unites States are far more discriminatory than those employed internationally"

2. "…there is extensive evidence that bidding restrictions are associated with low revenue"

3. "…international evidence confirms that low frequency spectrum is not a competitive necessity"

Verizon has then claimed – referring to the results of Mobile Future - that spectrum aggregation limits can lead to "suppressed bidding" and depressed revenues in spectrum auctions.[2]

In this report, we analyze all recent auctions in the large economies in the European Union, where spectrum below 1 GHz was sold.[3] Based on the evidence provided it is shown that:

1. The proposed spectrum aggregation limits in the US are not more restrictive than those employed in the European Union. Several European countries installed spectrum aggregation limits that were of similar quality as the proposals in the US. Also the average European spectrum aggregation limit is in line with spectrum aggregation limits proposed in the US.

2. The reasoning by Mobile Future and Verizon for their claims on revenue is logically flawed and thus invalid. Mobile Future and Verizon argue that in some European auctions the revenue expectations of the regulator were not met. We show that in most of the examples brought forward by Mobile Future and Verizon expectations were formed after the auction

[1] *See* Mobile Future, *The case for inclusive spectrum auction rules. How failed international experiments with auction bidding restrictions reveal the strength of inclusive rules that put consumers and innovation first*, attached to Letter from Jonathan Spalter, Chair, Mobile Future to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 12-268; WT Docket No. 12-269 (filed Sept. 12, 2013) ("Mobile Future report").

[2] *See* Letter from Tamara Preiss, Vice President, Federal Regulatory Affairs, Verizon to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 12-268; WT Docket No. 12-269 (filed Nov. 8, 2013) ("Verizon Letter").

[3] A precise definition of the selection criteria for our sample of auctions is given below in section I.

design and the spectrum aggregation limits were known. Any meaningful expectation should take the existing information such as the specific market information and the specific auction design into account. Particularly, the effect of spectrum aggregation limits should have been taken into account in the examples by Mobile Future and Verizon when forming the expectations for auction revenues and thus could not have been the cause if expectations were not met. Even if, for whatever reason, market specifics and aspects of the auction design like spectrum aggregation limits were not considered for the formation of expectations, we show that, taking into account all recent spectrum auctions in the large economies of the European Union, there is no systematic bias when comparing the results of the auctions with the formed expectations. Thus, the conclusion that European evidence implies lower revenues due to spectrum aggregation limits cannot be drawn.

3. European regulators assign a special role to spectrum below 1 GHz. All countries in the large European Union economies other than the Netherlands employed spectrum aggregation limits specifically for spectrum below 1 GHz. The Netherlands set aside spectrum below 1 GHz for new entrants instead. By documenting the arguments brought forward by European regulators on why they imposed spectrum aggregation limits or a set-aside for frequencies below 1 GHz, we highlight that European regulators regard an uneven distribution of 1 GHz spectrum across mobile network operators as a significant threat to the sustainability of the competitive landscape.

I. Spectrum aggregation limits are the norm in the European Union

This report is based on a sample of spectrum auctions in the European Union which satisfy the following criteria:

A. Recentness: The spectrum auction took place in the year 2010 or later.

B. Relevance: Spectrum in the bands below 1 GHz was available in the auction.

C. Large Economy: The spectrum auction took place in a country with a GDP > 200bn USD.

That is, our sample includes *all* recent auctions in the large economies in the European Union, with spectrum below 1 GHz. For these auctions, Table 1 on page 6 lists, sorted by date, the frequencies below 1 GHz that were auctioned and whether or not a spectrum aggregation limit and a specific spectrum aggregation limit for spectrum below 1 GHz was imposed.

All spectrum auctions in the large European Union economies employed spectrum aggregation limits, and all but the Netherlands employed a spectrum aggregation limit specifically for spectrum below 1 GHz.[4] The Netherlands used set-asides of spectrum below 1 GHz for new entrants. Thus, rather than being an experiment as claimed by Mobile Future, spectrum aggregation limits are the norm in Europe. [5]

II. The restrictions proposed in the United States are in line with restrictions that were imposed in Europe

Each country from our sample uses a slightly different approach on how to define spectrum aggregation limits. To make the regulations in the individual countries comparable, we translated all imposed spectrum aggregation limits into a relative cap, *i.e.* the maximum share of sub 1 GHz spectrum that a single operator is allowed to own. The result is summarized in Table 2 on page 7.

[4] Even though in the Netherlands there was no specific spectrum aggregation limit for spectrum below 1 GHz, some spectrum below 1 GHz was set aside for new entrants. In addition, the Netherlands employed an overall spectrum limit where spectrum below 1 GHz was weighted 15 times higher in the overall aggregation limit. For details *see infra* note 7. In addition to a spectrum aggregation limit of 2x10 MHz, the Czech auction also included a set-aside for new entrants. As no potential new entrant took part in the auction, the spectrum aggregation limit was the only effective measure against spectrum aggregation. See Czech Invitation to Tender (Aug. 15, 2013), available at http://www.ctu.cz/ctu-online/elektronicka-uredni-deska/vyhlaseni-vyberoveho-rizeni-na-kmitocty-v-pasmech-800-mhz-1800-mhz-a-2600-mhz-2013/vyhlaseni-vyberoveho-rizeni-2013.html (untranslated).

[5] For example Mobile Future writes that "[s]ome argue that auction restrictions are advisable in the United States because some international regulators have experimented with them." *See* Mobile Future report, *supra* note 1, at 1.

Country	Date	Frequency	Aggregation limit imposed	Specific Aggregation limit imposed for spectrum below 1 GHz
Germany	May 2010	2x30 MHz (800 MHz)	Yes	Yes
Sweden	Mar 2011	2x30 MHz (800 MHz)	Yes	Yes
Spain	Jul 2011	2x25 MHz (800 MHz)	Yes	Yes
Italy	Sep 2011	2x30 MHz (800 MHz)	Yes	Yes
Portugal	Nov 2011	2x30 MHz (800 MHz) 2x10 MHz (900 MHz)	Yes	Yes
France	Dec 2011	2x30 MHz (800 MHz)	Yes	Yes
Denmark	Jun 2012	2x30 MHz (800 MHz)	Yes	Yes
	Oct 2010	2x5 MHz (900 MHz)	Yes	Yes
Ireland	Nov 2012	2x30 MHz (800 MHz)	Yes	Yes
Netherlands	Dec 2012	2x30 MHz (800 MHz) 2x35 MHz (900 MHz)	Yes	No[6]
United Kingdom	Feb 2013	2x30 MHz (800 MHz)	Yes	Yes
Austria	Oct 2013	2x30 MHz (800 MHz) 2x35 MHz (900 MHz)	Yes	Yes
Finland	Nov 2013	2x30 MHz (800 MHz)	Yes	Yes
Czech Republic	Nov 2013	2x30 MHz (800 MHz)	Yes	Yes
Poland	Dec 2013	2x25 MHz (800 MHz)	Yes	Yes

Table 1: Recent spectrum auctions in the large economies in the European Union

We calculated for each country and for each bidder the percentage of the spectrum below 1 GHz it could at most achieve during the auction, taking the bidder's pre-auction holding of spectrum into account. Table 2 shows for each country the maximum share calculated in this way across all bidders. For example, in Germany Vodafone and T-Mobile each owned 2x12.4 MHz of spectrum below 1 GHz before the 2010 spectrum auction took place. In the auction each of them was allowed to buy at most 2x10 MHz of spectrum in the 800 MHz band. The total amount of spectrum in the 800 MHz and 900 MHz band available for mobile operators was 129.8 MHz. Thus, the aggregation limit for these two firms was 35% each. The other two mobile operators, O2 and E-plus, owned 2x5 MHz

[6] In the Netherlands two blocks of 2x5 MHz spectrum in the 800 MHz band and one 2x5 MHz block in the 900 MHz band were set aside for new entrants.

of spectrum below 1 GHz before the auction took place. In the auction, they were allowed to acquire up to 2x15 MHz of spectrum in the 800 MHz band. Thus, they could end with at most 2x20 MHz of spectrum below 1 GHz, which is 31% of the overall spectrum. In Table 2, the relevant figure for the German auction is thus 35%, the largest share of spectrum below 1 GHz a single bidder could obtain.

Country	Aggregation limit for spectrum below 1 GHz
Sweden	31%
Ireland	31%
Poland	33%
Portugal	34%
Germany	35%
Czech Republic	35%
France	39%
Italy	39%
Spain	39%
Finland	41%
United Kingdom	42%
Denmark	49%
Austria	54%
Netherlands[7]	84%

Table 2: Spectrum aggregation limits in European Union for spectrum below 1 GHz[8]

Mobile Future claims that "[t]he restrictions proposed in the United States are far more restrictive than those employed internationally."[9] This claim is not supported by the data. It is our understanding that one of the most discussed proposals in the US includes a spectrum aggregation limit, which allows each carrier to hold at most 33% of the sub 1 GHz spectrum in an individual

[7] The Netherlands had a point rule during the multiband auction that assigned 15 points to each 2x5 MHz block of spectrum below 1 GHz, 1 point for a 2x5 MHz block of spectrum in the 1800 MHz and 2000 MHz band, 1 point for 14.6 MHz of unpaired spectrum in the 2000 MHz band and 1 point for 5 MHz of unpaired spectrum in the 2600 MHz band. New entrants were allowed to bid for up to 220 points whereas other operators were only allowed to bid for a maximum of 190 points. Moreover, two blocks of 2x5 MHz spectrum in the 800 MHz band and one 2x5 MHz block in the 900 MHz band were set aside for new entrants. For Table 2, only the set asides were taken into consideration.

[8] Sources: Cullen International, Table 14 – Spectrum caps (Apr. 2013); Cullen International, Table 24 – Mobile operators' licenses (May 2013); and original analysis.

[9] *See* Mobile Future report, *supra* note 1, at 2.

market.[10] As shown in Table 2 this proposal is very much in line with restrictions that were imposed in recent spectrum auctions across the European Union.[11] Several European countries installed spectrum aggregation limits that were of similar size. Moreover, the average of the spectrum aggregation limits is 39% across Europe and thus in line with the proposal in the US.[12]

III. The claim that bidding restrictions lead to lower revenue is not supported by the data

In this section it will be shown that the reasoning by Mobile Future for the claim that "[t]he international evidence linking non-inclusive auction rules and restrictions with poor results – both in terms of competition and revenue – militates against imposing them in the United States" is logically flawed and thus invalid.[13] The conclusion that international evidence implies lower revenues due to spectrum aggregation limits cannot be drawn from the European experience.[14]

To support their claim, Mobile Future and Verizon argue that in some European countries the revenue expectations of the regulators or other bodies were not met. However, meaningful expectations can only be formed on the basis of the specific market situation and the specific auction design. We show that in most of the examples brought forward by Mobile Future expectations were formed after the auction design and the spectrum aggregation limits were known. Thus, the effect of spectrum aggregation limits should have been taken into account. So whether or not these

[10] Moreover, under the current proposal each bidder would be able to acquire at least a single 5x5 MHz block of spectrum even if this transaction would put it above the spectrum aggregation limit. *See* Letter from Trey Hanbury, Counsel for T-Mobile USA, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 12-269, 2 (filed May 31, 2013).

[11] The FCC already enforces spectrum aggregation limits. Broadly speaking, the Commission prevents further acquisition once a company has acquired more than 33% of the available spectrum in an individual market. But that limit is applied on a case-by-case basis, usually when one mobile operator acquires another and requests permission to transfer ownership of the spectrum.

[12] The GDP weighted average of the spectrum aggregation limits amounts to 39%.

[13] *See* Mobile Future report, *supra* note 1, Chapter II; *see also* Verizon Letter, *supra* note 2 at 2-3 (arguing that "bidding restrictions often result in reduced auction revenues").

[14] A discussion of non-European spectrum auctions is outside the scope of this paper. However, other studies have argued that spectrum aggregation limits do not correlate to lower revenues. *See, e.g.*, Letter from Rebecca Murphy Thompson, General Counsel, Competitive Carriers Association to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 12-269; GN Docket No. 12-268 (filed Sept. 4, 2013) (highlighting, in addition to European examples, international regulatory authorities in Australia, Canada, Iceland, South Korea, Norway, Greece, Peru, Switzerland, Argentina, Columbia, Brazil, Mexico, Singapore, and Thailand that have adopted spectrum aggregation limits); *see also* Letter from Trey Hanbury, Counsel to T-Mobile USA, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 12-269; GN Docket No. 12-268 (filed Oct. 28, 2013) (discussing the use of spectrum aggregation limits in New Zealand's auction of 700 MHz spectrum).

expectations were met does not provide information on whether spectrum aggregation limits lead to lower or higher revenue.

Even if for whatever reason the market specifics and the auction design were not considered for the formation of expectations, we show that if all recent spectrum auctions in the large economies of the European Union are taken into account, there is no systematic bias when comparing the results of the auctions with the formed expectations. In some cases officials reported higher than expected revenue and in other cases lower than expected revenue. Thus, as expectations are inherently uncertain, the conclusion that international evidence implies lower revenues due to spectrum aggregation limits cannot be drawn.

A. Most examples brought forward by Mobile Future are meaningless with regard to the question whether spectrum aggregation limits have an impact on revenue

We first comment on the examples brought forward by Mobile Future and then broaden the scope to the complete sample of recent spectrum auctions in the large economies of the European Union with spectrum in the bands below 1 GHz.[15]

1. UK – multiband auction – 2013

Mobile Future states that "low revenues earned from the UK auction generated significant controversy within the British government. The auction generated only £2.34 billion, more than 30% below the Office of Budget Responsibility's revenue forecast."[16] It is then implied that this failure to raise the forecasted revenue is directly linked to the fact that spectrum aggregation limits were imposed. However, this assertion does not withstand a closer examination as the estimate by the UK Treasury was released on December 5, 2012, well after it was known that limits would be imposed.[17] Hence, the estimate to which Mobile Future refers was made in awareness of the existence of

[15] The order of the countries discussed below follows that used by Mobile Future.
[16] *See* Mobile Future report, *supra* note 1, at 5.
[17] *See* Treasury—Seventh Report, *Autumn statement 2012* (Dec. 5, 2012), *available at* http://www.publications.parliament.uk/pa/cm201213/cmselect/cmtreasy/818/ 81806.htm ("Treasury Report"). The Treasury Report was released well after the publication of the spectrum aggregation limits by Ofcom. *See* Ofcom, *Assessment of future mobile competition and award of 800 MHz and 2.6 GHz* (July 24, 2012), *available at* http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/statement.pdf.

spectrum aggregation limits. Thus, the limits could not have been the cause for the smaller-than-expected revenue.[18]

In our opinion, the reason for the public controversy concerning the revenue can be found in the use of a variant of Vickrey pricing.[19] As a consequence of this specific feature in the auction design, the British government and the British public could observe how much the winning bidders would have been willing to pay, and how much they actually had to pay.[20] It is well documented that the transparency of the implied profit for the mobile operators can cause public dispute.[21]

2. Germany – multiband auction – 2010

Mobile Future links spectrum aggregation limits to seemingly poor revenue in the German multiband auction in May 2010. They state: "In line with other auctions where bidding restrictions were imposed, the German auction raised just short of EUR 4.4 billion, an amount well below analysts' expectations. For example, KPMG had estimated that the auction would raise between EUR 6-8 billion."[22] Again – as with the UK spectrum auction – the assertion of Mobile Future does not withstand a close examination. The forecast by KPMG was first published on 20 April 2010.[23] The rules for the auction including the spectrum aggregation limits were published well before KPMG conducted their estimation.[24] Thus, we can presume that KPMG were aware of the limits when

[18] The Treasury Report states "given the final details of the auction have now been announced, we have been able to certify an estimate of the proceeds." *See* Treasury Report, *supra* note 17.

[19] Broadly speaking, with Vickrey pricing bidders indicate the maximum willingness to pay for the final allocation in the auction but are only required to pay the minimum amount that would have been required to sustain the final allocation. Thus, the difference between the maximum willingness to pay and the final prizes is exposed to the public.

[20] For example BBC News reported on 16 April 2013 that "[t]he amount [raised in the auction] was also far lower than the £5.2bn actually offered by all the bidders, as an eBay-type system was used, whereby the highest bidder puts on the table the maximum it is prepared to pay, but is required to pay only slightly more than the sum offered by the next highest bidder." "4G auction to be investigated by National Audit Office," BBC News.com (Apr. 16, 2013), *available at* http://www.bbc.co.uk/news /business-22165797. Moreover, the Guardian noted on 15 April 2013 that "[f]igures published by Ofcom in March showed that the highest bids for 4G spectrum came to a total of £5.2bn. But Ofcom said those were only theoretical because it was using a rule whereby winners only paid slightly more than the second-highest bidder – similar to an eBay auction – a measure taken to make the auctions harder to rig." Charles Arthur, "4G auction to be investigated by audit office after poor return," The Guardian.com (Apr. 14, 2013), *available at* http://www.theguardian.com/technology/2013/apr/14/4g-auction-national-audit-office.

[21] In *Selling Spectrum Rights,* John McMillan reports a second-price New Zealand auction in which the winner bid NZ $7 million but paid the runner-up's bid of NZ $5,000, which resulted in politically embarrassing newspaper headlines. *See* John McMillan, *Selling Spectrum Rights*, 8 The Journal of Economic Perspectives 145, 148 (Summer 1994), *available at* http://www.columbia.edu/itc/sipa/u8213-03/packet/mcmillan-600.pdf.

[22] *See* Mobile Future report, *supra* note 1, at 6.

[23] *See* Press Release, "KPMG legt erstmals detaillierte Prognoserechnung für Mobilfunkfrequenz-Auktion vor," KPMG (Apr. 20, 2010), *available at* http://www.kpmg.de/Presse/19870.htm.

[24] *See* Bundesnetzagenur (BNetzA), *Decisions of the President's Chamber of the Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway of 12 October 2009 on combining the award of*

deriving their estimate. As in the previous section, we can conclude that spectrum aggregation limits cannot have been the cause for the lower-than-expected revenue.

Moreover, Mobile Future claims that "E-Plus, an incumbent that was not limited by the limit, obtained its spectrum 'at a bargain' for less than half the expected price."[25] It should be noted, however, that E-Plus did not acquire any spectrum in the bands below 1 GHz in the German auction.

3. Netherlands – multiband auction – 2012

Concerning the spectrum auction in the Netherlands in 2012, Mobile Future claims that the main reason for the unexpectedly high revenue is that "the regulator required incumbent providers to compete to reacquire usage rights for spectrum they were already using. […] The incumbent licensees were therefore under substantial pressure to bid aggressively to prevent service disruptions to their customers and to avoid stranding billions of dollars of investment."[26] Again, this was obviously known when the Dutch government formed its expectations about the revenues of the auction. Thus, we can presume that this consideration entered the forecast of the auction revenues.[27]

4. Denmark – 800 MHz and 900 MHz auction – 2012 and 2010

Mobile Future states that in Denmark "The result was that Hi3G Denmark ("3"), an existing 1.9 GHz/2.1 GHz licensee, was the only bidder for either of the licenses. […] As such, Hi3G Denmark won the licenses at the reserve price." While this is correct, one should take into account that the

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*spectrum in the bands 790 to 862 MHz, 1710 to 1725 MHz and 1805 to 1820 MHz with proceedings to award spectrum in the bands 1.8 GHz, 2 GHz and 2.6 GHz for wireless access for the provision of telecommunications services, and on the determinations and rules for conduct of the proceedings to award spectrum in the bands 800 MHz, 1.8 GHz, 2 GHz and 2.6 GHz for wireless access for the provision of telecommunications service*s (Oct. 12, 2009), *available at* http://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Frequenzen/OffentlicheNetze/VergabeverfDrahtloserNetzzugang2010/PraesKammerEntschg_Id17404pdf.pdf?__blob=publicationFile&v=1 ("BNetzA decision").

[25] *See* Mobile future report, *supra* note 1, at 6.

[26] *See id.* at 6; *see also* Verizon Letter, *supra* note 2, at 2-3.

[27] "Four players have acquired LTE spectrum licenses in The Netherlands, delivering a EUR 3.8bn windfall to the Dutch Treasury, far higher than expected. […] The total paid for the licenses was almost eight times higher than the government's projected sum of EUR 480m." Caroline Gabriel, "Dutch auction delivers record sums," Rethink Wireless (Dec. 17, 2012), *available at* http://www.rethink-wireless.com/2012/12/17/dutch-auction-delivers-record-sums.htm.

auction only included a single 2x5 MHz block in the 900 MHz band that was made available by refarming measures.[28]

5. Sweden – 800 MHz – 2011

Mobile Future links spectrum aggregation limits with seemingly disappointing revenue in Sweden by stating: "A bidder, therefore, could not be assigned more than two licenses of 2x5 MHz through the auction. […] [F]inal prizes were close to the reserve prices and revenue was described as 'lukewarm.'" From Mobile Future's statement, it is not clear who was disappointed with the revenues. PTS, the Swedish regulator, stated after the auction: "It is […] gratifying that SEK 300 million during the next few years will be used to cover precisely those households and companies that lack coverage today."[29]

B. Considering all recent spectrum auctions with spectrum below 1 GHz in large European economies shows that there is no systematic bias when comparing the results of the auction with previously made expectations

We do not think that whether in specific auctions revenue expectations have been met or not gives any indication of whether spectrum aggregation limits lead to more or less revenue. Typically, expectations are formed for a given market situation and a given auction design. In different market situations, and under different auction rules, results are expected to differ. Still, as Mobile Future and Verizon seem to argue that revenue below expectation in European auctions gives an indication for the expected revenue in the upcoming US auction, we will comment here upon those recent auctions in Europe which neither Mobile Future nor Verizon listed.[30] In this unrestricted sample it becomes evident that expectations towards revenue are sometimes achieved and sometimes not achieved, *i.e.* there is no systematic bias in one or the other direction. Thus, comparing revenue expectations and results in Europe is inconclusive concerning the effect of spectrum aggregation caps.

[28] Erhvervsstyrelsen states on its homepage: "To improve the competition on the market for mobile communication these licences [were] only made available for new entrants through an auction." Danish Business Authority, *available at* http://dba.erhvervsstyrelsen.dk/900-1800-mhz-auction.
[29] *See* Swedish Post and Telecom Agency (PTS), Press release: "The 800 MHz auction is closed—three bidders won licenses" (Mar. 4, 2011), *available at* http://www.pts.se/en-gb/News/Press-releases/2011/Press-release/.
[30] The Mobile Future report utilized a sample of auctions that seemed rather arbitrary. Such an approach suggests that the authors cherry-picked the auctions that fit their line of argument. As stated above, in this report we include all recent spectrum auctions from large European economies with spectrum in the bands below 1 GHz, listed by date.

6. Spain – multiband auction – 2011

In 2011, Spain auctioned a total of 79.6 MHz in the bands below 1 GHz. No bidder was allowed to purchase spectrum that would give it more than 38% of the overall spectrum in the bands below 1 GHz. The auction raised a total of EUR 1.6bn which was in line with the expectations of the Ministry of Industry. The Ministry said that the auction results will have a "positive repercussion in reducing Spain's public deficit and public debt."[31]

7. Italy – multiband auction – 2011

One of the auctions that exceeded the expectations was the Italian 2011 multiband auction. Among other spectrum, 60 MHz of sub 1 GHz spectrum were auctioned and none of the operators could acquire spectrum that would give it more than 39% of the available spectrum below 1 GHz. The auction raised EUR 3.9bn, well above the budgeted revenue of EUR 2.4bn.[32] After the close of the auction, the Italian Industry Minister Paolo Romani stated: "It is an amazing achievement, which places Italy in a more advanced position than most of Europe. In a difficult market situation, we managed to attract a large amount of investment. The total proceeds go beyond expectations."[33]

8. Portugal – multiband auction – 2011

In 2011 the Portuguese regulator ANACOM awarded 82.5 MHz of spectrum in the bands below 1GHz. No bidder was allowed to purchase more than 34% of the available spectrum in the bands below 1 GHz. All lots were sold by their reserve prices. While some spectrum was not even sold, in the 800 MHz band all spectrum was allocated. One explanation brought forward for this result was that reserve prices had been chosen too high.[34]

9. France – multiband auction – 2011

In 2011, the French regulator ARCEP awarded 60 MHz of spectrum in the 800 MHz band. The auction raised EUR 2.6bn. A spectrum aggregation limit was imposed such that after the auction no bidder could hold more than 39% of the available spectrum in the bands below 1 GHz. In the result of the auction, however, the spectrum aggregation limit, though applicable to the auction, did not come

[31] See Cullen International, *Spectrum Award Report: Spanish 4G auction awards 270 MHz for EUR 1.647bn* (Sept. 2011).
[32] See Cullen International, *Spectrum Award Report: Italy 2011 auction* (Sept. 2011).
[33] *See* Benny Har-Even, "Italy LTE spectrum auction exceeds expectations," Telecoms.com (Oct. 6, 2011), *available at* http://www.telecoms.com/34352/italy-lte-spectrum-auction-exceeds-expectations/.
[34] See Cullen International, *Spectrum Award Report: Portugal 2011* (Apr. 2012).

into play because no bidder exceeded the applicable spectrum-aggregation threshold.[35] The results exceeded the government expectations who aimed to raise EUR 1.8bn in the auction.[36]

10. Denmark – 800 MHz auction – 2012[37]

In 2012 the Denmark Business Authority, Erhvervsstyrelsen, auctioned 60 MHz of spectrum in the 800 MHz band. The auction raised EUR 99m. The main goal of Erhvervsstyrelsen in this auction was to ensure that 800 MHz spectrum would be utilized to improve high speed broadband availability in new and existing markets across Denmark.[38] This goal was reflected in the auction design,[39] where bidders could bid on different degrees of exemptions from coverage obligations.[40] The relatively low reserve prices of 0,06 EUR/MHz/pop ensured that in the end all low frequency spectrum was assigned in the auction and the coverage obligations were met.[41]

11. Ireland – multiband auction – 2012

In the Irish spectrum auction in 2012, among other spectrum a total of 70 MHz of spectrum below 1 GHz was auctioned. The spectrum aggregation limit required that no bidder could bid for more than 31% of the available spectrum in the bands below 1 GHz. The auction was considered a success by the Irish regulator ComReg. Its Chairperson Alex Chisholm stated: "On behalf of ComReg, I am delighted that the process has been completed successfully with 140 MHz of paired spectrum released to operators in a competitive and efficient process, which has also raised approximately €854 million through the release of this valuable spectrum."[42] Moreover, the Communications

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[35] *See,* Cullen International, *Spectrum Award Report: France 2011 – 800 MHz* (Apr. 2012).

[36] *See* "France gets four bids in 4G auction," Reuters (Dec. 15, 2011), *available at* http://www.reuters.com/article/2011/12/15/us-francetel-idUSTRE7BE0TZ20111215.

[38] *See* Danish Business Authority, 800 MHz Auction Information Memorandum, Auction Objectives, Section 1.1 (Mar. 2012), *available at* http://erhvervsstyrelsen.dk/file/251159/information-memorandum-800mhz-auction.pdf ("Danish Information Memorandum").

[39] *See id.* at Section 2.2.2.

[40] The coverage obligation was initially attached to all blocks. In the auction, bidders could bid for exemptions from the coverage obligation alongside the spectrum they wished to acquire. Winning a particular regional exemption would exempt the licensee from serving the coverage obligation in that region and winning all regional exemptions would exempt the licensee from the obligation completely. Therefore unlike in other European countries where the coverage obligation had been attached to specific lots, the Danish auction supported a range of spectrum and coverage obligation assignment outcomes. *See* DotEcon, "Digital Dividend, the Danish way," DotEcon Perspectives (Autumn 2012), *available a*t http://www.dotecon.com/assets/images/perspec10.pdf.

[41] *See* DotEcon, "Danish 800 MHz auction completed" (June 2012), *available at* http://www.dotecon.com/news/ danish-800mhz-auction-completed/.

[42] *See* Commission for Communications Regulation (ComReg), Media Release: "ComReg Announces Results of its Multi-Band Spectrum Auction" (Nov. 15, 2012), *available at* http://www.comreg.ie/publications/media_release_-_comreg_announces_results_of_its_multi-band_spectrum_auction.583.104237.p.html.

Minister of Ireland Pat Rabbitte said: "The proceeds of the auction are greater than many people expected and are a statement of confidence in the economy."[43]

12. Austria – multiband auction – 2013

In 2013, Austria auctioned, among other bands, a total of 70 MHz of spectrum in the bands below 1 GHz. A spectrum aggregation limit was employed that limited each bidder to acquire at most 54% of the available spectrum. The auction generated total revenue of EUR 2bn well above the expectations of the Austrian regulator who stated that "From the point of view of the regulation authority, the surprisingly high price of above EUR 2bn is due to the sustainably aggressive behavior of the bidders."[44]

13. Finland – 800 MHz auction – 2013

In 2013, the Finish regulator FICORA auctioned a total of 60 MHz of spectrum in the 800 MHz band. No bidder was allowed to bid on spectrum that would give it more than 42% of the available spectrum in the bands below 1GHz. The auction yielded revenue of EUR 108m. However, the auction rules were ill designed, and did not require that bidders increase their offers in every round of bidding, causing bidders to be stuck for 9 months and 993 rounds in an endless bidding cycle.[45] In September 2013 the auction was halted to make adjustments to the rules unrelated to the spectrum aggregation limit.[46] However, the market players opposed revising the auction rules and the auction was concluded quickly after the break.[47]

14. Czech Republic – multiband auction – 2013

In 2012, the Czech Republic initiated an auction of 60 MHz of spectrum in the 800 MHz band. However, the auction was quickly stopped due to excessively high prices, with the government expressing concern that the bids were "economically unrealistic." [48] To address this problem, the Czech government revised the rules for a re-auction taking place in 2013, and added to the existing

[43] *See* John Kennedy, "ComReg reveals 4G auction results – EUR 450m instant windfall for Irish Govt" (Nov. 15, 2012), *available at* http://www.siliconrepublic.com/comms/item/30238-comreg-reveals-4g-auction-r.
[44] *See* Rundfunk & Telekom Regulierungs-GmbH (RTR), Press release: "Telecom Control Commission ends Multiband Auction: Overall Result of the Auction is EUR 2,014bn" (Oct. 21, 2013) (own translation), *available at* https://www.rtr.at/de/pr/PI21102013_02TK.
[45] *See* "Finnish regulator to revise 800 MHz auction rules to speed up sale process," Telegeography.com (Sept. 5, 2013), *available at* http://www.telegeography.com/products/commsupdate/articles/2013/09/05/finnish-regulator-to-revise-800mhz-auction-rules-to-speed-up-sale-process/.
[46] *See* "Finland halts 800 MHz spectrum auction after 8 months," Telecompaper.com (Sept. 5, 2013), *available at* http://www.telecompaper.com/news/finland-halts-800-mhz-spectrum-auction-after-8-months--965058.
[47] See Cullen International, *Finnish 800 MHz auction yields EUR 108m* (Nov. 4, 2013).
[48] *See* Czech Telecommunication Office, Press Release: "The Czech Telecommunication Office decided to break off the auction" (Mar. 8, 2013), *available at* http://www.ctu.eu/main.php?pageid=342.

spectrum aggregation limit a 2x10 MHz set aside for new entrants.[49] The auction generated total revenue of EUR 311m. The Czech Telecommunication Office (CTO) stated in a press release that "Jiří Cieńciała, the Minister of Industry and Trade is also satisfied with the result of the auction."[50]

We conclude that, taking into account all recent spectrum auctions from the large economies in the European Union, in some cases expectations of regulators or other bodies were met, in some case exceeded and in some cases not met. Thus, comparing revenue expectations and results in Europe is inconclusive concerning the effect of spectrum aggregation caps.

IV. European regulators emphasize the special role of frequencies below 1 GHz

It should be evident from the previous chapters that European regulators assign a special role to spectrum below 1 GHz. In all countries but in the Netherlands spectrum aggregation limits were used for bands with sub 1 GHz spectrum. Even the Netherlands used set-asides in the sub 1 GHz spectrum bands and as part of the spectrum aggregation rule, with the weight given for sub 1 GHz spectrum much larger than for spectrum above 1 GHz.

To further emphasize the special role of sub 1 GHz spectrum, we cite from statements made by regulatory bodies in Europe concerning spectrum aggregation limits in the respective auctions.[51] The statements show that European regulators regard the distribution of sub 1 GHz spectrum to be of vital importance for a competitive mobile market. Thus the claims made by Mobile Future that low-frequency spectrum is not necessary to compete aggressively in the mobile market, and that "[i]nternational evidence confirms that there is no basis for regulatory policies that discriminate against operators holding low-frequency spectrum" cannot be aligned with the evidence from the European Union.[52]

Germany (2010): "Compared with high frequency spectrum, the 800 MHz frequencies have very good propagations characteristics and are relatively scarce […]. Thus, those frequencies should be treated separately and special provisions have to be made to ensure equal chances of access [for all operators]."[53]

[49] Press Release, "Czech Telecommunication Office announces the conditions of the new frequency auction" (Apr. 8, 2013), 1, *available at* http://www.ctu.eu/164/download/Press_releases/pr25_08042013_an.pdf.
[50] *See* Czech Telecommunication Office (CTO), Press Release: "Frequencies for the LTE networks auctioned off" (Nov. 19, 2013), *available at* http://www.ctu.eu/main.php?pageid=341&page_content_id=5597.
[51] We provide more detailed quotes from a larger sample of countries in the Appendix.
[52] *See* Verizon Letter, *supra* note 2, at 3; Mobile Future report, *supra* note 1, at 1.
[53] *See* BNetzA decision, *supra* note 24, at 62 (own translation).

Portugal (2011): "In particular, ICP-ANACOM, aware of the need to promote greater competition in electronic communications markets and taking into account the comments of the interested parties, considers that it is vital to impose spectrum caps on the frequency bands below 1 GHz […]."[54]

Ireland (2012): "[H]ighly asymmetric distributions of sub 1 GHz spectrum could be detrimental to competition downstream."[55]

The Netherlands (2012): "It is important that sufficient players have access to low frequencies to also retain the effective competition goal in the long term."[56]

Austria (2013): "All participants of the consultation consider spectrum below 1 GHz essential, respectively of great importance, for a cost-efficient operation of a nationwide network."[57]

UK (2013): "We consider there is a risk that consumers would place sufficient value on [the difference in outdoor coverage] that national wholesalers with a large amount of sub-1 GHz spectrum would have an unmatchable competitive advantage over those without any sub-1 GHz spectrum."[58]

These statements by European regulators on why they imposed spectrum aggregation limits or a set-aside for frequencies below 1 GHz show that they regard an even distribution of 1 GHz spectrum across mobile network operators as essential to sustain a competitive landscape.

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[54] *See* Autoridade Nacional de Comunicações (ANACOM), *Comments to the articles of the draft regulation—Limits to the Allocation of Spectrum*, Chapter II, Section I, Article 8 (Aug. 22, 2011), *available at* http://www.anacom.pt/render.jsp?categoryId=342106 ("ANACOM Comments").

[55] *See* Commission for Communications Regulation (ComReg), *Response to Consultation and Draft Decision: Multi-band spectrum release*, Document No. 11/60a (Aug. 24, 2011), *available at* http://www.comreg.ie/_fileupload/publications/ComReg1160a.pdf ("ComReg Response").

[56] *See* Dutch Ministry of Economic Affairs, Agriculture, and Innovation, *Regulation of the Dutch Ministry of Economic Affairs, Agriculture, and Innovation to establish the application and auction procedure for licenses for the frequency spectrum in the 800, 900 and 1800 MHz bands for mobile communication applications*, 36-37 (Jan. 6, 2012), *available at* http://www.agentschaptelecom.nl/sites/default/files/courtesy-translation-auction-rules.pdf ("Dutch Regulation").

[57] *See* RTR, *Results of the Consultation and Next Steps*, 6 (July 2011), *available at* https://www.rtr.at/en/komp/Erg_DD_Reframing/Ergebnisse_Konsultation_DD_Reframing.pdf (own translation).

[58] *See* Ofcom, *Annex 6: Competition Assessment, Consultation on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues*, 54 (Mar. 22, 2011), *available at* http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/annexes/Annex_6.pdf.

Conclusion

In this report it is shown that the claims made by Mobile Future and Verizon regarding the restrictiveness of the proposed spectrum aggregation limits, the revenue associated with spectrum aggregation limits and the importance of sub 1GHz spectrum are not supported by the evidence from the recent spectrum auctions in the large economies in the European Union.

Spectrum aggregation limit proposals in the US are in line with spectrum aggregation caps across the European Union.

Drawing conclusions regarding the effects of spectrum aggregation limits on revenue from the observation of whether expectations by regulators or other bodies are met is logically flawed. These expectations should have taken the limits and other specifics of the market and auction design into account. Even if one accepts that whether a revenue expectation by a regulator was achieved during the auction is somehow indicative of the revenue effects of spectrum aggregation limits, all recent European auctions have to be taken into account in the examination. Evidence then shows that there is no systematic bias in whether the expectations were met or not. Thus, the claim that spectrum aggregation limits had a negative effect on revenue is not supported by European data.

Regulators across Europe assign a special role to sub 1 GHz spectrum. This is reflected in the specific spectrum aggregation limits in the auctions and backed by explicit statements of European regulators.

Appendix I: Quotes by European regulators

The Swedish regulatory authority PTS comments on the value of low frequency spectrum in its decision prior to the 800 MHz auction in 2011: "The 800 MHz band is an extremely valuable resource for the Swedish electronic communications market, as the frequency band has very good propagation characteristics and very good preconditions for high speed services. The quantity of radio spectrum available is 2×30 MHz. In October 2009, PTS conducted a survey of the interest shown in licences to use radio transmitters in the frequency band and the findings demonstrated that there was great interest; in total 2×125 MHz was being requested. Demand for spectrum in the 800 MHz band consequently far exceeds the access to spectrum in this frequency band. As there is a lack of frequency, the number of licences may be limited and licensing shall thereby take place after an open invitation to apply has been issued and after a selection procedure."[59]

The Polish regulator UKE states in the invitation for public consultation concerning the 2013 multiband auction that "The 800 MHz band, due to its propagation characteristics, is perceived as one of the most optimal bands to ensure availability of wireless broadband services over large areas with low population density."[60]

ANACOM the Portuguese communication authority argues that "the introduction of spectrum caps contributes to the creation of more favorable conditions so that operators of different sizes may participate in the auction on equal terms, at the same time preventing any single entity (or a very reduced number of entities) from hoarding all the available spectrum in each one of those bands. In particular, ICP-ANACOM, aware of the need to promote greater competition in electronic communications markets and taking into account the comments of the interested parties, considers that it is vital to impose spectrum caps on the frequency bands below 1 GHz, where the scarcity of spectrum is greatest, with that restriction applying both in the 800 MHz and the 900 MHz. The bands in question permit the development of extensive coverage solutions more easily and at lower costs, and as a result there may be various entities interested in the acquisition of rights in those bands, in terms of operators that already hold rights of use of frequencies in equivalent bands and operators that do not yet hold those rights, but that intend to enter the market."[61]

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[59] *See* PTS, "Decision about licenses to use radio transmitters in the 791-821/832-862 MHz frequency band," Decision 10-10534, 4 (Dec. 13, 2010), *available at* http://www.pts.se/upload/beslut/radio/2011/10-10534-desicion-assignment-800mhz.pdf.

[60] *See* Republic of Poland, Office of Electronic Communications (UKE), *Public Consultations on Auction in the 800 MHz and 2.6 GHz* (Aug. 21, 2013), *available at* http://en.uke.gov.pl/public-consultation-on-auction-in-the-800-mhz-and-26-ghz-bands-12833.

[61] *See* ANACOM Comments, *supra* note 54.

The German regulator BNetzA justifies the introduction of spectrum aggregation limits with the statement: "Compared with high frequency spectrum the 800 MHz frequencies have very good propagations characteristics and are relatively scarce […]. Thus, those frequencies should be treated separately and special percussions have to be made to ensure equal access [for all operators]. […] By introducing a spectrum cap the chamber ensures a fair competition and promotes competitive markets."[62]

The Austrian mobile regulator RTR states in the public consultation prior to the 2013 multiband auction that "because of their propagation properties the sub 1 GHz frequencies are especially suited for a cost-efficient rollout of broadband services. Moreover, with those frequencies the provision of mobile broadband services indoors can be greatly improved. The consumers and the Austrian economy would benefit from a cost-efficient rollout of mobile broadband services using sub 1 GHz frequencies. The amount of such frequencies is very limited. […] All participants of the consultation consider spectrum below 1 GHz essential respectively of great importance for a cost-efficient operation of a nationwide network. […] The result of the [auction] will form the competitive landscape of the years to come."[63]

Comreg, the Irish regulator, writes: "While perfect symmetry in sub 1 GHz spectrum distribution between competitors is not necessary to facilitate competition, highly asymmetric distributions of sub 1 GHz spectrum could be detrimental to competition downstream."[64]

The French regulator ARCEP acknowledges the importance of sub 1 GHz frequencies indirectly by setting separate caps for sub 1 GHz and above 1 GHz frequencies and stating that "the system used to award frequencies must also satisfy the goal, set by the law, of ensuring fair and effective competition in the mobile market."[65]

Ofcom, the British mobile regulator, states that the "advantages [of sub-1 GHz spectrum] could mean that national wholesalers with a large amount of sub-1 GHz spectrum would have an unmatchable competitive advantage over those without any sub-1 GHz spectrum. By an unmatchable competitive advantage we mean that the national wholesalers without sub-1 GHz

[62] *See* BNetzA decision, *supra* note 24, at 62 (own translation).
[63] *See* RTR, *Results of the Consultation and Next Steps*, 6 (July 2011), *available at* https://www.rtr.at/en/komp/Erg_DD_Refarming/Ergebnisse_Konsultation_DD_Refarming.pdf.
[64] *See* ComReg Response, *supra* note 55.
[65] *See* Autorité de regulation des communications électroniques et des postes (ARCEP), Press release, "ARCEP publishes draft decisions on procedures for 800 MHz and 2.6 GHz frequency band allocations, which it has submitted to the Electronic communications advisory committee for feedback" (May 16, 2011), *available at* http://www.arcep.fr/index.php?id=8571&L=1&tx_gsactualite_pi1%5Buid%5D=1382&tx_gsactualite_pi1%5BbackID%5D=1&cHash=5774070235.

spectrum suffer a material competitive disadvantage because they are unable to develop their networks to offer services sufficiently similar to national wholesalers with sub-1 GHz spectrum. This would depend partly on technical differences between wholesalers with different spectrum portfolios and partly on how sensitive consumers are to any such technical differences, such as the quality of deep indoor coverage."[66]

The Dutch Ministry of Economic Affairs, Agriculture and Innovation writes in the context of the Dutch multiband auction: "Low frequencies are much scarcer than high frequencies. The quantity of the frequency spectrum in relation to the low spectrum is limited to such a degree and newcomers are so behind with regard to existing players that it cannot be excluded that the existing players may obtain all available low frequencies if threshold lowering measures are not implemented. It is important that sufficient players have access to low frequencies to also retain the effective competition goal in the long term. It has, therefore, been determined in the strategic policy documents that 2x10 MHz in the frequency spectrum in the 800 MHz band shall be reserved for newcomers in the auction."[67]

Appendix II: Biographical information on the authors

Prof. Achim Wambach, Ph.D. is professor for economics at the University of Cologne and speaker of the economic advisory board to the German Federal Ministry of Economics and Technology. He is principal investigator in the research unit "Design and Behavior: Economic Engineering" at the University of Cologne, focusing on market design and auctions. Wambach is a cofounder of TWS Partners AG, a consulting company specializing in the application of game theory and market design. He advised telecommunication companies in spectrum auctions across Europe.

Dr. Stephan Knapek is a partner at TWS Partners AG. He supports his clients mainly in the areas of competitive negotiation strategies and negotiation design projects. He has advised telecommunication companies in spectrum auctions across Europe and has also advised in the design of spectrum auctions. Prior to TWS Partners AG, he worked at McKinsey & Company, Inc.

Dr. Vitali Gretschko is a senior consultant at TWS Partners AG. He received a doctorate in economics for his work on applied auction theory. His expertise includes the design, simulation and

[66] *See* Ofcom, *Consultation on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues*, 42 (Mar. 22, 2011), *available at* http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/summary/combined-award.pdf.
[67] *See* Dutch Regulation, *supra* note 56, at 36-37.

implementation of auctions and other negotiations for complex, high-volume and strategic projects. Prior to TWS Partners AG, he worked at Accenture.