Sunrise – Frequency auction in Switzerland

Possible competition effects of the Swiss 5G spectrum auction under its proposed design

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FINAL VERSION

1   Executive summary

1.1   A total spectrum bandwidth of 475 MHz in the frequency blocks 700 MHz, 1,400 MHz, 2.6 GHz and 3.6 GHz will be awarded to Swiss MNOs in a coming auction.

1.2   This auction represents a rare opportunity to shape future competition in mobile services in Switzerland. The spectrum awarded to Swiss MNOs in that occasion will be key to their respective abilities to offer next-generation (5G) mobile services and to the cost, price and quality conditions under which they will be able provide those services.

1.3   The auction will take place within a highly concentrated telecommunication sector in Switzerland, where Swisscom holds a dominant position in both mobile service markets and fixed service markets. The current auction framework contains provisions (e.g. spectrum caps) which purport to limit the extent of spectrum concentration with any individual MNO.

1.4   Yet those caps still leave significant scope for Swisscom to increase its dominance by further improving its spectrum endowment. This concerns in particular the most valuable frequency bands (700 MHz and 3.6 GHz) for which, under the current auction caps, Swisscom can acquire a much larger share of spectrum than any of its rivals. As this would contribute to further strengthen Swisscom's dominant position in the supply of mobile services and its ability to exercise market power, this outcome could eventually cost above a billion CHF and up to CHF 2.73 billion to Swiss mobile customers over the 15 year license timeframe.

1.5   Consistently with Art. 23 para. 4 of the Swiss Telecommunication Act (FMG) which commands that the granting of a telecommunications license shall "*not eliminate or*

constitute a serious obstacle to effective competition"[1], the current auction caps should therefore be revised, in order to avoid the customer welfare costs attached to Swisscom's strengthening its dominance and the resulting distorted market structure and impaired competition. Conversely, this auction represents an opportunity to reinforce the future intensity of competition in the Swiss mobile market.

1.6   Swisscom is expected to increase its dominance by securing the maximum amount of spectrum permitted by the auction rules.

a.   Notwithstanding the fact that Swisscom has still failed to use all the spectrum acquired in the most recent auction,[2] the proposed caps give Swisscom the ability to acquire a significantly larger share of the spectrum auctioned than either of its smaller rivals, in particular in the frequency ranges that are the most valuable for next generation services (700 MHz and 3.6 GHz). Precisely, auction caps free Swisscom to win 47.4% of new spectrum[3] which would increase its spectrum holding from 44.3% to 45.7%.

b.   Swisscom is highly likely to acquire the maximal amount of spectrum allowed by the auction caps, as a result of its superior incentives to outbid competitors resulting from its established position in the Swiss mobile and fixed markets. Conversely, each of Sunrise and Salt would be expected acquire significantly less spectrum. As one of them will win no more than one 700 MHz FDD block (and may get none) and/or could get not even a third of Swisscom's endowment in the 3.6 GHz band, it will face a significant risk of becoming marginalized as a result of holding insufficient spectrum in the most relevant frequency ranges.

1.7   Swisscom's incentives to outbid competitors are related to its superior ability to monetize spectrum on its mobile customer base which is thrice larger than that of any other MNO, also because of its well-developed network infrastructure and its broader frequency portfolio, which allow Swisscom to leverage superior scale and scope economies.

1.8   Swisscom's incentives also relate to the aim of preserving its incumbency rents earned on both mobile and fixed services and protecting those rents against increased competition by rival MNOs. This is a direct by-product of Swisscom's dominant position of these markets.

1.9   The incumbent's superior incentives to outbid rivals, which have been stressed in the academic literature on spectrum auctions,[4] are illustrated by the outcome of recent spectrum auctions in Europe, in which the largest players have secured more and/or a better balanced spectrum endowment than their smaller rivals did, in any case bidding up to the limits imposed by the auction rules. Thus, in a very asymmetric market as in Switzerland,

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[1]   784.10 Telecommunications Act of 30 April 1997 (Status as of 1 January 2018)
https://www.admin.ch/opc/en/classified-compilation/19970160/index.html#a23

[2]   See Appendix A.

[3]   Under the current auction framework,Swisscom could win up to 3 blocks in the 700 MHz FDD band, 9 blocks in the combined 700 MHz SDL band and 1400 MHz SDL band, 1 block in the 2.6 GHz FDD band, and 7 blocks in the 3.6GHz TDD band.

[4]   Jehiel, Philippe, and Benny Moldovanu. "An economic perspective on auctions." Economic Policy 18.36 (2003): 269-308. Cramton, Peter, et al. "Using spectrum auctions to enhance competition in wireless services." The Journal of Law and Economics 54.S4 (2011): S167-S188.

auctioning spectrum without sufficient safeguard is bound to reinforce the existing dominant position of Swisscom.

1.10 Swisscom acquiring the maximum possible amount of spectrum allowed by the current caps creates a very significant risk of harm to competition in the Swiss mobile service markets, which could cost over CHF 1.37 billion and up to CHF 2.73 billion to Swiss customers over the 15 year license timeframe.

a. By enlarging Swisscom's spectrum endowment relative to its rivals, it would reinforce Swisscom's already dominant position, by conferring a next generation service capability and cost advantages that other MNOs would not be able to match. It would thereby maintain the significant market concentration and reinforce the asymmetry that characterizes the Swiss mobile market as compared to other European mobile markets. This shall translate into an upwards lift of mobile service prices in Switzerland.

b. Swisscom acquiring spectrum up to the auction cap would increase spectrum in use concentration by an additional six (6) percentage points. Assuming that this increase in spectrum endowment results in a three times lower increase in market share of 2 percentage points, and using estimates of the impact of concentration upon prices in retail mobile markets derived from a cross-country empirical analysis co-authored by the European Commission DG COMP's chief economist[5], the price increases that would result from increased concentration could cost Swiss customers between CHF 1.37 billion and CHF 2.73 billion over the license 15 year timespan.

c. The likely anticompetitive effects and resulting customer welfare losses of increased concentration in mobile markets is further attested by the outcome of the reviews of several mobile mergers by the European Commission. These dwarf the potential efficiency effects of concentrating spectrum to leverage scale and scope economies. This is why several academic contributions[6] have warned against large disparities in spectrum endowments and have emphasized that a welfare-maximizing auctioneer should aim at symmetric spectrum endowments, in a way that equalize the MNOs' service capabilities and costs and thereby stimulate intense product market competition.

d. To fulfill an objective of preserving effective competition and thereby maximizing customer welfare, as opposed to maximizing the auction proceeds, the coming Swiss spectrum auctions should thus involve more stringent safeguards than currently proposed. These should guarantee that each MNO will be endowed with the right quantity of spectrum and the right mix of frequencies needed to compete effectively for the provision of next-generation services.

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[5] Genakos, Christos, Tommaso Valletti, and Frank Verboven. "Evaluating market consolidation in mobile communications." Economic Policy 33.93 (2018): 45-100.

[6] Peha, Jon M. "Cellular economies of scale and why disparities in spectrum holdings are detrimental." Telecommunications Policy 41.9 (2017): 792-801. Hazlett, Thomas W., and Roberto E. Muñoz. "A welfare analysis of spectrum allocation policies." The RAND Journal of Economics 40.3 (2009): 424-454. Rey, Patrick, and David Salant. "Allocating essential inputs." (2018).

2 Swiss 5G spectrum auction

A bandwidth of 475 MHz will be awarded through the Swiss 5G spectrum auction.

2.1 In November 2017, the Swiss Federal Council decided to auction off all available blocks in the frequency bands 700 MHz (second digital dividend), and in 1,400 MHz, and a part (e.g. 300 MHz) of the available blocks in 3.6 GHz, and the remaining frequencies in the 2.6 GHz band.[7] Overall, a bandwidth of 475 MHz will be awarded through this auction.

2.2 This new allocation of spectrum in Switzerland is in response to the ever growing volume of data transferred through mobile networks, following the increase market penetration of smartphones, the growing number of devices and objects connected wirelessly and constant increases in data usage.[8] According to the Swiss government, these frequencies will be critical to overcome current capacity bottlenecks in current 4G networks and will also be important for the future development of 5G services,[9] notwithstanding the high-frequency spectrum has been reduced compare to what was initially announced in the consultation paper issued in Summer 2017.

2.3 The frequency blocks which will be awarded have different technical transmission properties and therefore unequal range and bandwidth capacities.

   a. The low frequency spectrum (700 MHz band) is well suited to provide mobile service coverage in sparsely populated, rural areas as it is more cost effective to implement than higher frequency spectrum. Low frequencies may also be used to provide mobile service deep-in-building coverage in urban area. In particular, the use of lower frequency bands for 5G will be necessary for implementing machine-type communication services, including the ability to support a massive number of low cost Internet of Things connections (e.g. thermostats, cars, lights, refrigerators) with very long battery life and wide coverage including inside buildings.

   b. The higher frequency spectrum (e.g. 3.6 GHz band) is more suited to provide network capacity in dense, urban areas where data traffic is heavy. In particular, higher frequencies will support multi-gigabit per second data rates for applications like augmented reality, 3D video and 4k/8k screens. It will also support low latency (sub-1ms) and very high availability, reliability and security, which will be critical for services such as autonomous vehicles and mobile healthcare.

2.4 These frequency blocks should thus be considered as complements rather than (imperfect) substitutes to each other for the purpose of offering different mobile services. As a consequence, a balance of endowment in between frequency bands would be required to support certain next-generation services.

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[7] Frequency ranges were identified for IMT systems at the World Radiocommunication Conference organized by ITU in November 2015. https://www.itu.int/en/ITU-R/conferences/wrc/Pages/default.aspx

[8] https://www.bakom.admin.ch/bakom/en/homepage/telecommunication/facts-and-figures/statistical-observatory/broadband/mobile-networks1.html

[9] https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-68725.html

Despite the existence of safeguards, Swiss spectrum auction outcome could reinforce market asymmetry and negatively impact competition for mobile services.

2.5   The spectrum portfolio held by each Swiss MNO at the conclusion of the auction will have an influence over the type and quality of mobile services that this operator will be able to deliver on its network, in both their coverage and capacity dimensions. Therefore, MNOs' respective spectrum endowments will condition the nature and extent of competition for the supply of mobile services.

2.6   Spectrum caps have been introduced in order to limit the quantity of each type of frequency blocks that one (or several) operator(s) can acquire. In particular, Swisscom's bids will be subject to the following spectrum caps:[10]

    a.   A maximum of three blocks in the 700 MHz FDD band;

    b.   A maximum of seven blocks in the 3.6GHz TDD band; and

    c.   A maximum of nine blocks in the combined 700 MHz SDL band and 1400 MHz SDL band (meaning a maximum of 45 MHz SDL spectrum across both SDL bands).

2.7   In addition, a cumulative bid restriction applies to ensure that two bidders together cannot acquire more than 5 blocks in the 700 MHz FDD band, as long as there is at least one other bidder who is interested in a block in this band.

2.8   Under the current auction design, Swisscom could therefore acquire up to a maximum of 3 out of the 6 blocks in the 700 MHz FDD band and 7 out of the 15 blocks in the 3.6GHz TDD band.

2.9   If this happens, the other contenders, Salt and Sunrise, will be left to compete for the remaining blocks, i.e. 3 blocks of 700 MHz FDD and 8 blocks of 3.6 GHz TDD. Therefore, one (or both) of Swisscom's rivals [Salt and/or Sunrise] will at the best end up with a relatively asymmetric portfolio of frequency spectrum, which will not have the same degree of complementarity between frequency blocks as Swisscom does, and at the worst end up with a narrow spectrum portfolio, lacking 700 MHz FDD completely and lacking 3.6 GHz TDD bands for the main part for example.

2.10   Precisely, amongst possible outcomes of the spectrum auction:

    a.   One MNO [Salt or Sunrise] would acquire up to 2 blocks of 700 MHz FDD and 7 blocks in the 3.6 GHz TDD. The other MNO [Salt or Sunrise] would be left with at most 1 block in the 700 MHz FDD band and 1 block in the 3.6 GHz TDD. In such a scenario, [Salt or Sunrise] would end up with a narrow spectrum portfolio, as compare to the other two MNOs.

    b.   One MNO [Salt or Sunrise] would acquire 2 blocks of 700 MHz FDD and 4 blocks in the 3.6 GHz TDD. The other MNO [Salt or Sunrise] would be left with at most 1 block in the 700 MHz FDD band and 4 blocks in the 3.6 GHz TDD. One MNO [Salt or Sunrise] would therefore end up with an asymmetric spectrum endowment, actually awarded without 700 MHz.

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[10]   Comcom (2018), "Version for Consultation Auction of Frequency Blocks for the Nationwide Provision of Mobile Telecommunications Services in Switzerland."

2.11   This assumes that all blocks would be allocated. However, Sunrise and Salt could decide not to bid for only one block in the 700 MHz band. In which case, one block could be left unallocated, so that Swisscom could be in a position to secure 3 out of the 5 blocks in the 700 MHz band.

2.12   Hence, there is a possibility that one (or both) of the smaller MNOs [Salt and/or Sunrise] obtains a very limited amount of additional spectrum compared to Swisscom – in some frequency bands at least.

2.13   We show in the following that this asymmetric auction outcome is not only possible but also very likely. It would reinforce the current asymmetry in market structure and strengthen Swisscom's position.

3   The expected impact of the Swiss mobile market structure on the likely spectrum auction outcome

It is likely that Swisscom will acquire frequency blocks up to the auction caps.

3.1   Given the pre-auction market structure in the Swiss telecommunication services, the spectrum auction entails a very significant risk of further strengthening Swisscom's dominant position and thereby of dampening competition between MNOs.

3.2   This is so because Swisscom is highly likely to acquire frequency blocks up to the auction caps, since in the pre-auction situation:

a.   Swisscom holds a market share close to 60% in terms of customers of residential mobile services.[11] This market share, which stands largely above the single dominance market share threshold of 50%, is three times larger than that of any of its rivals. It is also more than 1.5 times larger than the average market share for incumbents in other European countries.[12] Similar observations can be made on revenue market shares.[13]

b.   Swisscom has a well-established position in fixed services. In 2016, Swisscom is the dominant market participant with about 53% market share for broadband internet services,[14] well ahead of its two other main competitors, Cablecom which holds a 20% market share and Sunrise which holds a 9% market share. Again, Swisscom's market share in fixed services stands above the single dominance threshold and is more than 1.5 times larger than the average market share held by other incumbents in European countries.[15]

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[11]   https://www.bakom.admin.ch/bakom/en/homepage/telecommunication/facts-and-figures/statistical-observatory/structure-of-the-market-and-employment/market-shares-on-mobile-networks.html

[12]   Bakom (2016)," Le marché suisse des télécommunications en comparaison internationale", available at: https://www.bakom.admin.ch/bakom/fr/page-daccueil/telecommunication/faits-et-chiffres/etudes/analyse-generale.html, hereafter "Bakon (2016)".

[13]   Companies annual reports.

[14]   https://www.bakom.admin.ch/bakom/en/homepage/telecommunication/facts-and-figures/statistical-observatory/structure-of-the-market-and-employment/internet-access-market-shares.html

[15]   Bakom (2016), p.30.

c. Swisscom already holds the largest and most diversified portfolio of frequencies amongst the three MNOs.[16] During the 2012 spectrum auction, which concerned all frequencies that could be used for Swiss mobile networks,[17] Swisscom purchased a total of 255 MHz (or 44.3% of the available spectrum awarded in the auction), while Salt and Sunrise each acquired 160 MHz only (or about 27.8% of available spectrum). Table 1 in Appendix shows in particular Swisscom's stronger endowment in 1,800MHz, 2.1 GHz and 2.6 GHz bands at the conclusion of the 2012 spectrum auction.

3.3 As a consequence of the above, Swisscom is in a better position to monetize the spectrum tendered by the Swiss government than any other MNO would:

a. Swisscom will be able to offer new or enhanced services permitted by the additional spectrum to a thrice larger set of customers than for any other MNO.

b. Swisscom will benefit from stronger scale economies at network operation level than its rivals would, insofar as (i) Swisscom is endowed with more spectrum than its rivals so it will benefit more from its network infrastructure, and (ii) Swisscom is likely to have the most developed network[18] and will benefit more from every new MHz of spectrum than a MNO with a lesser developed network.[19]

c. Due to its broader frequency portfolio and its superior ability to optimize the combination and utilization of different frequency blocks, Swisscom shall have a superior ability to effectively deliver full range of 5G services[20] and/or ensure a higher quality of services than would its competitors, in both its coverage and capacity dimension.[21] Conversely, smaller rivals may not be able to offer certain services, for lack of the adequate frequencies, or match Swisscom's quality of services, for lack of an equivalent bandwidth.

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[16] See Appendix A.

[17] A total of 2 x 265 MHz for FDD usage, distributed among the five frequency bands 800, 900, 1800, 2100 and 2600 MHz, and 1 x 45 MHz for TDD usage in the 2600 MHz band were allocated to the mobile network operators Salt, Sunrise, and Swisscom.

[18] Swisscom holds approximately 8,400 antenna sites out of the 11,683 antenna sites in Switzerland, or about 72% of them.
http://reports.swisscom.ch/download/2017/en/swisscom_geschaeftsbericht_gesamt_2017_en.pdf
(Swisscom's number of antenna sites); and
https://www.bakom.admin.ch/bakom/en/homepage/frequencies-and-antennas/location-of-radio-transmitters.html (total number of antenna sites in Switzerland).

[19] A MNO's mobile network capacity increases proportionally with the number of towers times spectrum holding. The MNO with the most towers will therefore benefit the most from another 10 MHz of spectrum, and the MNO with the most spectrum will benefit the most from another tower. See Peha, Jon M. "Cellular economies of scale and why disparities in spectrum holdings are detrimental." *Telecommunications Policy* 41.9 (2017): 792-801.

[20] See paragraph 2.3.

[21] This is all the more true as 2.6 GHz TDD bands can also benefit from TDD massive MIMO, which is expected to have much higher spectral efficiency than FDD bands. This would further exacerbate Swisscom's spectrum advantage as it is the sole operator that was awarded frequency bands in the 2012 spectrum auction. See Qualcomm (2017), "Making 5G a reality".

3.4   Swisscom will also have stronger incentives than those of its rivals to protect its established position and corresponding rent by pre-empting the spectrum auctioned. These stronger incentives relate to Swisscom's established position in both mobile services and in fixed services.

   a. In respect of mobile services, Swisscom would have a stronger incentive to hamper competition than any other MNO. This is so because Swisscom's customer base is three times larger than that of any of its rivals and shall entail a larger number of high-margin customers than its rivals. We note in this regard that Swisscom's mobile ARPU is by far higher than the ARPU of any other MNO[22] and its EBITDA margin is well above the one of Sunrise.[23] Swisscom would therefore suffer more than any other MNO from an intensification of competition that would result in lowering the earnings made on its customers. These higher margins also give Swisscom the ability to outbid rivals for any available spectrum.

   b. In respect of fixed services, Swisscom also holds a strong position that it would aim to protect from substitution by 5G services. We observe that the extent of substitution between fixed and mobile data services is bound to increase with the introduction of more bandwidth and capacity permitted by the new spectrum, in particular with the high frequency (e.g. 3.6 GHz) blocks that allow boosting capacity in dense areas, and (almost) unlimited capacity that until now only fixed infrastructure could. At equivalent quality of service, consumers may favour wireless data services over equivalent fixed data services because they value indoor mobile connectivity. We also note that Sunrise and Salt do not have their own fixed infrastructure. Moreover, Sunrise only has a limited market share in fixed services (which is only one-sixth of Swisscom's) and that Salt has only recently announced fixed services, therefore that none of them would have any comparable incentives to protect profits earned on fixed services.

3.5   Thus, Swisscom would be better positioned and have stronger incentives to consolidate its portfolio of frequencies than other MNO would. As a consequence, the auction is likely to result in Swisscom acquiring the maximum of available frequency blocks up to the auction caps even if not to use them as the fact Swisscom still has not used a part of the acquired frequencies would suggest.

3.6   Conversely, with smaller market shares, smaller players [Salt or Sunrise] would be eager to pay a fraction of what Swisscom would be eager to pay, and so would only be expected to obtain a limited amount of additional spectrum compared to Swisscom.

3.7   Precisely, if Swisscom acquires the maximum available frequency blocks up to the auction caps, Salt and Sunrise would have to compete for the few remaining available frequency blocks. One of the two MNOs (if not both) will certainly end up with a spectrum endowment that is less than half as important than Swisscom's endowment, especially in the 700 MHz

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[22]   In Q4 2017, Swisscom (blended) mobile ARPU was 35 CHF, as compare to 31.5 CHF and 31.5 CHF for Sunrise and Salt respectively. Swisscom is therefore serving higher value customers as compare to its rivals. Companies annual reports.

[23]   In Q1-Q3 2017, Swisscom's EBITDA margin is 41% as compared to 33% only for Sunrise. Companies annual reports.

FDD and the 3.6GHz TDD bands. In other words, one (or both) of Swisscom's rivals [Salt and/or Sunrise] will at the best end up with a relatively asymmetric portfolio of frequency spectrum and at the worst end up with a narrow spectrum portfolio, lacking 700 MHz FDD and 3.6 GHz TDD bands for example.[24]

3.8 The asymmetry of spectrum endowments between Swisscom and its rivals could be such that Sunrise and/or Salt would not be able to match Swisscom's quality of new-generation services and would have no choice but to offer deteriorated services. As a consequence, they could get rapidly excluded from the provision of (certain) next-generation services and could eventually be marginalized in the broader provision of mobile services, as and when those shift to next generation services. This is so because:

a. A balanced mix of spectrum in complementary frequencies will be important for delivering widespread coverage (e.g. 700 MHz band) and supporting all use cases with enough capacity (e.g. 3.6 GHz band),[25] especially in the context of the development of 5G services. Absent an adequate amount of spectrum in the different frequency bands, Salt and/or Sunrise would not be able to offer a full set of 5G services,[26] which in turn would limit their ability to effectively compete with Swisscom. Under the two possible auction outcomes foreseen above, Salt or/and Sunrise would therefore not necessary be able to provide data intensive next-generation services, or eventually under deteriorated conditions.

b. If endowed with a relatively narrow spectrum portfolio, Sunrise or/and Salt would likely experience capacity constraints unless they deploy more sites to add capacity. However, if undertaking costly network investments to increase capacity,[27] they would find themselves at a cost disadvantage vis-à-vis Swisscom insofar as capacity cost is minimized when spectrum endowment and site deployment are well balanced.[28]

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[24] See paragraphs 2.9 to 2.12.

[25] As explained above, 5G network environment is not expected to be homogeneous but would likely consist in the combination of a thin low capacity layer providing wide area coverage with limited capacity at 700 MHz and supporting machine-type communication services, with 3.6 GHz block providing high capacity in areas of high demand.

[26] See paragraph 2.3.

[27] According to a theoretical modelling by former Chief Technology Officer of the US FCC, J. Peha, the number of cells towers that a MNO should deploy in order to meet a given capacity level (expressed in Mb/s per square km) is inversely proportionate to spectrum holding. It means that a MNO [Swisscom or/and Salt], which would acquire two times less spectrum that Swisscom in the spectrum auction, would have to deploy about two times more cells towers that Swisscom would. This could in turn lead to higher fixed costs but also higher variables costs associated to the operation of cells towers. See Peha, Jon M. "Cellular economies of scale and why disparities in spectrum holdings are detrimental." *Telecommunications Policy* 41.9 (2017): 792-801.

[28] One cannot rule out that a smaller MNO strikes a network sharing agreement with another MNO endowed with the right amount spectrum, to compensate for its deficit in certain frequencies. However, the commercial terms of that agreement are likely to put the smaller MNO at a cost disadvantage compared to its host.

The likelihood of Swisscom pre-empting the maximum possible spectrum is supported by general economic principles and empirical evidence from recent auctions

3.9 Academic research confirms that in a spectrum auction without adequate safeguards, the dominant operator is likely to get a larger share of spectrum than any of its rivals, because it is likely to have a larger willingness to pay for it.[29]

3.10 This hinges on the fact that an incumbent and/or dominant operator has generally more to lose upon losing an auction that its smaller rivals have to win, first because it is better placed to monetize the additional spectrum acquired through the auction than smaller rivals are, because of e.g. a larger customer base, a more comprehensive network infrastructure and usually a better pre-existing spectrum endowment. This is also because the incumbent also has stronger incentives to protect its established position from an increased competition by its rivals, than its rival do – simply because these latter have less to protect.[30] This latter effect need not be limited to mobile services.[31]

The above is further confirmed by empirical evidence on past auctions in European countries confirming that main players have won the bulk of the spectrum for sale in these auctions and/or acquired spectrum up to the limits imposed on them in these auctions.

3.11 Table 3 in Appendix provides a summary of eight recent spectrum auctions in major European countries that have been held between 2010 and 2013. This sample involves countries with asymmetric pre-auction market structures, featuring either an incumbent (Netherlands, Austria) or the top two MNOs (Germany, Spain, Italy and Portugal) positioned well ahead of their rivals in terms of market shares.

3.12 This table shows in particular that with asymmetric market structures, unless there are specific provision precluding this, incumbents and/or front runners tend to acquire a most significant share of spectrum. This holds particularly for low frequency blocks, in which the incumbent (or the front runner) tends to secure a much larger share of spectrum than other contenders. As a series of illustration

    a. In the 2011 Spanish spectrum auction, the largest Spanish MNOs (Telefonica, Vodafone and Orange) won the same amount of 800 MHz spectrum. However, the third largest

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[29] Jehiel, Philippe, and Benny Moldovanu. "An economic perspective on auctions." *Economic Policy* 18.36 (2003): 269-308.

[30] See e.g. Cramton, Peter, et al. "Using spectrum auctions to enhance competition in wireless services." *The Journal of Law and Economics* 54.S4 (2011): S167-S188. This is an instance of the "*efficiency effect*" which can explain the persistence of monopoly position and which simply derives from the fact that a monopoly can earn larger profits than a duopoly would. See e.g. Tirole, Jean, *The theory of industrial organization*, MIT press, 1988, Chapter 8. This effect extends to asymmetric market situations in which higher concentration (a higher share of profit for the dominant firms) coincides with higher industry profits.

[31] We note that, with an increasing extent of fixed-mobile substitution for data services, the "business stealing" effect attached to additional spectrum for the incumbent's rivals can also affect the fixed service sales of the incumbent.

MNO (Orange) won the "impaired" 800 MHz spectrum, which have much less value. Also, none of the entrants (more than 8) won any low frequency blocks.

b. Similarly, in the 2013 Austrian spectrum auction, Telekom Austria and T-Mobile acquired respectively 54% and 38% of the 800 MHz spectrum that were auctioned. Hutchinson 3, the third MNO, was left with only a single 10MHz block in the 900 MHz band, or less than 10% of the sub 1GHz band spectrum which was auctioned.

In the vast majority of European auction taking place in countries with asymmetric market structure, safeguards were implemented to limit the extent of spectrum concentration with any individual MNO.

3.13   Table 3 in the Appendix also shows that incumbents and/or front runners tend to acquire up to the caps set by the auctioneer, limiting correspondingly the amount of spectrum accessible to their rivals. As an illustration,

a. In the 2010 German spectrum auction, the two leading MNOs (Vodafone and Deutsche Telekom) acquired up to the cap of 20 MHz each out of 60 MHz on offer in 800MHz bands. Telefonica won the remaining "impaired" 20 MHz while E-Plus did not acquire spectrum in the sub 1GHz band.

b. In the 2011 Italian spectrum auction, the MNO with the weakest pre-auction market share (3 Italia) won no 800 MHz spectrum.

c. In the 2012 Portuguese spectrum auction, all three MNOs acquired a maximum of 20 MHz cap out of 60 MHz on offer in 800MHz bands.

3.14   For high frequency blocks, while incumbents and/or front runners may not get the largest share, they are never marginalized – while smaller MNOs sometimes do. As an illustration,

a. In the 2012 Dutch spectrum auction, a new entrant (Tele2) won the two set-aside blocks in the 800MHz bands, but did not acquire any high frequency spectrum, as there was no specific restriction on these blocks. The other new entrant, Ziggo, was left with no spectrum.

b. In both the 2013 UK auction and the Austrian auction, Hutchison 3, the third largest MNO in these countries, was left without any high frequency band.

c. In auctions where even small MNOs could acquire spectrum in high frequency bands, some blocks in high frequency band were left unsold, as in Portugal and in Italy. This could indicate that this frequency was not considered as valuable from incumbents' point of view.

3.15   As a straight consequence of the above, incumbent and front runners always end up with a relatively balanced portfolio of spectrum, with significant endowments in different frequency bands, while this was not the case for several of their rivals MNOs which could end up being weakly endowed in one band or the other.

4   Negative welfare consequences of the likely auction outcome

4.1   Spectrum endowment is a significant driver of a MNO's competitive position, because it affects its capacity to serve numerous customers, the quality of its services and the cost conditions under which it supplies those. As such, it is a determinant of the MNOs' market

shares and their respective ability to exercise market power.[32] The auction outcome is likely to increase the asymmetry in spectrum endowments between Swisscom and other MNOs, thus to increase Swisscom's dominance in the mobile markets in Switzerland, ultimately to the detriment of Swiss customers.

The negative welfare impact of Swisscom acquiring the lion's share of spectrum would offset potential efficiencies.

4.2   Theoretical and empirical academic research suggests that the negative welfare consequences of distorted retail competition between MNOs as a result of asymmetric spectrum allocation would offset the potential efficiencies from granting the largest share of spectrum to Swisscom. Three recent articles reach that same conclusion from three different angles.

   a. Peha (2017) has developed a theoretical cost model to investigate the presence of scale economies in cellular network and the consequences of disparities in spectrum holding.[33] His purpose is to assess how to best divide spectrum resources among MNOs given economies of scale, in the face of two conflicting objectives: optimizing mobile network costs through e.g. concentration in spectrum holding in order to benefit from scale economies and increasing competition.[34] Examining the Pareto-optimal division of spectrum and network towers with respect to these two conflicting objectives, Peha shows that any Pareto optimal assignment will split the spectrum fairly evenly among competing mobile operator. This means that a symmetric situation which coincides with the most intense competition is preferable to a strict cost minimization approach through spectrum concentration – which leads Peha to conclude that "[*l]arge disparities in spectrum holding are therefore not in the public interest*".

   b. Hazlett and Munoz (2009) emphasizes that the welfare consequences of spectrum allocation policies cannot be confused with the importance of auction proceeds – in particular that rules favoring high levels of concentration increase license values but reduce welfare. They show on the basis of a cross-country empirical comparison of performance metrics in mobile telephony markets, that "*countries allocating greater bandwidth to licensed operators and achieving more competitive market structures realize efficiencies that generally dominate those associated with license sales.*"[35] Their

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[32]   The relationship between spectrum endowment, market position and ability to exercise power is the premise under which public policies aimed at fostering competition have introduced safeguards against excessive spectrum concentration. See for instance the FCC example cited in https://obamawhitehouse.archives.gov/sites/default/files/page/files/20160502_competition_issue_brief_updated_cea.pdf

[33]   Peha, Jon M. "Cellular economies of scale and why disparities in spectrum holdings are detrimental." *Telecommunications Policy* 41.9 (2017): 792-801. Peha models the cost of mobile network as a linear function of total capacity, which itself is a quadratic function of the MNO's spectrum share.

[34]   The degree of competition is measured using the Herfindahl–Hirschman Index. For the HHI calculation, it is assumed that market shares are proportional to the capacity of each operator – which leads to a quadratic function of spectrum share.

[35]   Hazlett, Thomas W., and Roberto E. Muñoz. "A welfare analysis of spectrum allocation policies." *The RAND Journal of Economics* 40.3 (2009): 424-454.

results are based on the observation that the release of larger quantities of spectrum resulting in lower market concentration leads to lower prices.

    c. Rey and Salant (2016)[36] develop a theoretical framework to analyse the impact of allocating the spectrum (or any scarce resource) on competition in product market where it is used as an input – emphasizing the trade-off between the maximization of proceeds from the sale of spectrum and the maximization of consumer welfare obtained by fostering competition. They in particular show that "*when the regulator's only objective is maximizing consumer surplus, the optimal policy is to allocate the resource so as to equalize the costs of the two firms, as consumer prices are lowest in that case.*" This welfare-maximizing spectrum allocation thus points to a design of the spectrum allocation process rebalancing spectrum endowment between competing MNOs (in case this rebalancing is achievable), as opposed to maintaining differences in spectrum endowments in order to leverage scale economies and maximize the auction's proceeds.

4.3   Therefore, to the extent the auction design aims at maximizing social welfare, it should prevent maintaining or increasing the concentration of spectrum with Swisscom - as opposed to what would in all likelihood happen with the current auction setting – in order to stimulate retail competition. This is a significant concern given the current market structure for mobile services in Switzerland.

The negative consequences of the likely auction outcome on Swiss customers could amount to several hundred millions CHF over the license timeframe.

4.4   An increase in concentration in the Swiss mobile market, resulting from the auction, would result in higher prices thereby further deteriorating the current performance of the Swiss mobile market. This would hold true even if the three MNOs were to remain active in supplying all types of mobile services – and would be even truer if one of the smaller MNOs was marginalized in the provision of e.g. next generation services, as a result of an insufficient spectrum endowment. Conversely, an auction achieving a decrease in concentration by e.g. allocating spectrum more symmetrically would result in a stronger competitive pressure upon the incumbent Swisscom and thereby in lower prices for Swiss mobile customers.

4.5   The impact of increased concentration in mobile markets on prices for mobile services has been extensively analysed, in particular following a recent wave of mergers in mobile markets in Europe several of which have been reviewed by the European Commission. The common finding of several empirical analyses is that prices of mobile services tend to be materially higher when market structures are more concentrated.

4.6   This stems in particular from empirical research undertaken by Genakos, Valletti and Verboven[37] on the basis of a cross-sectional analysis of data from thirty-three OECD

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[36]   Rey, Patrick, and David Salant. "Allocating essential inputs." (2018).

[37]   Genakos, Christos, Tommaso Valletti, and Frank Verboven. "Evaluating market consolidation in mobile communications." Economic Policy 33.93 (2018): 45-100. T. Valletti is currently Chief economist at DG COMP. [*NB: The same research also yields more ambiguous results in terms of investment, as it indicates that an increase in concentration may propel firm-level investments, while not increasing (in a*

countries, which indicates that an increase in market concentration, in particular an increase in HHI, would coincide with higher prices. In particular, they find that on average over the sample of OECD countries under study, an increase in HHI by 1,000 points (in other words 10 percentage points) would coincide with an increase in prices comprised between 8% and 20%. If restricting their analysis to European countries alone, they also find significant, albeit lower, average price effects attached to increased concentration.[38]

4.7   While the precise impact of increased concentration in any given market will depend on the specifics of this market, these estimates can be used to gain some insights on the potential magnitude of the customer welfare losses that could result from increased concentration. If Swisscom acquires frequency up to the caps, its share of spectrum would increase by about six (6) percentage points.[39] Assuming that this increase in spectrum endowment results in an increase in market share of 2 percentage points – no more than a third of the increase in the spectrum endowment – this would yield an HHI increase of roughly 200 points[40] which, according to the base model estimated by Genakos *et al.,* would yield an increase in the prices of Swiss mobile services of between 2% and 4%. [41]

4.8   Applied to a CHF 4.55 billion Swiss mobile market,[42] this could mean an additional cost of up to CHF 182 million per year for Swiss mobile customers – or about CHF 2.73 billion over a

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statistically significant manner) sector-level investments, namely the sum of individual firm-level investments.]

[38]   In the main specification studied in the model, the 20% average effect is estimated on a large sample of OECD countries over the period 2006-2014. While this effect is statistically significant, it has a relative wide 90% confidence interval, between 7.9% and 24.7%. This may reflect specific circumstances in a country a given point in time. When the sample is increased to the period 2002-2014 and/or restricted to European countries only, the average estimated effect decreases to 8% which corresponds to the lower bound of the confident interval with the first sample. See. Genakos, Christos, Tommaso Valletti, and Frank Verboven. "Evaluating market consolidation in mobile communications." Economic Policy 33.93 (2018): 45-100.

[39]   Swisscom holds 210 MHz of the spectrum bands in use (39.6%) to which could be added 270 MHz, existing unused frequencies as well as new ones. Swisscom could therefore end up with 45.7% of the spectrum in use after the auction. Mechanically, Swisscom could increase its share of spectrum in use by up to 6 percentage points if it were to hit the caps incorporated in the draft auction rules.

[40]   Given the structure of the Swiss mobile market, this increase in HHI could raise competitive concerns. Precisely, in its assessment of horizontal mergers, the Commission is likely to identify horizontal competition concerns in a merger with a post-merger HHI above 2,000 and a variation of HHI resulting from the merger below 150. In the post-auction situation, the Swiss mobile market HHI would be 4,300, which would represent an increase of 200 as compared to the pre-auction situation. See http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52004XC0205(02)&from=EN

[41]   In the pre-auction situation, Swisscom is the dominant market participant with 59% market share. Smaller MNOs, Sunrise and Salt, hold 19% market share and 17% market share respectively. This corresponds to a HHI of 4,100. In the post auction situation, if Swisscom were to increase its market share by 2 percentage points (reducing rivals market shares accordingly), then HHI would increase by 200 points, to 4,300. This reasoning assumes that all spectrum is sold. If some of the spectrum goes unsold, Swisscom's market share could increase by more than 2 percentage points, The HHI would then increase by more than 200 points.

[42]   https://www.bakom.admin.ch/bakom/en/homepage/telecommunication/facts-and-figures/statistical-observatory/fixed/financial-results-on-31-12.html

period of 15 years corresponding to the license duration of 700 MHz, 1,400 MHz and 3.6 GHz bands.[43] Even if considering an impact of Swisscom's increased spectrum endowment of one point of market share only, or the more conservative estimate of the price effect identified by Genakos *et al.* , the cost to Swiss customers would remain very important – about CHF 1.37 billion[44] over the licenses' lifetime.

4.9   That increased concentration is akin to a reduction in the competitive pressure on prices and leads to increased prices is further confirmed by the several in-depth investigations of mobile mergers that have been undertaken by the European Commission recently. The European Commission has consistently found that mergers reducing the number of mobile operators from e.g. four to three would have led to significantly higher prices, because of unilateral effects arising from the reduction of the competitive pressure exerted by the merging Parties[45]. The European Commission either prohibited these contemplated mergers[46] (despite efficiency claims) or imposed significant remedies upon them[47], to prevent their price effects. Its case-specific assessments, which were prospective by nature, were further supported by post-mortem studies on the price impact of mergers it reviewed in the past.[48] In the case of Switzerland, the market concentration resulting from the auction would affect a pre-auction situation in which only three MNOs are active, thus would be expected to trigger more pronounced effects than with the somewhat less concentrated market structures analysed by the European Commission.

4.10   The European Commission's concerns have not been limited to retail price levels only. Increased concentration could also worsen the wholesale conditions, thereby affecting retail competition between MNOs and reducing the competitive pressure of MVNOs, as was the case in the aborted TeliaSonera / Telenor merger.[49]

4.11   Furthermore, following recent theoretical work undertaken by the European Commission's Chief Economist Team, there is now a well-founded presumption that a reduction in the

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[43]   Comcom (2018), "Auction of Frequency Blocks for the Nationwide Provision of Mobile Telecommunications Services in Switzerland".

[44]   CHF 1.37 billion = CHF 182 million / 2 x 15 years.

[45]   This is consistent with the findings of Genakos *et al.* that an increasing in the number of suppliers would lead to a price reduction of 8.6%.

[46]   Telia/Telenor decided to abandon the transaction, before the Commission issued a formal prohibition decision.https://ec.europa.eu/commission/commissioners/2014-2019/vestager/announcements/competition-telecom-markets_en

[47]   The European Commission has approved the Hutchison/VimpelCom joint venture in Italy, subject to significant remedies aimed at recreating a fourth operator. See http://europa.eu/rapid/press-release_IP-16-2932_en.htm

[48]   http://ec.europa.eu/competition/publications/reports/kd0215836enn.pdf. We also note that in the specific case of Switzerland, according to a study by OFCOM published in 2016, infrastructure-based competition in Switzerland would be severely impaired if the number of mobile communications operators were reduced to two, to the detriment of customers. See WIK-Consult, "Network Sharing in Mobile Communications and Landline-Mobile Communications Convergence in Switzerland". Study for the Federal Office of Communications and the Swiss Federal. Communication Commission, 2016, accessible at: http://www.comcom.admin.ch/themen/00823/index.html.

[49]   See footnote 46.

number of suppliers would also hamper innovation, by reducing the rivalry-induced incentives to innovate[50]. This type of concerns has also been raised in the context of industry consolidation involving direct competitors.[51]

4.12   Those considerations are relevant to the present situation to the extent that one smaller MNO could be foreclosed from the supply of certain mobile services as a result of the auction – which in that situation would have had the effect of eliminating the competitive rivalry with that MNO on next-generation services. While we are not aware of equivalent research results on the impact of sector concentration, as opposed to that of a reduction in the number of suppliers, these effects would be likely to carry over at least in a situation in which a small MNO would be significantly weakened and could no longer exert a significant competitive constraint on other MNOs in the product market.

4.13   Therefore, insofar as the auction under is current design is likely to result in increased spectrum concentration which itself would yield further concentration in the mobile telecommunications markets in Switzerland, this auction is bound to have negative welfare consequences for Swiss customers, by weakening effective competition in the mobile markets in Switzerland.

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[50]   Federico, Giulio, Gregor Langus, and Tommaso M. Valletti. "Horizontal Mergers and Product Innovation." *International Journal of Industrial Organization* (2018).

[51]   Recently The Commission has blocked the proposed acquisition of O2 by Hutchison under the EU Merger Regulation. It had strong concerns that the deal would have harmed innovation in the mobile sector. http://europa.eu/rapid/press-release_IP-16-1704_en.htm

Appendix

A   Current allocation of frequencies

A.1   In 2012, all frequencies that could be used for mobile networks (both the mobile network frequencies that were already free and those that became available from 2014 to 2017 as a result of the expiration of the corresponding GSM and UMTS concessions) were reallocated as part of an auction procedure.

A.2   A total of 2 x 265 MHz for FDD usage, distributed among the five frequency bands 800, 900, 1,800 MHz, 2.1 GHz and 2.6 GHz, and 1 x 45 MHz for TDD usage in the 2.6 GHz band were allocated to the MNOs. The frequency ranges were awarded in a technologically neutral manner.

A.3   Table 1 below shows the Mobile network frequency distribution after the allocation in 2012.

Table 1: Mobile network frequency distribution after the allocation in 2012.

Frequency band	Salt		Sunrise		Swisscom		TOTAL (MHz)
	MHz	%total band	MHz	%total band	MHz	%total band	
800 MHz	20	33.3%	20	33.3%	20	33.3%	60
900 MHz	10	14.3%	30	42.9%	30	42.9%	70
1,800 MHz	50	33.3%	40	26.7%	60	40.0%	150
2.1 GHz FDD	40	33.3%	20	16.7%	60	50.0%	120
2.6 GHz FDD	40	30.8%	50	38.5%	40	30.8%	130
2.6 GHz TDD	0	0%	0	0%	45	100%	45
TOTAL	**160**	**27.8%**	**160**	**27.8%**	**255**	**44.3%**	**575**

Source: https://www.bakom.admin.ch/bakom/en/homepage/frequencies-and-antennas/new-mobile-telephony-frequencies-orange-sunrise-and-swisscom.html

A.4   While Swisscom purchased a total of 255 MHz at auction in 2012, Salt and Sunrise each acquired 160 MHz. Even if every MNOs acquired frequencies from all bands, the auction resulted in an asymmetrical allocation of the 900MHz, 1,800MHz band, 2.1 GHz band, and 2.6 GHz for TDD usage band. For these frequency bands, Swisscom was awarded 40% or more of the auctioned frequency range.

A.5   Table 2 below shows the frequency distribution after the allocation in 2012, identifying frequencies are actually used. It also presents the likely distribution of frequencies after the upcoming allocation, if no adequate safeguards are implemented.

Table 2: Frequency distribution after the allocation in 2012, including usage of spectrum and likely allocation after upcoming allocation (without proper safeguards).

	Sunrise & Salt		Swisscom		Total
	MHz	%total band	MHz	%total band	MHz
Frequency distribution after the allocation in 2012 auction	320	55.7%	255	44.3%	575
Of which frequency holdings not in use (2.6TDD)	*0*	*0%*	*45*	*100%*	*45*
Likely allocation of new frequency spectrum	250	52.6%	225	47.4%	475
Likely frequency distribution after the allocation in 2018 auction	**570**	**54.3%**	**480**	**45.7%**	**1,050**

Notes: *(i) Uplink and downlink accumulative; (ii) We consider the situation where Swisscom would acquire the maximal amount of spectrum it can access within the auction caps.*

Source: *https://www.bakom.admin.ch/bakom/en/homepage/frequencies-and-antennas/new-mobile-telephony-frequencies-orange-sunrise-and-swisscom.html*

A.6   While Swisscom purchased a total of 255 MHz at auction in 2012, 6 years after this auction Swisscom still has not used a part of the acquired frequencies. Hence, Swisscom holds 210 MHz of the spectrum bands in use (39.6%) to which could be added 270 MHz (existing unused frequencies as well as new ones. Swisscom could therefore end up with 45.7% of the spectrum in use after the auction. Furthermore, Swisscom could add even more spectrum than the total of the existing spectrum bands in use (i.e. 270/210 = 1.29), while Sunrise and Salt would add less than the existing spectrum bands in use (i.e. 250/320 = 0.78). This dissymmetry in spectrum holdings will have a significant impact on the mobile market structure.

B   Market shares on mobile networks

B.1   Figure 1 below presents market shares (pre-paid and post-paid) in terms of customer numbers over period 2007-2016.

Figure 1: Market shares in terms of customer numbers, 2007 – 2016.
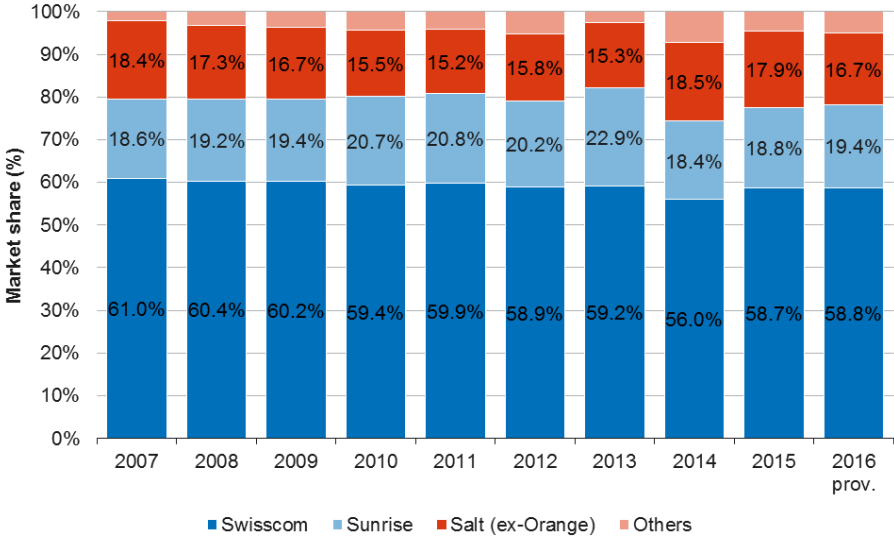
Notes: *As of the first quarter of 2014, the figures below published by operators are based on the '12 month rule', listing the number of prepaid accounts with an active SIM card logging at least one incoming or outgoing call via the network over the previous 12 month period. To date, only Swisscom applied this '12 month rule', while Sunrise and Salt (formerly Orange) applied a 'three month rule' (account activity in the previous 3 months).*

Source: *https://www.bakom.admin.ch/bakom/en/homepage/telecommunication/facts-and-figures/statistical-observatory/structure-of-the-market-and-employment/market-shares-on-mobile-networks.html*

Table 3: Eight European auctions going back to 2010 (countries featuring asymmetric market structure at the time of the auction).

Country	Year	Band	Main participants	Share[i] (%)	Spectrum bought[ii] HF (%)	Spectrum bought[ii] LF (%)	Spectrum bought[ii] Tot. (%)	Main safeguards	Comments
Germany	2010	800 MHz, 1.8 GHz, 2.1 GHz, 2.6 GHz	DT	34%	25%	33%	26%	Vodafone and Deutsche Telekom were restricted to a maximum of 20 MHz each out of 60 MHz on offer in 800MHz bands.	Vodafone and Deutsche Telekom acquired a maximum of 800 MHz blocks up to the auction cap. There was a fight over the remaining 20 MHz was between Telefonica O2 and E-Plus.
			Vodafone	33%	25%	33%	26%		
			E-Plus	18%	23%	0%	19%		
			Telefonica	15%	26%	33%	28%		
Spain	2011 (Q2)	900 MHz, 1.8 GHz, 2.6 GHz	Orange	23%	0%	100%	25%	Movistar and Vodafone were prevented from participating. Orange in the 1800 MHz award.	Strongest incumbents were prevented to participate, at the benefit of the weakest MNO (Yoigo).
			Yoigo	5%	100%	0%	75%		
Spain	2011 (Q3)	800 MHz, 900 MHz, 2.6 GHz	Telefonica	40%	21%	38%	26%	There was a 2x20 MHz cap on sub-1 GHz spectrum. There was a limit of 115 MHz on joint 1800 MHz, 2.1 GHz and 2.6 GHz spectrum.	The weakest incumbent won impaired 800 blocks. No challengers won anything available to incumbents.
			Vodafone	32%	21%	25%	22%		
			Orange	23%	21%	25%	22%		
			Yoigo	5%	0%	0%	0%		
Italy	2011	800 MHz, 1.8 GHz, 2.1 GHz, 2.6 GHz	Vodafone	34%	19%	33%	23%	There was a 2x20 MHz cap on sub-1 GHz spectrum, and a 55 MHz cap on joint paired and unpaired 2.6 GHz spectrum, applicable to all bidders.	The weakest incumbent (3 Italia) won no 800 MHz There was unsold in 2.1 GHz band.
			Telecom Italia	32%	19%	33%	23%		
			Wind	23%	22%	33%	25%		
			3 Italia	10%	30%	0%	22%		
Portugal	2012	800 MHz, 900 MHz, 1.8 GHz MHz, 2.6 GHz	MEO	43%	22%	24%	22%	There was a 2x10 MHz cap on 800 MHz and 2x5Mz on 900 MHz.	Incumbents acquired a maximum of 800 MHz blocks up to the auction cap. There were unsold blocks in other frequency range.
			NOS	21%	22%	24%	22%		
			Vodafone	36%	22%	36%	25%		
Netherlands	2012	800 MHz, 900 MHz, 1.8 GHz	KPN	48%	35%	31%	33%	There was a 2x10 MHz on 800 MHz.	Tele2 (a new entrant) won the two set aside blocks, while incumbents won everything else. Only 2 of the incumbent operators were able to win 2x10 MHz of 800 MHz.
			Vodafone	28%	22%	31%	25%		
			T-Mobile	24%	43%	23%	36%		
			Tele2	0%	0%	15%	6%		
Switzerland	2012	800 MHz, 900 MHz, 1.8 GHz, 2.1 GHz, 2.6 GHz	Swisscom	59%	38%	43%	42%	There was a combined 2x 25 MHz cap on 800 MHz and 900 MHz; a 2x20MHz for the 900MHz band.	The sub 1 GHz cap was binding for Swisscom and Sunrise, and the cap on 2.1GHz for Swisscom only. There was unsold in unpaired 2.1 GHz band.
			Sunrise	20%	38%	23%	26%		
			Salt	16%	23%	27%	26%		
UK	2013	800 MHz, 2.6 GHz	EE	35%	37%	17%	32%	There was a spectrum floors.	Vodafone was the only participant to gain the ideal combination of 2 x 10 MHz in 800 MHz and 2 x 20 MHz in 2.6 GHz. While EE acquired half of the spectrum in 2.6 GHz and 2 x 5 MHz in 800 MHz, both O2 and H3G obtained very little spectrum.
			O2	29%	0%	33%	8%		
			Vodafone	26%	34%	33%	34%		
			Hutchison 3	10%	0%	17%	4%		
			NSV	0%	29%	0%	22%		
Austria	2013	800 MHz, 900 MHz, 1.8 GHz	Telekom Austra	44%	47%	54%	50%	No new entrant was present at the auction, thus all reserved spectrum was available to the existing operators.	Hutchison 3 is left with only a single 2x5MHz block in 900 MHz band after the auction.
			T-mobile	31%	27%	38%	32%		
			Hutchinson 3	26%	27%	8%	18%		

Note: (i) Market shares in terms of number of subscribers at the time of the auction; (ii) Market shares do not sum up to 100% when there are unsold blocks.
Source: Telecommunications Regulatory Authorities websites (UK, Austria); Ofcom (2013), https://www.ofcom.org.uk/__data/assets/pdf_file/0023/78323/annual-licence-fees-annex_8.pdf;