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**Federal Department of the
Environment, Transport, Energy and Communications
(DETEC)**

Federal Office of Communications OFCOM

Public consultation

regarding

the tender and allocation of new mobile network frequencies in Switzerland.

Date: June 2017

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1 Introduction

The volume of data transferred through mobile networks is rising steadily due to increasing market penetration of smartphones, the growing number of devices and objects connected wirelessly to the Internet (Internet of Things; IoT), and rising data usage. These developments have prompted a need for new frequencies for IMT systems[1] and are the reason why additional frequency ranges were identified for IMT systems at the World Radiocommunication Conference (WRC) organized by ITU[2] in November 2015. These frequencies will soon be available and allocated by ComCom.

Mobile network frequencies were last allocated in 2012 within the scope of an auction. This allocation process concerned both the reallocation of frequencies that had already been allocated and the allocation of what were, at the time, new frequency ranges for providing telecommunication services across the country. Unlike in 2012, this planned allocation process only concerns new frequency ranges.

ComCom has commissioned OFCOM to perform the preparatory work for the allocation of the newly available frequencies. OFCOM's first step is an invitation to all interested parties to comment on the present consultation by July 31, 2017. The goal is to gather the opinions of interested parties regarding the allocation of these new frequencies. The statements will be incorporated into the draft of the tender documents.

At the same time as this consultation, ComCom will conduct oral hearings in June with Salt, Sunrise, Swisscom, and upc. Additionally, ComCom reserves the right to hear other stakeholders wherever necessary.

Responses must be sent to the following address (electronic version): E-mail:

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2 Initial situation

2.1 Mobile network frequencies

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. This reallocation made it possible to quickly introduce better-performing mobile network technologies like LTE (Long-Term Evolution).

A total of 2 x 270 MHz for FDD usage[3], distributed among the five frequency bands 800, 900, 1800, 2100 and 2600 MHz, and 1 x 45 MHz for TDD usage[4] in the 2600 MHz band were allocated to

1 International Mobile Telecommunications (IMT), GSM standards family (2G), UMTS (3G), LTE (5G), WiMax (IEEE 802.16)

2 International Telecommunication Union

3 FDD: frequency division duplex

4 TDD: time division duplex

the mobile network operators Orange (now Salt), Sunrise, and Swisscom.[5] While Swisscom purchased a total of 255 MHz at auction, Salt and Sunrise each acquired 160 MHz. The concessions are valid until 2028.

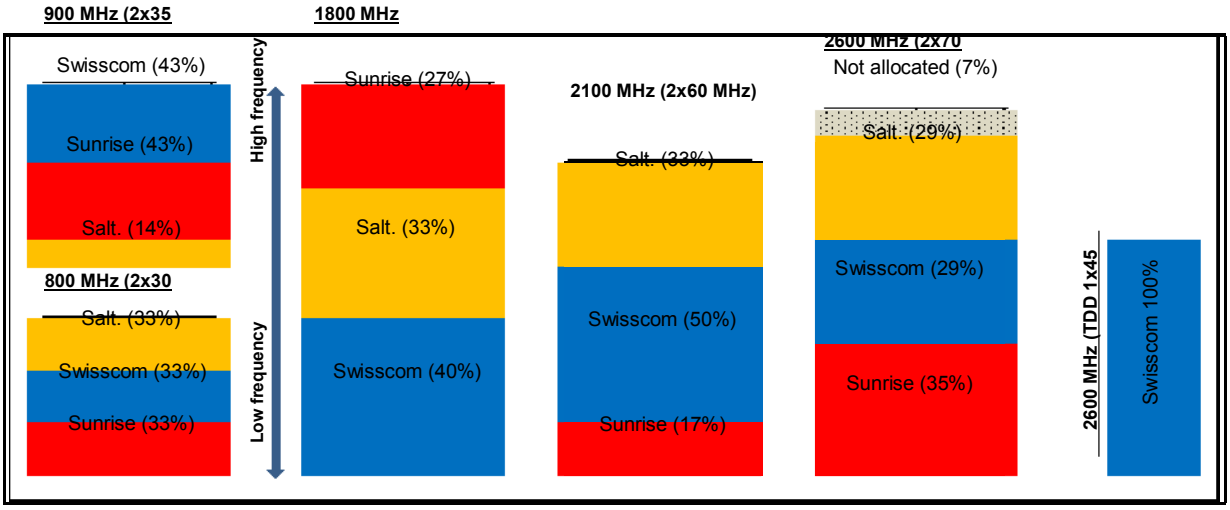

Figure 1: Mobile network frequency distribution after the last allocation in 2012

The auction resulted in an asymmetrical allocation of the frequencies. Every carrier acquired frequencies from all bands.

The frequency ranges that were allocated were awarded in a technologically neutral manner, and some of them are used intensively. LTE Advanced (fourth mobile network generation; 4G+) has already been introduced to large sections of the Swiss telecommunication market.

Of the frequency bands that were reallocated in 2012, the 800 MHz band is being used more intensively than the 2600 MHz band. Until now, the network operators have primarily used the 800 MHz band for the development of LTE because it enables the largest cell radii and the best building penetration.

GSM is operated in the 900 and 1800 MHz bands and UMTS in the 900 and 2100 MHz bands while the 800, 1800, and 2600 MHz bands are used for LTE. GSM is continually being replaced by LTE; Swisscom is planning to discontinue operation of GSM by the end of 2020. The other two network operators have not yet determined an exact time for the decommissioning.

The main reason for the change in technology is LTE's considerably higher data transfer capacity. This makes it possible to increase the network capacity even at transmitter sites where the NIR budget is already exhausted while complying with the effective exposure limits stipulated by the NISV[6]. However due to the steady increase in data traffic and the NIR budget restricted by the specifications of the Ordinance on the Protection against Non-ionizing Radiation, additional antenna sites need to be constructed so that the new frequencies can be used.

5 Four companies had submitted their application documents by the end of 2011. The company In&Phone could not be admitted to the auction because it did not fulfill the statutory requirements and the specific requirements of the call for tenders. The choice of allocation process meant that the number of concessions to be allocated and the frequencies contained therein were determined during the auction rather than by the authorities.

6 NISV: Ordinance on the Protection against Non-ionizing Radiation SR 814.710

2.2 Broadband wireless access (BWA)

From November 1, 2007, to the end of 2016, regional concessions for broadband wireless access (BWA) could be acquired upon application. They were restricted to certain regions that were stipulated by the applicants. No specific wireless technology was prescribed in the process. Currently, only the company immensys AG, which has its headquarters in Brugg in the canton of Aargau, possesses a regional BWA concession. It was allocated in April 2012 and will expire on December 31, 2017.

For regional usage, the available frequency band in the 3.41-3.6 GHz range was divided into frequency blocks of 3.5 MHz. Using these frequencies, the holders of the concessions can provide fixed or nomadic services (point-to-multipoint) in the region(s) stipulated in the application. "Nomadic use" is the use of a terminal device at any location under the condition that the location does not change during use.

Before 2007, three nationwide concessions for public telecommunication services in the same frequency band were allocated to Cablecom[7], Swisscom Mobile, and Inquam Broadband GmbH within the scope of auctions. None of the three companies has used the frequencies. In fact, the BWA standards were not uncontroversial on the telecommunication market, and only an infinitesimally small market for BWA developed in Switzerland.

2.3 New technologies

In the short term, increasing data volumes can be managed by switching from GSM to LTE technology and by using previously unused frequency resources. In the medium term, however, network operators will undoubtedly require additional frequencies.

While the widely-used LTE Advanced is being further developed into "LTE Advanced Pro", the fifth mobile network generation is taking shape. The standardization of the new radio interface of the fifth mobile network generation (5G), referred to as "5G New Radio" (5G NR), should be completed by the end of 2019[8]. The introduction of LTE Advanced Pro and 5G NR (starting with Release 15) can first be expected in the frequency bands under 6 GHz. The 5G NR radio interface will support all available mobile network bands in the long term.

The further development of LTE should make it possible to quickly introduce services with 5G properties. Among these properties are a shortened network latency (reaction time), increased availability of the connection or services, increased data transfer capacity, and support for a very large number of IoT devices.

3 New frequency ranges for mobile networks

3.1 Introduction

Three new frequency ranges will be available in Switzerland by around 2020 for the further expansion of the networks with present and future technologies. They are located in the 700, 1400, and 3400–3800 MHz bands. In Europe, these frequency bands were identified by CEPT/ECC[9] as future frequency ranges for the introduction of the fifth mobile network generation (5G). 2 x 5 MHz in the 2600 MHz band, which were not allocated in 2012, are also still free. In addition to the three

7 Cablecom acquired its concession from Priority Wireless AG, which had originally purchased the concession at an auction.

8 ETSI 3GPP

9 http://www.cept.org/ecc/topics/spectrum-for-wireless-broadband-5g

new frequency bands, a bandwidth of 561 MHz is also being discussed. In total, a bandwidth of 571 MHz at most is available for allocation (see the table in section 3.2).

Before the beginning of the allocation process, outstanding issues still need to be addressed with regard to the individual frequency ranges. Depending on the results of this, it can be assumed that the new frequency bands will become available for use at different points in time. The times of usage are unlikely to be identical with the time of allocation.

In the context of the next WRC, which will be held in 2019, additional frequencies for fifth-generation mobile network systems are expected to be identified in higher frequency ranges (greater than 6 GHz). The upcoming allocation process does not cover these frequency ranges, however.

3.2 Overview and availability of allocated frequencies

The following table shows a summary of the availability of existing frequencies.

Frequency band	Arrangement	Maximum useable bandwidth	Availability
700 MHz	703–733 MHz / 758–788 MHz: • 2 x 30 MHz FDD (subject to PS[10]-IMT allocation) 738–758 MHz: • 1 x 20 MHz only downlink SDL (subject to PS-IMT allocation)	60 MHz FDD 20 MHz SDL	Date: Nationwide from 2019, if available in the border regions and defined in the national frequency allocation plan (NFAP).
1400 MHz	Everything only downlink SDL (total 91 MHz): • 1427–1452 MHz, 1 x 25 MHz • 1452–1492 MHz, 1 x 40 MHz • 1492–1518 MHz, 1 x 26 MHz	91 MHz SDL	Date: Nationwide from 2019 • 1 x 40 MHz • 1 x 25 MHz and 1 x 26 MHz (outer bands), possibly from 2019 with restrictions[11]
3400–3600 MHz 3600–3800 MHz	3410–3600 MHz: • 1 x 190 MHz TDD or 3410–3490 MHz / 3510–3590 MHz: • 2 x 80 MHz FDD 3600–3800 MHz: • 1 x 200 MHz TDD	390 MHz TDD or 160 MHz FDD plus 200 MHz TDD	Date: Nationwide from 2019 • 1 x 190 MHz TDD or 2 x 80 MHz FDD • possibly 1 x 200 MHz TDD or SDL (to be determined whether the range 3400–3600 MHz will be used for public mobile communications. Alternative use from 2019 for LSA MFCN/Video PMSE). • 3600–3800 coordination with satellite ground stations mandatory
2600 MHz remaining frequencies	2565–2570 MHz / 2685–2690 MHz: • 2 x 5 MHz FDD	10 MHz FDD	Date: Starting right now

10 Public safety

11 EU mandate RSCOM17-03rev2 from March 14, 2017 states "... harmonized technical conditions for the use of outer bands of the 1.5 GHz range...". Final report is planned for November 2017. In addition, the outer bands must be implemented in the ECC decision (DEC (13)03) and defined in the NFAP. The use of the external bands inland, and particularly in areas near the border, may be restricted due to existing radio links.

Frequency band	Arrangement	Maximum useable bandwidth	Availability
	Total for maximum **FDD** usage	230 MHz FDD + 200 MHz TDD + 111 MHz SDL = **541 MHz**	The use of the 3400-3600 MHz band with FDD creates a duplex gap of 30 MHz that is not usable for mobile communications. Therefore, the total of the maximum TDD usage drops by 30 MHz.
	Total for maximum **TDD** usage	70 MHz FDD + 390 MHz TDD + 111 MHz SDL = **571 MHz**	

3.3 Open Points

Discussions are currently underway whether a part of the 700 MHz frequency band is to be allocated to the Public Safety IMT network[12] (PS-IMT). If the allocation for PS-IMT occurs, the bandwidth planned for public mobile communications in this band will be reduced accordingly from the current 2 x 30 MHz and 20 MHz SDL.

The corresponding ECC decision must be added to the 1400 MHz band, so that the lower and upper bands can also be used. Furthermore, the outer bands are used by radio broadcasting. Until the ECC decision has been put into effect, the core range of 1 x 40 MHz is only available starting from 2019.

The question arises whether frequencies for regional BWA concessions should be provided for in the allocation of frequencies in the 3400-3600 MHz band. At this time, only one regional BWA concession exists, which is valid until the end of 2017. The concessionaire is still interested in the use of the allocated range. Other radio applications, such as wireless cameras, are used in this frequency band on a temporary basis. According to analyses made by OFCOM, it is difficult to find alternative frequency bands for these applications during big events (e.g. Tour de France/Switzerland). Since other countries are also affected by this dilemma, discussions for possible solutions are also taking place at the international level. A definitive solution at the national level is still being sought.

The use of the 3600-3800 MHz range by a public mobile phone network can be restricted locally due to the equal use of local satellite ground stations in Switzerland and with regard to the useable bandwidth. This requires technical coordination led by OFCOM.

12 PS-IMT is an IMT network designed to carry out public safety tasks (e.g. blue-light organizations)

4 Questionnaire

4.1 Details of supplying party

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☒ **Operator of a nationwide public mobile phone network in Switzerland**
– Operator of a regional network in Switzerland
☐ Operator of a wireless private network in Switzerland
☐ Network operator of a nationwide grid-bound network in Switzerland
☐ Operator of a mobile phone network abroad
☐ Telecommunications network equipment
☐ Telecommunications service provider
☐ Content provider
☐ Consumer organization
☐ Interest group
☐ Public authority
☐ Consulting firm
☐ Other, which?

Please mark which of the following statements below you wish to remain confidential.

4.2 General questions

1. How do you rate (including temporally) the development of mobile phone technology (LTE Evolution, 5G, etc.)?

   Capacity and coverage is currently expanded through the continuing deployment of 4G and 4.5G.

   5G will bring higher spectral efficiency, in particular massive MIMO primarily in the high frequency TDD bands, to increase wireless capacity and reliability.

   5G technologies are in standardisation currently and will be available only from 2020 onwards.

   The deployment of the new 5G equipment and antennas (including new building permits) required for massive MIMO will be challenging with respect to rollout and required investments.

2. How do you rate its impact on applications, services, terminals, convergence landline network / mobile communications, etc.?

The evolution from 4G to 4.5G enables key uses of last mile TV/video streaming and thereby makes fixed-to-mobile substitution increasingly viable technically and commercially.

The higher wireless capacities increase the need for access to high-speed fiber transmission backhaul, which is challenging for operators who do not own fixed infrastructure, and must rely on the incumbent for some of their backhaul needs.

3. How do you rate long-term market development in terms of participants, volume, applications (such as the Internet of Things)?

   The introduction of 4.5/5G technologies and additional frequencies is capital-intensive and increases the advantage of the dominant market player with the risk of further market consolidation.

   The introduction of 4.5/5G based high-speed broadband access has the potential to put increasing competitive pressure on fixed-line services.

   Mobile data volume will keep growing strongly driven by 4K TV/video streaming and augmented/virtual reality applications e.g. in connected cars. However, the increase in data usage cannot be commercialized largely as the Swiss market has already moved substantially to unlimited offerings.

   The business potential for ultra-low latency use cases enabled by 5G remains limited in the medium term. The relevant Internet of Things-applications are already provided on existing 4G networks, either by common 4G technology itself, or by the 4G based Narrow Band IoT Standard.

4. How do you assess the impact of the current NISV limits on expanding mobile phone networks and the use of the newly available frequencies?

   The current NISV does not allow meeting the traffic demand in the medium term.

   The current NISV effectively locks in market shares.

   The introduction of 5G does not remove the NISV limitations. In theory, the introduction of 5G together with massive MIMO and beamforming (in the 3.5 GHz band) offers a substantial improvement in spectral efficiency and thereby could help alleviating the NISV issues. In practice however, three main obstacles exist: the first one is that deep indoor coverage is difficult to achieve at 3.5 GHz even with the use of massive MIMO and beamforming. The second one is that 3.5 GHz on the existing antenna grid does not provide the large area coverage needed in areas outside the cities. The third one arises from the several years long transition phase from 4G to 5G, where due to NISV limitations both technologies could operate only at a fraction of their full potential. In addition, the NISV will need to be amended to allow for massive MIMO and beamforming.

   The addition of new frequencies would require reducing the emission power at the cost of reduced coverage and total capacity.

Furthermore, the rollout of many more sites in the entire network to compensate the NISV restriction on sector level is not feasible from a cost and permitting perspective and with respect to indoor coverage and quality.

4.3 Questions on concessions and conditions

5. How long should a concession be valid? (please state your reasons)

   The concession should be valid for 20 years. As the conditions for a renewal are not known, only a relatively long duration provides for sufficient certainty for the investments to be made.

6. Which conditions (per frequency band) should be included in the concessions (e.g. coverage requirements, wireless cameras, terrestrial broadcasting)? Or are none necessary?

   The concession should be made conditional on the provision of 50% population coverage through own radio equipment and on the demonstrated ability to provide commercial telecommunication services to the public.

   In principle, there shall be no conditions on the use of frequencies for public mobile communications. Narrow exceptions may be made for the coordination with existing local satellite ground stations and microwave radio links.

7. Should frequency resources be reserved for regional networks? If so, how many, in which frequency band and for which application?

   The use of frequencies for regional networks leads to interferences and requires substantial efforts for coordination.

   The reservation of frequencies for other uses reduce the economic value of the frequencies assigned to mobile network operators and complicate the allocation proceedings.

   With the deployment of 4/4.5G based high-speed broadband technologies by all mobile operators, the business potential for the provision of regional wireless broadband services is no longer viable. This increases the risk that an assignment of regional frequencies fails (see e.g. the return of 3.5 GHz spectrum by Broadband Belgium).

4.4 Questions on the procurement procedure

8. Do you consider the date of the procurement procedure – expected at the end of 2018 – to be appropriate?

   The allocation in 2018 of new spectrum is too early and should be postponed to 2020 with deferred payment options available.

   An allocation in 2020 would allow for continued investments into existing 4.5G networks to provide customer-relevant services to drive the Swiss

digital economy, thereby keeping the current competitive momentum in the Swiss mobile market.

By 2020, NISV limitations could be amended to allow for the actual use of the new frequencies and to provide the required certainty for investments in frequencies and technical rollout.

The equipment required for 5G is expected to be standardized and available for deployment in 2020 only.

The compatibility of handsets for new frequencies (e.g. 700 MHz SDL) depends on harmonization, which has yet to be done over the next years.

9. Do you consider frequencies in different bands to be potential substitutes and/or complements?

   There are no complements among the frequencies.

   There is a certain substitution effect between 700 MHz FDD and SDL and between 700 MHz and 1400 MHz, respectively, due to technical interferences (e.g. possible intermodulation products between existing spectrum and newly allocated spectrum).

   There is a certain substitution effect among all the frequencies because in principle they could all be used to increase capacity and peak speeds for downlink traffic.

   With no complementary effects present, a combinatorial auction format is not warranted and there is no exposure problem (no bidders ending up with a non-value maximizing package).

   Because blocks in the different bands are substitutes, auctions for the different bands should be undertaken simultaneously or, in case of a sequential auction, start with the auction of the 700 MHz frequencies.

10. How should the frequency bands be procured (auction, criteria competition, direct allocation)? Should all frequency bands be procured in the same manner?

    The guiding principle for the allocation of frequencies is that competition in the market should be enhanced, or at least not be reduced. Both the economic analysis and the legal framework mandate this guiding principle.

    Key economic analysis shows that consumer welfare is maximized when the allocation of frequencies is designed to maximize ex-post competition in the market. Absent provisions to handicap large bidders, small participants are unlikely to win new spectrum; hence, regulators should concentrate their efforts on achieving an efficient allocation rather than on revenue maximization (Klemperer (2004), Cramton et al. (2011), Myers (2013), Rey and Salant (2017)).

    Empirical studies have identified a significant positive relation between market concentration and consumer prices and an encouragement of

investments by increased competition (Hazlett and Muñoz (2009), Landier and Thesmar (2012)).

The Swiss constitutional framework and the Swiss Telecommunications Act (TCA) as well as other applicable provisions such as the Swiss Cartel Act require that effective competition within the Swiss telecommunications market is safeguarded at all times. This guiding principle does not only constitute a main aim of the TCA (art. 1 par. 2 lit. c TCA), but is also expressly mentioned in connection with the conditions required for granting frequency licenses (art. 23 par. 4 TCA, Thouvenin and Weber (2017) p. 9). Thus, the allocation of frequencies shall in any case neither eliminate nor significantly restrict effective competition unless an exception can be justified on grounds of economic efficiency. Competition in the Swiss telecommunications market is of particular importance as it ultimately ensures the attainment of other important aims of the TCA, inter alia the provision of reliable, high-quality, state-of-the-art and cost-efficient services (art. 1 par. 1 TCA, art. 0.2 and 0.10 ITU Regulations, Thouvenin and Weber (2017) p. 7). In order to attain effective competition in the Swiss telecommunications market, equitable access to the scarce spectrum is a necessary prerequisite.

In light of the above, the regulator shall therefore – within its duly discretionary power – uphold and keep the current competitive momentum in the Swiss telecommunications market when allocating new frequencies. Only in case of remaining competition in the market also after such allocation, the Swiss telecommunications market will remain undistorted and, in consequence, perform results for the benefit of the consumers. With regard to the Swiss telecommunications market, competition in the market can be safeguarded best when new frequencies are assigned by way of a direct allocation or criteria competition based on objective criteria respectively. Art. 21 par. 1 and art. 22 Ordinance on Frequency Management and Licenses expressly provide a legal basis for such form of frequency allocation. Only thereby, a level playing field between the existing and possible future competitors in the Swiss telecommunications market is effectively ensured.

In contrast, an auction scenario – despite possibly providing limited competition for the market – could severely threaten and distort effective competition. The incumbent market player Swisscom holds already a major part of the currently used frequencies and has superior spending power, in particular because it is still by majority state owned. In an auction scenario, there exists thus a clear risk of such dominant market player to use its unparalleled financial capacity in order to acquire more spectrum quantities than is required by its foreseeable technical needs (anticompetitive spectrum hoarding), thereby outbidding its challengers and strengthening the already existing asymmetries. Even if Swisscom would not be able to outbid its challengers entirely, it could nevertheless push prices up to such an extent that challengers are likely to suffer a winner's curse (Thouvenin and Weber (2017) p. 6 and 9 et seq., ITU policy guidelines and economic aspects on the assignment and use of radio spectrum (2016) p. 10 et seq.). This in turn is detrimental for effective competition since challengers are, in fact, foreclosed and

denied equitable access to the scarce spectrum, eventually leading to higher prices and poorer services for consumers.

Hence, an auction process would contradict the main aims of the constitutional framework and the TCA to maintain effective competition in a liberalized Swiss telecommunications market and, if anything, solely enhance the gain of public revenue. The latter has no effective legal basis (Thouvenin and Weber (2017) p. 8), at least no basis which could outweigh created negative outcome for competition in the market after the allocation of the new frequencies by an auction.

In sum, the criteria to evaluate the allocation process should be the impact on the ex-post competition in the market. Competition in the market is achieved and safeguarded best by an allocation of spectrum, which does not increase the risk of further consolidation. With potentially only the existing three operators being interested in the new spectrum, criteria based allocation achieves this objective best. In principle, Swisscom's current high share of 45% of all frequencies mandates that no further 700 MHz spectrum should be allocated to Swisscom in order to reduce the existing asymmetry. In practical terms and in particular, **all three existing operators should be offered 2x 10 MHz 700 MHz FDD spectrum each at a minimal price.**

Should the regulator in spite of the above opt for an auction, SMRA (standard or pay-as-bid clock auction) is preferred as it is most suited given the nature of the spectrum to be allocated and as the format is most experienced and analyzed. In addition and as outlined below (answers to question 11), limitations by way of caps would need to be put in place in order to prevent Swisscom from hoarding frequencies and thereby hampering effective competition in the telecommunications market.

Entire remaining answer to question no. 10 is confidential:

11. Should the maximum obtainable frequency bandwidth be limited per auction participant? If yes, why and how much?

As required by the legal framework, the auction design needs to ensure that competition in the market is promoted through an allocation of spectrum, which does not increase the risk of further consolidation. In case of an auction, limitations by way of caps need to be put in place to handicap large bidders and to ensure the possibility for smaller challengers to procure sufficient spectrum (see answer to question no. 10 for economic and legal requirements).

To ensure that the current asymmetry in favour of Swisscom does not increase further, **the acquisition of 700 MHz FDD spectrum by each participant should be capped at 2x 10 MHz. In addition, 700 MHz SDL spectrum acquisition should be capped at 10 MHz.** This would result in relative frequency holdings in the low frequency range combining both the existing 800 and 900 MHz as well as the new 700 MHz frequencies (assuming Swisscom acquires the maximum spectrum available under the applicable cap) of up to 38.1% for Swisscom, up to 38.1% for Sunrise and up to 28.6% for Salt (39.1%, 39.1% and 30.4% respectively for the downlink spectrum that is more important due to traffic asymmetry).

The detailed frequency distributions are set out in the following tables with the detailed analysis included in Annex C (color coding: yellow means win or loss, green means loss for Swisscom and win for competitors, orange means win for Swisscom and loss for competitors).

Existing 800 and 900 MHz FDD

	Swisscom	Sunrise	Salt
Existing 800/900 MHz spectrum holding	38.5%	38.5%	23.1%

Cap at 2x 10 MHz 700 MHz FDD and at 10 MHz 700 MHz SDL

	Swisscom	Sunrise	Salt
New 700/800/900 spectrum holding MHz (downlink and uplink)	38.1%	33.3% – 38.1%	23.8% – 28.6%
New 700/800/900 spectrum holding MHz (downlink only)	39.1%	30.4% – 39.1%	21.7% – 30.4%

For comparison: no cap for 700 MHz

	Swisscom	Sunrise	Salt
New 700/800/900 spectrum holding MHz (downlink and uplink)	61.9%	23.8%	14.3%
New 700/800/900 spectrum holding MHz (downlink only)	65.2%	21.7%	13.0%

Almost the same outcome as with the cap of 2x 10 MHz for 700 MHz FDD and of 10 MHz for 700 MHz SDL would result if a combined cap of 30 MHz would be applied both for FDD and for SDL in 700 MHz.

Combined Cap of 30 MHz both for 700 MHz FDDx2 and for 700 MHz SDL

	Swisscom	Sunrise	Salt
New 700/800/900 spectrum holding MHz (downlink and uplink)	38.1%	33.3% – 38.1%	23.8% – 28.6%
New 700/800/900 spectrum holding MHz (downlink only)	34.8% – 43.5%	30.4% – 39.1%	21.7% – 30.4%

Providing more spectrum to a participant who obtained less spectrum in a previous auction would retroactively adjust the outcome of the previous auction, which was not foreseen by the auction terms and therefore should **not** be considered as a feasible scenario. For illustration, such a combined cap for all low frequencies would result in the following relative shares:

Combined Cap of 80 MHz both for 800/900/700 MHz FDDx2 and for 700 MHz SDL

	Swisscom	Sunrise	Salt
New 700/800/900 spectrum holding MHz (downlink and uplink)	38.1%	23.8% – 38.1%	23.8% – 38.1%
New 700/800/900 spectrum holding MHz (downlink only)	34.8% – 43.5%	21.7% – 39.1%	21.7% – 43.5%

Other potential cap scenarios will allow **Swisscom to increase its asymmetry and introduce substantial risks in particular to Salt, which would be in violation of the guiding principles for the auction design** as mandated by law:

Cap at 2x 15 MHz 700 MHz FDD and at 10 MHz 700 MHz SDL
Cap at 2x 40 MHz 800/900/700 MHz FDD and at 10 MHz 700 MHz SDL

	Swisscom	Sunrise	Salt
New 700/800/900 spectrum holding MHz (downlink and uplink)	42.9%	23.8% – 42.9%	14.3% – 33.3%
New 700/800/900 spectrum holding MHz (downlink only)	43.5%	21.7% – 43.5%	13.0% – 34.8%

Combined Cap of 100 MHz both for 800/900/700 MHz FDDx2 and for 700 MHz SDL

	Swisscom	Sunrise	Salt
New 700/800/900 spectrum holding MHz (downlink and uplink)	47.6%	23.8% – 38.1%	14.3% – 28.6%
New 700/800/900 spectrum holding MHz (downlink only)	43.5% – 52.2%	21.7% – 43.5%	13.0% – 34.8%

4.5 Questions on frequencies

700 MHz

12. How do you assess the desirability of this frequency band? (please state your reasons)

    The 700 MHz frequencies are attractive to increase peak speeds and capacity for wide coverage especially in rural and suburban areas but also in urban environments for deep indoor coverage.

13. How do you assess the desirability of the SDL blocks in this frequency band? Should these blocks also be procured? (please state your reasons)

    SDL is of interest due the current high asymmetry of data traffic in LTE (predominantly downlink) and allows for selectively boosting downlink capacity. However, SDL in 700 MHz is not yet harmonized and terminals do not yet support it at this time.

    There should be no reservation for emergency services.

14. What aspects should be taken into account when awarding this frequency band?

    For limitations, see answer to question 10 and 11 above.

    As the availability of SDL in 700 MHz and the availability of compatible handsets is not yet secured, an allocation at a later time (2020) and deferred payment options are advisable.

15. How interested are you in the bandwidth of this frequency band? Do you think that there is a minimum requirement below which use may be inefficient? If yes, what is the frequency range?

1400 MHz

16. How do you assess the desirability of this frequency band? Should these blocks also be procured? (please state your reasons)

    The 1400 MHz frequencies are attractive to increase peak speeds and capacity for downlink traffic, in particular potentially in combination with adjacent existing frequency bands.

    The outer bands of the 1400 MHz frequencies should be made available for public mobile communications as sufficient guard bands are foreseen

to avoid interference with adjacent satellite applications.

17. What aspects should be taken into account when awarding this frequency band?

    In case of an auction, a customary cap of 40 MHz (in case 91 MHz are available) or of 20 MHz (in case 40 MHz are available) should be applied to ensure competition in the market (see also answer to questions no. 10 and 11).

    As the availability of SDL in 1400 MHz in the outer bands and the availability of compatible handsets is not yet secured (due to still open decisions in the harmonization process), an allocation at a later time (2020) and deferred payment options are advisable.

18. How interested are you in the bandwidth of this frequency band? Do you think that there is a minimum requirement below which use may be inefficient? If yes, what is the frequency range?

3400–3800 MHz

19. How do you assess the desirability of this frequency band? Should these blocks also be procured? (please state your reasons)

    The 3.5 GHz frequencies are attractive to increase peak speeds and capacity, especially by deploying massive MIMO as part of 5G. In addition to small cells based scenarios, massive MIMO and beam forming technologies make the deployment of the 3.5 GHz band on macro site grids a viable strategy. The combination of high bandwidth and increased spectral efficiency and propagation range due to massive

MIMO will make the 3.5 GHz band an important capacity band for mobile network operators.

The whole band between 3600 and 3800 MHz (1x 200 MHz TDD) should be made available for public mobile communications as secondary uses for LSA MFCN/PMSE should be relocated to other bands (e.g. 2300 to 2400 MHz) (with potential compensation of affected users for the cost of equipment changes to be funded out of allocation proceeds).

20. Do you prefer to use TDD or FDD in the 3400-3600 MHz range?

TDD is clearly preferred. Reciprocity based massive MIMO works best with the TDD mode. Furthermore, TDD allows to better cope with asymmetric traffic (more capacity can be allocated to downlink than to uplink).

21. What aspects should be taken into account when awarding this frequency band?

In case of an auction, a cap for 3.5 GHz TDD should take into account the current exclusive TDD holdings in 2600 MHz by Swisscom as the TDD frequencies have become substantially more attractive due to their potential use for massive MIMO to be introduced by 5G. A combined cap of 150 MHz both for 2600 and 3.5 GHz TDD (assuming 390 MHz TDD available) ensures that the relevant requirements are met by allowing each participant to obtain up to 34.5% of the combined frequencies (see answers to questions 10 and 11), whereas a higher cap would hinder competition (assuming Swisscom acquires the maximum spectrum available under the applicable cap). The detailed analysis is included as Annex C.

Existing 2600 MHz TDD

	Swisscom	Sunrise	Salt
Existing 2600 MHz TDD spectrum holding	100%	0%	0%

Combined Cap of 150 MHz for 2600/3.5 GHz TDD

	Swisscom	Sunrise	Salt
New 2600/3.5 GHz TDD spectrum holding	34.5%	31.0% – 34.5%	31.0% – 34.5%

For comparison: Combined Cap of 200 MHz for 2600/3.5 GHz TDD

	Swisscom	Sunrise	Salt
New 2600/3.5 GHz TDD spectrum holding	46.0%	8.0% – 46.0%	8.0% – 46.0%

As both standardized 5G terminals and standardized network equipment are not yet available for commercial deployment, an allocation at a later time (2020) and deferred payment options are advisable.

22. How interested are you in the bandwidth of this frequency band? Do you think that there is a minimum requirement below which use may be inefficient? If yes, what is the frequency range?

4.6 Additional comments

Appendix:

Confidential Annex A:

Annex B: Legal Memo of University of Zurich by Thouvenin and Weber

Annex C: Detailed Analysis on Frequency Holdings