

**BEREC-RSPG report on infrastructure and spectrum sharing in
mobile/wireless networks**

June 2011

Section I: Introduction and definitions

Ia. Introduction

1. This report is the second of two which the joint working group BEREC/RSPG on competition issues was asked to develop in 2010, focusing on the use of spectrum by the mobile sector. While the first report¹ deals with competition related issues arising from the liberalization of spectrum at 900, 1800 MHz and other bands suitable for electronic communications services, this document is a report on infrastructure and spectrum sharing in mobile / wireless networks.
2. The report analyzes the situation in Europe, based on the answers from 16 RSPG/BEREC members to a questionnaire circulated in July 2010 amongst NRAs and administrations, and on a second questions roundup in September 2010. Answers were provided until the first week of November 2010.
3. A last round for submission of comments was held in February/March 2011.
4. The report provides definitions based on the types of current sharing agreements in Europe, including the available technical choices, provides a survey of existing agreements and their scope, illustrates the financial implications and key competitive issues, together with an analysis of existing regulation. Taking into account the dynamics of the mobile market, the report presents some highlights on their nature as well as recent and expected developments in Europe. The answers provided are used to reach some conclusions on the current development of infrastructure sharing agreements and their nature, and their potential impact on competition.

Ib. Definitions

5. Passive infrastructure sharing is defined as sharing the passive elements of network infrastructure (mast, sites, cabinet, power, conditioning). This will also be called site sharing for the purposes of this document.
6. Active infrastructure sharing currently includes a common exploitation of the active equipments in the access network (antenna, node, the radio network controller elements). It can be operated by some or all the operators who are part in the sharing scheme and it takes essentially the form of sharing of the radio access network (RAN)², i.e. the sharing of all access network equipment, including the antenna and the backhaul segment to the RNC³.
7. Active infrastructure sharing can also include core network elements. However, this goes beyond the scope of this paper and thereby is not dealt with hereafter.
8. Spectrum sharing is defined as the simultaneous usage of a specific radio frequency band in a specific geographical area by a number of *independent* entities, leveraged

¹ "Transitional issues in the mobile sector in Europe" Document RSPG10-351 Final– published on 10 February 2011

² Notably includes base stations (BSC), radio network controllers (RNC) and backhauled to the BSC/RNC.

³ National roaming, i.e. access frequencies to extend coverage, whereby a mobile network operator offers a roaming service to another mobile network operator using its own RAN and frequencies, is not considered here.

through mechanisms other than traditional multiple- and random-access techniques⁴. To put it simply, spectrum sharing consists in a common exploitation of frequencies among several operators: the end users of these operators can access the services of their respective MNO through all the frequencies that are shared in the access network. Active infrastructure sharing can actually include spectrum sharing.

9. Figure 1 below shows an example of various forms of sharing agreements, ranging from simple passive sharing to more complex active infrastructure/network architecture sharing.
10. a) Passive sharing: in this case (see figure 1 below), equipment such as the mast (left) or the whole site (right) are shared:

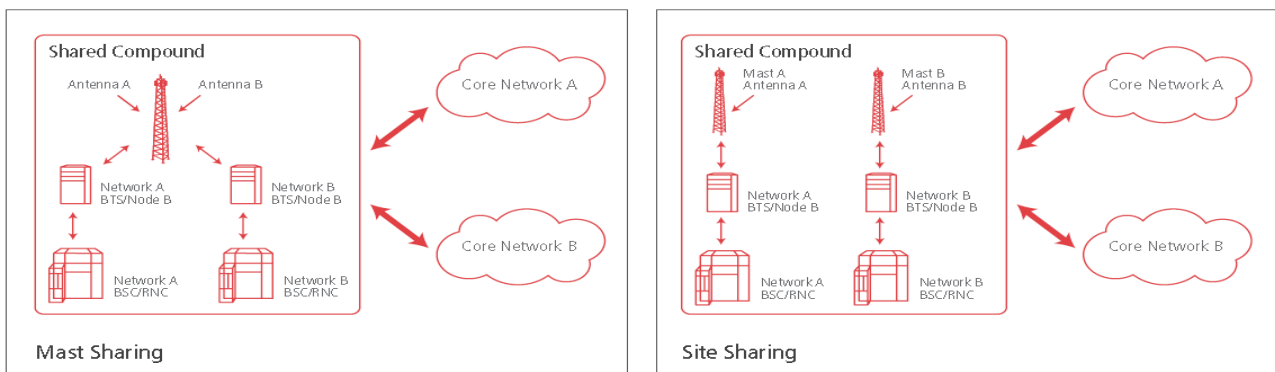
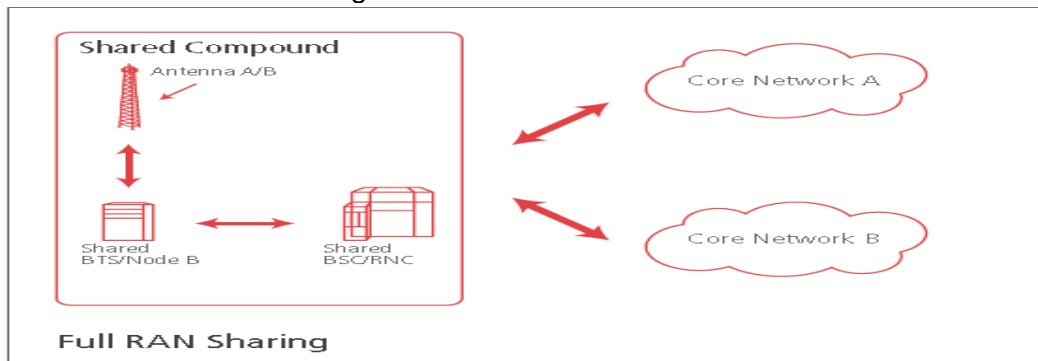


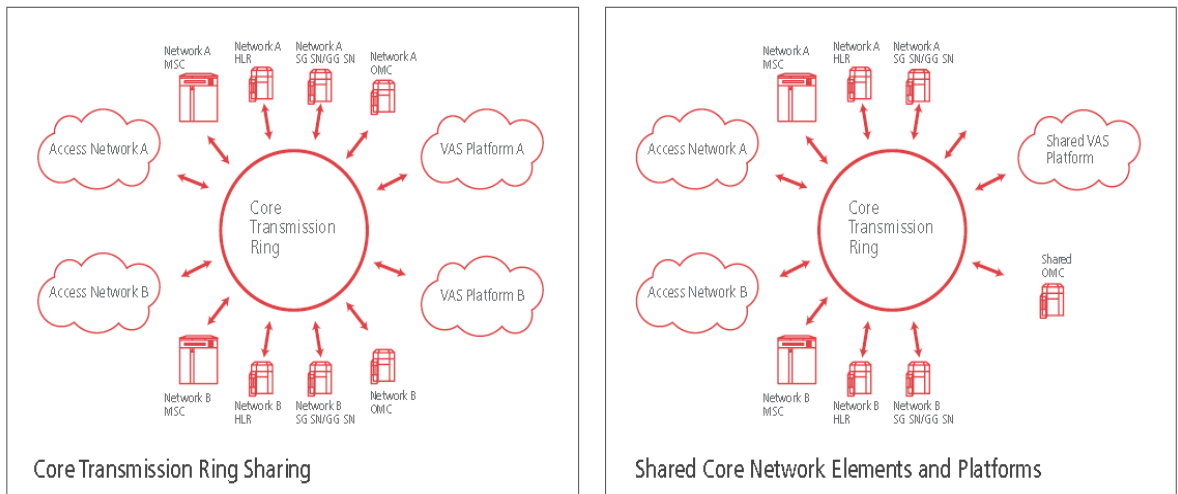
Figure 1,2,3: Access sharing (Source:Berec/RSPG based on GSMA figures)

11. b) Active sharing: in this case (see figure 2 below), the antenna, the node and the radio network controller might be shared:



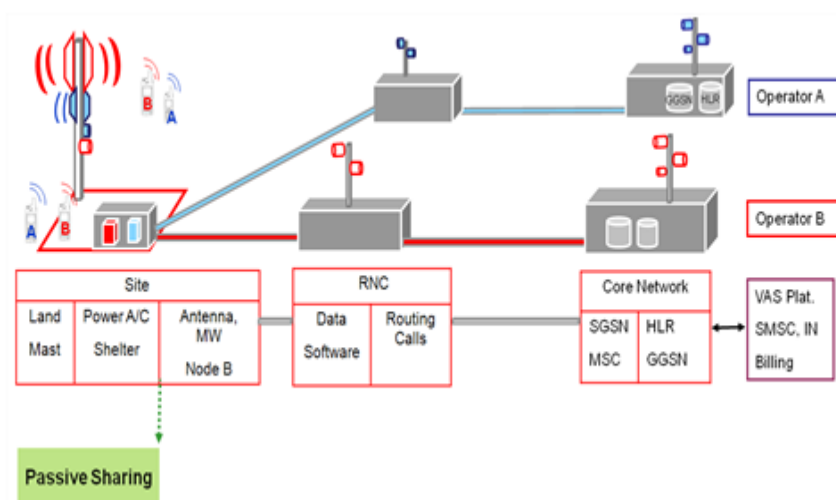
12. c) Core sharing is not dealt with in this document; the illustration (figure 3 below) provides examples of sharing at the core transmission ring level and the level of platforms and network elements.

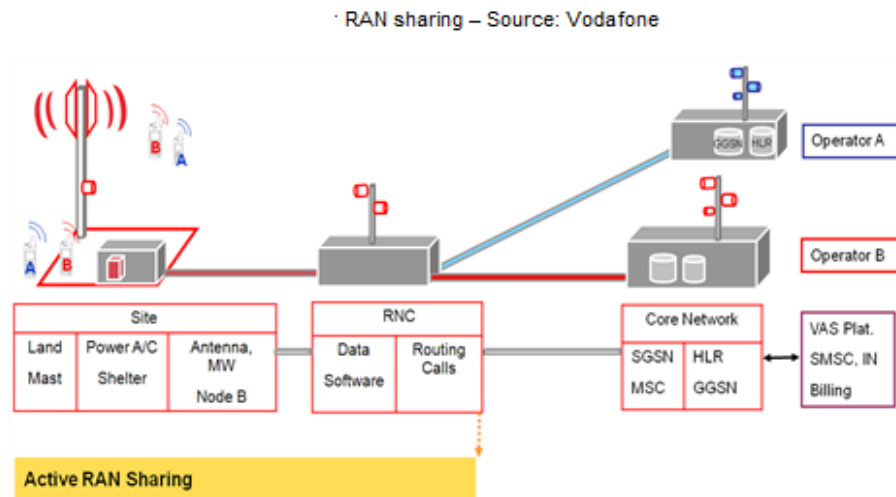
⁴ Cognitive radio communications and networks: principles and practice. A Wyglinski et al, Elsevier 2009



13. Technically, there are various solutions used by operators for active sharing, such as, but not exclusively:
14. In the case of 2G, there is equipment in the market that allows multiple operators to share all site equipment except transceivers. Accordingly, each Node-B will have two sets of transceivers, one using X's frequencies and another one using Y's frequencies. The parties will also share feeders, antennas, and other ancillary and transmission equipment, as well as the RNC. Although antennas will be shared, operators should control their own radio optimization, allowing for coverage differentiation. Moreover, even though the RNC also will be shared, the architecture developed by the equipment supplier reportedly allows for service differentiation (i.e. while having separate licensed frequencies, separate core network, separate services and dedicated carrier unit per operator in BTS/Node-B with own cell and level parameters).
15. With regard to RAN sharing, there are solutions which allow operators to share their spectrum and the core network. A multiple-operator core network allows RAN sharing with a single carrier. Several core network operators can be connected to the same RNC sharing fully all RAN resources (e.g. while having common sites and cell level parameters).

Site and mast sharing – Source: Vodafone





16. Figures 4,5 – further schemes for passive (site) and active (RAN) sharing. Source: Vodafone 2009

Section II: key findings

II.a Nature of sharing and present situation

17. Based on research and on the responses to the questionnaires, this report illustrates the characteristics of a number of sharing agreements in place across Europe, in terms of:

- Scope of sharing;
- Scale of sharing;
- Significance of sharing agreements in terms of costs;
- Innovative forms of sharing;
- Competition issues;
- Sharing governance.

Scope of sharing

18. Based on research and the answers to our survey from participating RSPG/BEREC members, in all EU 27 member states there are agreements based on passive network sharing, that is, at the level of site sharing; increasingly, active network sharing is also used by operators, as technology progresses and, in some cases, as regulation allows. Starting from Sweden in 2001, with the deployment of a nationwide 3G network (quickly followed by Germany), the number of contracts increased heavily from 2006 onwards. The whole practice of passive sharing has come a long way and it is now considered commonplace. With regard to active sharing, RAN sharing is the most common form, which may escalate to joint operation support systems management and single backhaul.

Scale of sharing

19. Increasingly, within the same country a sharing agreement would involve more than two incumbent operators. The scope of the issues covered (infrastructures and spectrum sharing, passive and active infrastructures, business and regulatory

modalities, etc.) is such that it can be said that sharing practices are moving towards a higher level of cooperation. However, in terms of competition assessment, NRAs and NCAs will need to monitor developments so that there is no prejudice to the competitive environment.

20. While a general trend seems to emerge in the direction of an increase in sharing agreements, it has to be pointed out that the actual intensity of sharing may vary.
21. For instance, in Germany BNetzA has recently (2010) updated their sharing guidelines, already published in 2001; notwithstanding the fact that positive regulation has been in place for a long time, figures seem to indicate that 15% of sites are shared by 2 Mobile network operators (MNOs), 10% of sites are shared by 3 MNOs and only 1% is shared by 4 MNOs. Whereas BNetzA previously ruled out RAN / core sharing as a principle, BNetzA will now consider wider cooperation, following a case-by-case analysis. In particular, BNetzA considers that joint use of spectrum could be accepted for a limited time in rural areas currently not covered with broadband.

In Austria, almost 50% of sites were shared at the end of 2009. In other countries the intensity of sharing might differ substantially, though. In Italy, ca. 15.000 out of 70.000 sites (approx 20 %) are shared to various degrees. In Sweden, on the other hand, until March 2011 no more than 70% of one own's network could be shared (generally, most facilities are shared). Regulation was subsequently made more flexible by lifting that limit.

22. In the UK, the current trend is towards large-scale network sharing rather than ad hoc arrangements. Indeed, the merger between Orange and T-Mobile, which led to the creation of Everything/Everywhere, was preceded by the creation of a company in charge of managing a massive site decommissioning, coupled with a re-design of what were previously separated networks⁵. Currently there are three bilateral network sharing deals between T-Mobile and H3G, Vodafone and Orange, and Vodafone and O2⁶.
23. In Spain, since 2006, there is an agreement between Orange and Vodafone for full 3G RAN sharing in small towns with less than 25000 inhabitants.
24. In France, a 2G sharing program, including a roaming scheme between the MNOs was set in place in the early 2000s' to improve population coverage, especially in rural areas. In more recent times, active sharing is also going to be used in 3G to extend the coverage (a RAN sharing agreement was signed by the four MNOs in July 2010).
25. For further country data, see table 1 in Annex I.

Significance of sharing agreements in terms of costs

⁵ MBNL (Mobile Broadband Network Ltd) is the network joint-venture between 3 UK and "Everything Everywhere", the company that runs Orange and T-Mobile in the UK. MBNL was previously the 3G network sharing joint venture formed in December 2007 between T-Mobile UK and Hutchison 3 UK. MBNL has more than 12,000 active shared sites of 12,500 cell sites, and has so far brought to the decommissioning of more than 5000 sites

⁶Press release by Ericsson UK, 12 November 2010:

http://www.ericsson.com/news/1462148?idx=20&categoryFilter=press-releases_1270673222_c

26. According to the industry, passive sharing alone already allows for significant savings (most industry sources indicate between 15-30% overall, with savings up to 60% of the yearly site capex depending on the geographical or quantitative extent of sharing⁷, plus a variable share of opex) and coverage improvement. This seems to provide, for most operators, sufficient benefits with a lower degree of coordination than that which would be required by active sharing (i.e. in terms of access to sites and equipments, maintenance, service level agreements and secure delivery. To make but one example, since compression rates for images transferred across the networks may vary, in the case of active sharing one common policy has to be decided).

Potential Savings of Network Sharing

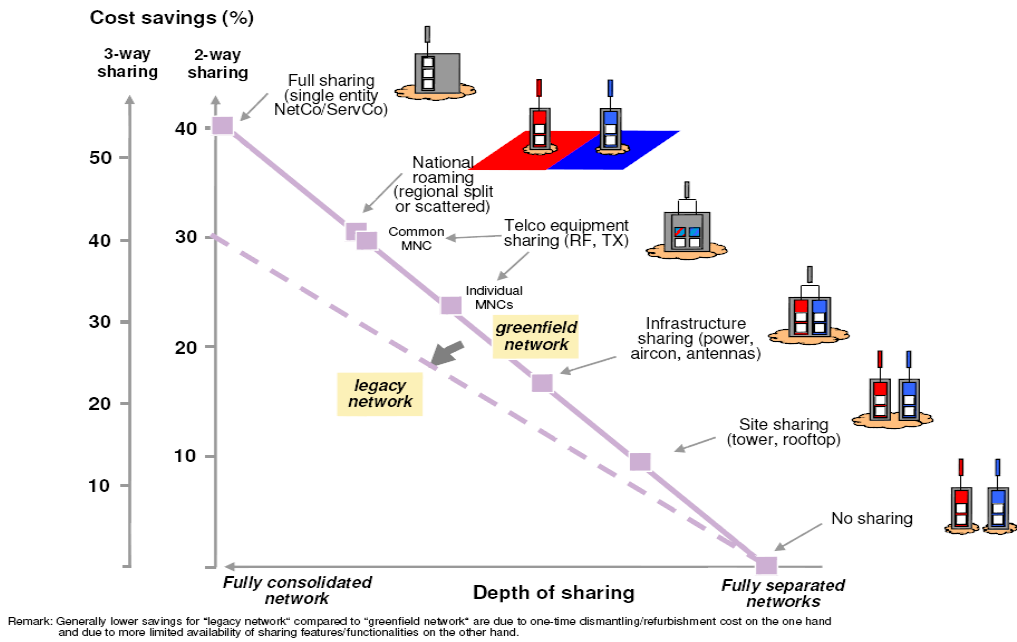
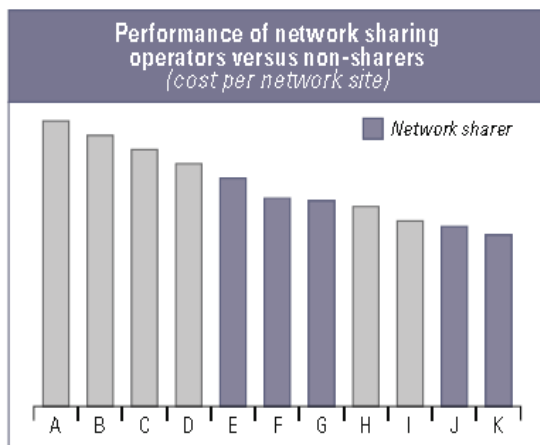


Figure 6 - Vodafone estimates of savings from network sharing, June 2009.



Source: A.T. Kearney

| Costs | Cost advantage of extensive network sharing operators |
|----------------------------|---|
| Processes | |
| Design and planning | 0% |
| Deployment and rollout | 31% |
| Operations and maintenance | 40% |
| Optimizations | 38% |
| Specific costs | |
| Site rental costs | 69% |
| Power consumption | 47% |
| Total access layer | 59% |

⁷ As reported by several sources, such as Ericsson, AT Kearney, Vodafone, Telecom Italia and others. See Annex III for a more detailed bibliography.

Figure 7 - Cost savings estimates, source: AT Kearney survey over 100 MNOs, 2009

The figure above shows a breakdown of costs in the access layer, while Figure 8 below shows in more detail the relation between CAPEX and OPEX savings:

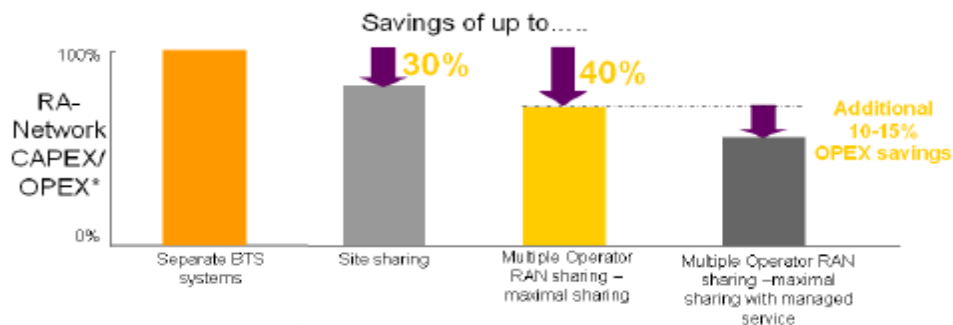


Figure 8 – Network sharing solutions and potential OPEX/CAPEX savings, Source: Nokia 2010

Innovative forms of sharing

27. With regard to active sharing, RAN sharing might be boosted by recent technical developments (such as VBS or virtual base stations⁸). There is a technical possibility to share frequencies as well while keeping the customers of different networks separate.
28. With regard to spectrum sharing, one example could be RAN sharing with dedicated frequencies, with physical sharing of the node (hardware) but where the logical part (software) is managed separately. Where multiple operators own the same spectrum, RAN sharing can take place with shared spectrum (and one cell instead of two). The second option is technically and operationally more complex.



Figure 9 - Examples of spectrum sharing

Source: ZTE (see link in Bibliography), 2010

⁸ The VBS concept allows operators, using dedicated software, to operate a physical base station as several virtual base stations at once.

From the regulatory perspective, both spectrum sharing (via cognitive technologies) and enhanced frequency re-use might allow the spectrum users to exploit under-used spectrum and promote a more efficient use of resources.

As an example of frequency re-use, in Finland the mandatory co-ordination distance for frequency re-use between geographically adjacent service areas has been minimised and in some cases completely removed in the 3.5 GHz frequency band, through voluntary agreements between license holders. The holders of the same frequency block have agreed on co-existence in the co-ordination area. These agreements have maximised the cumulative service area and contributed to an improved broadband coverage. However, this is not legally possible in some member states.

29. In some countries it has been reported that sharing, both active and passive, is hampered by strict local regulation on EM fields emission limits. Actually a wide divergence exists amongst the values set by different countries in Europe, so that operators in countries with the lowest limits may find difficult to share, even when willing. This situation has also been reported as limiting own network development with new technologies (i.e. LTE), when these have to coexist with the older ones (i.e. GSM, UMTS).
30. With regard to the transition from sharing within 2G/3G networks to sharing in a 3G/4G environment, there are a few considerations to make. Experience show that sharing between different generation of networks (e.g. 3G only to 3G-2G) might improve coverage of the 3G network, but this might have negative effects for the “receiving” network, the 3G-2G in this example, in terms of congestion in some areas if the network is not optimized.
31. With regard to the 3G to 4G transition, some manufacturers have introduced “native” RAN sharing options with the task of addressing a number of issues, including high volumes of data consumption per user and service classes.

Competitive aspects of infrastructure and spectrum sharing

32. In order to evaluate possible effects on competition, it should be evaluated whether any form of sharing has an impact on competition in the relevant wholesale and retail access markets. Some non-exhaustive criteria⁹, which might be considered when assessing possible distortion or restriction of competition by an infrastructure sharing agreement, could be¹⁰:
 - whether sharing agreements are unilateral (one operator agrees to provide access to another), bilateral (two operators agree to provide mutual access) or multilateral (several operators agree on terms on which they will provide access to each other),

⁹ Further legal and economic criteria that can help analyzing the compatibility of individual co-operation agreements with Article 101 of the TFEU can be found in the Commission Communication (2011/C 11/01) on Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements, OJ C of 14.01.2011, p. 1, in particular chapter 2 on general principles on the competitive assessment of information exchange and chapter 4 on production agreements.

¹⁰ Those criteria do not, however, constitute a ‘checklist’ which can be applied mechanically. Each case must be assessed on the basis of its own facts

- the geographic scope of the sharing agreement (one site, several or all sites in a certain region or the territory of a Member States, international),
- the impact on the competitive situation in the concerned markets before and after the sharing agreement (does the agreement affect important competition parameters such as coverage, prices and network quality?),
- whether the operators involved in the sharing agreement keep their independent control over the radio planning and the freedom to add sites,
- whether the operators are enabled to conclude similar agreements with other parties (no exclusivity clauses),
- whether it is ensured that the exchange of information between the parties is limited to what is strictly necessary for the purpose of the sharing agreement and does not extend to the exchange of confidential business information.
- whether the operators retain the ability to differentiate themselves in terms of prices and quality and variety of services;
- whether the independence of a network operator is prejudiced (where the emphasis would be on avoiding collusive behavior).

33. Indeed, infrastructure sharing agreements may raise the issue of their compatibility with Article 101 of the Treaty on the Functioning of the European Union (TFEU). Particularly, concerns can appear that relate to the immediate effects on competition in upstream and downstream markets, but also to the possibilities of the involved operators to collude or to exchange confidential information.

34. Eventually, the assessment depends on the own facts and merits of each case. In two past cases¹¹ the Commission considered that site sharing would not in itself lead to restrictions of competition. In the same cases the Commission ruled further that in so far as the agreements foresee national roaming, they limit infrastructure based competition and impact service level competition and therefore fall under Article 81 (1)¹² of the TFEU, but can be exempted from the competition rules according to Article 81 (3) EC for a limited time. Yet, following to an appeal by the parties in case *T-Mobile Deutschland /O2 Germany*, the European Court of First Instance (CFI) found in favor of the complainants that the Commission had wrongly concluded that the national roaming agreements were restrictive to competition by their very nature.¹³ The CFI held in contrary that a roaming agreement of the type concluded between T-Mobile and O2, instead of restricting competition between network operators, is capable of enabling, in certain circumstances, the smallest operator to compete with the major players.

¹¹ Cases *COMP/38.369: T-Mobile Deutschland /O2 Germany: Network Sharing Rahmenvertrag* and *COMP/38.370: O2 UK Limited / T-Mobile UK Limited: Uk Network Sharing Agreement*.

¹² With effect from 1 December 2009, Article 81 of the EC Treaty has become Article 101 of the Treaty on the Functioning of the European Union ("TFEU").

¹³ See Case T-328/03 – *O2 (Germany) GmbH & Co. OHG v Commission of the European Communities*. See also the communication from the Commission, *Towards the Full Roll-Out of Third Generation Mobile Communications*, COM(2002)301 final, 11th of June 2002. However the CFI decision was based on the conclusion that the EC's decision "suffers from insufficient analysis, first in that it contains no objective discussion of what the competition situation would have been in the absence of the agreement [...] and, second, in that it does not demonstrate, in concrete terms, in the context of the relevant emerging market, that the provisions of the agreement on roaming have restrictive effects on competition"

35. In general, antitrust regulation is likely to focus on assessing whether the parties involved in an infrastructure sharing agreement keep their independent control over important competition parameters and remain full competitors in all aspects. In their assessment, competition authorities will probably also have to balance anti-competitive concerns, if any, with positive effects on competition, as for instance increased incentives for network roll-out and more competition on services¹⁴.
36. Nowadays, in almost all European countries sharing is encouraged, provided that this is not detrimental to competition, on the grounds of, inter alia, efficient use of resources, environmental and health protection issues and coverage. For instance, in France, the Law of Modernization of the Economy has imposed the rollout of a shared network to all MNOs to foster and facilitate the widest 3G coverage of the territory. In order to do so, an active sharing scheme has been set up by them. In some countries (PT, UK, IT, FR, DE) regulation or guidelines are issued to provide guidance on regulatory requirements for infrastructure sharing to market players; those apply in parallel to competition law rules.
37. On the other side, in Romania (and similarly in Spain) it is not possible, for different operators, to jointly exploit frequencies originally assigned to individual operators.

Benefits of sharing

38. Sharing agreements solutions that are compatible with competition law may have advantages for all parties involved, including end users (e.g. in terms of coverage and/or quality of service).
39. Sharing agreements might have positive results in terms of overall efficiency. Clearly the first reason for sharing is the related cost reduction (according to industry estimates, up to 30% for site sharing only, while further potential cost savings are related to different network sharing solutions¹⁵).
40. In order to evaluate the real impact of sharing agreement, a significant aspect to take into account relates to market context, i.e. if network sharing takes place in a brownfield or greenfield setting. In the latter case (es. 4G), MNO's may design the new shared infrastructure almost from the outset to meet all own demand (capacity). Thus efficiency gains from sharing will be significantly higher.

¹⁴ Article 101(3) of the TFEU provides for that agreements between undertakings, decisions by associations of undertakings and concerted practices that may affect trade between Member States and which have as their object or effect the prevention, restriction or distortion of competition within the internal market may be exempted from the application of Article 101(1) of the TFEU in case they contribute to improving the production or distribution of goods or to promoting technical or economic progress, while allowing consumers a fair share of the resulting benefit, and which does not:

(a) impose on the undertakings concerned restrictions which are not indispensable to the attainment of these objectives;

(b) afford such undertakings the possibility of eliminating competition in respect of a substantial part of the products in question.

¹⁵ Additional cost savings are possible (up to 15% of Opex) with managed service.

41. One consequence seems to be that resources might be freed to improve mobile broadband coverage provided by MNOs individually. This has been experienced in some of Member States (FR, SE, IT, UK).
42. Further analysis at a national level would be required to obtain more solid data. Another outcome might be that infrastructure sharing limits duplications and gears investments towards underserved areas – or just improve broadband coverage and speed in high-demand areas, while incentivizing companies to focus on product innovation. In the figure below, core benefits of different types of sharing are summarized.

| Type of Sharing | Strategic Drivers | VAS systems | |
|---------------------------|--|---------------------------|--|
| Passive | | | |
| Site (co-location) | <ul style="list-style-type: none"> • Reduced site acquisition times for new entrants • Access to locations of strategic importance, particularly where space for new sites is limited • Increased likelihood of obtaining planning permission for new sites • Reduced opex (site lease) • Expansion into previously unprofitable areas by reducing capex and opex requirements • Environmental and alleged health concerns, for example, increasing pressure from environmental groups on existing operators to reduce the number of cell sites due to health concerns | | <ul style="list-style-type: none"> • Delayed investment in VAS system elements • Increased capacity VAS systems • Enhanced capability • Reduced maintenance and operational costs |
| Roaming | | | |
| | | National | <ul style="list-style-type: none"> • Reduced or delayed infrastructure investment • Increased coverage |
| | | International | <ul style="list-style-type: none"> • Increased service coverage |
| | | Inter-system technologies | <ul style="list-style-type: none"> • Facilitation of the introduction of new • Seamless interoperability between operator's own separate 3G and 2G networks • Delayed investment in new technology infrastructure |
| Mast (tower) times | | | |
| | <ul style="list-style-type: none"> • Reduced site acquisition and build completion times • Reduced capex (site build) • Reduced environmental and visual impact | | |
| Access | | | |
| RAN coverage | <ul style="list-style-type: none"> • Reduced number of sites and masts for the same • Reduced capex and opex (shared physical backhaul) • Reduced environmental and visual impact | | |
| Core network | | | |
| Fibre ring | <ul style="list-style-type: none"> • Capex and opex saving where spare capacity | | |
| Core network elements | <ul style="list-style-type: none"> • Delayed investment in core network elements • Reduced maintenance and operational costs | | |

Figure 10 - Source: Based on GSMA (see Bibliography), 2010

Potential downsides of sharing

43. Sharing agreements solutions might also present less beneficial aspects, though. For instance, the 2G local roaming solution deployed in France in the early 2000s has allowed an extended coverage in rural areas but initially with a lower quality of service (hand-over issues notably) than own operators networks. However, this downside has to be offset with the risk that these rural areas would not have been covered, or not at the same pace, without such a sharing agreement. Sharing agreements might, for their nature, also limit infrastructure-based competition and impact service level competition. Furthermore, proximity between operators might entail a potential reduction of incentives to invest in infrastructure and the differentiation in mobile services and pricing, with a consequent restriction of competition. This phenomenon might depend on the extent to which sharing is to take place.
44. Ultimately, all of the above should be evaluated on a case by case basis by the competent national authorities.

Sharing Governance

45. While the norm is a fully fledged commercial contract, in some countries (UK) specialized companies have been formed to oversight network sharing while another method consists in a governance-scheme gathering operators together, without the creation of a dedicated structure (FRA).
46. In Ireland, 3G MNOs have signed a code of practice for site sharing. The Code provides guidance on a common site-sharing framework for all 3G operators active in Ireland.
47. Since 2001, joint guidelines have been produced by OPTA, the NCA and the ministry in the Netherlands on joint construction and sharing of UMTS network elements. Mobile licences do not allow for sharing core networks though. Operators are obliged to allow site and mast sharing upon reasonable request, according to article 3.11 of the Telecommunications Act.

For further reference on guidance, see in particular the summary of the answer provided to questions 9, 10, 11 and 14 in Section III of this document.

Section III: detailed answers

In this section we summarize the answers from the responding countries. The following answers are based on NRAs or national frequency agencies responses to the questionnaire circulated in June 2010 (answers from AT, CH, DE, DK, ES, FR, FI, HU, IT, LT, NL, NO, PT, RO, SE, UK), and a further round of questions in September, with answers provided until the first week of November 2010. A last round of comments in Spring 2011 allowed for fine tuning the answers provided.

1. *What are the existing infrastructure sharing agreements (commercially driven or mandated) in your country? (please provide a short, but relatively detailed description of regulatory measures or commercial agreements, if available)*

There are sharing agreements in all the countries considered. Some of them are commercially driven (HU, UK, RO, DK, SE, DE, AT, NO, ES, FR, CH, FI, PT), some others are also encouraged by the competent authorities (PT, IT, FI) or else imposed from NRAs (NL, FR, LT) with particular conditions (ES¹⁶, FR). Most of them involve the sharing of passive infrastructures, mainly sites, power and masts, both on 2G and 3G networks, with a focus on rural areas. The first active sharing agreements are perhaps those signed in Sweden (Tele2 and Telia, H3G and Europolitan) in 2001, followed by similar agreements in UK and Germany (O2 and T-mobile), where in each nation the operators agreed to jointly deploy a nationwide 3G network. Then a growing number of operators entered in passive sharing agreements, initially mainly at national level and later sub-regionally. Amongst the latter, one was signed in 2006 between Orange and Vodafone, for sharing in Spain and UK; then a deal between Telefonica and Vodafone in 2009 regarding the cross-sharing of passive infrastructures in UK, Spain, Ireland and Germany. Cross-country agreements might foster efficient investments in mobile infrastructures, as operators have the possibility to maximize the value of their market share in each county while having, at the same time, access to a larger portion of the EU single market. 2010 marked a further increase of sharing agreements, including active sharing up to the RAN level.

2. *What are the existing spectrum sharing agreements in your country? How the original conditions attached to the spectrum rights of use have been/will be fulfilled?*

Seemingly, there are no specific spectrum sharing agreements within the EU (based on the temporary lease of frequencies between operators) and most Member States have no provisions on this topic. Generally, in EU countries, every MNO must use its own frequencies to deploy the radio access network, and in this sense frequency sharing is not allowed (eg. ES), or subject to limitations. In some countries, spectrum rights are linked to the obligation,

¹⁶ In Spain, the shared use of public/private property can be mandated by the public administration when necessary due to environmental, health, security and town-planning constraints. In that case, sharing agreements are left to the parties, but in case of non-agreement the conditions can be defined by CMT.

for license holders, to roll-out nationwide infrastructure: as network sharing is limited by licenses, spectrum sharing is limited in the same extent. In Sweden, for example, one of the conditions for licensing 3G spectrum until March 2011 was that no more than 70% of network infrastructure could be shared; in Denmark instead, the license owner is required to meet certain coverage obligations for the deployment of 2G and 3G network, having full control of the respective core network and Radio Access Network (RAN).

3. *What are the objectives of each regulation [if the latter exists]?*

Most of the respondents declared that the main objective of existing regulation is the efficient use of resources (DE, FR, DK, ES, IT, LT, FI, SE, NL, PT), fostering the deployment of telecommunications infrastructure with fair and transparent conditions. Another issue mentioned in several replies is the interest in promoting competition (PT, UK, IT, FR, DE) and/or fostering the widest infrastructure coverage (DK, ES, FR). Most of the times, each of these objectives are taken into consideration in combination with the others. Only a few respondents mentioned environmental (CH) and health protection as part of their regulation targets (ES, NL, FI, FR).

4. *Have you had a public consultation covering mobile/wireless infrastructure sharing in your country? If so, what are the results?*

The majority of answers are negative. Public consultations covering this topic were held in France and in UK (both in 2009). In some other cases, like Italy, Finland, and Denmark, the subject was part of the public consultation relative to market 15 (as per the 2003 EC Recommendation on relevant markets), while in others it was part of a different public consultation (Portugal). In a workshop hosted by the Danish regulator in May 2010 about network sharing, rules and technical issues were debated and it was indicated that flexible solutions are allowed, from sharing of masts and buildings to RAN-sharing, as long as the MNOs still fulfil their coverage obligations as foreseen in their licenses. At the same workshop, an estimate for the economical benefit of sharing agreements was presented by Ericsson¹⁷, in the order of 4-2-1 (Site sharing – Backhaul sharing – RAN sharing).

5. *Is infrastructure sharing mandated or under consideration for mobile or other wireless networks? If so, please provide details of the regulatory requirements.*

Infrastructure sharing is encouraged in several countries including Italy, Portugal and Switzerland, and is mandated in some countries, like the Netherlands¹⁸ (mast and sites), Spain (there is an obligation only when an operator cannot have separate access to the

¹⁷ Source: Ericsson, see Annex III

¹⁸ Art. 3.11, Telecommunication Act.

land), France (passive infrastructure sharing is mandated by law since 2006, as MNOs must share facilities when they roll-out new sites and have to accept reasonable access requests; a law in 2008 has imposed active sharing of the 3G networks of all the operators in the most rural areas), Lithuania (Art. 39 of Electronic Communication Law). In Finland an obligation to lease radio masts or sites may be imposed as an SMP remedy, but this remedy has not been used on the relevant mobile network markets. In Switzerland operators are encouraged (by a Recommendation issued from federal agencies that is addressed to municipalities, in charge of according building permits to operators) to share passive infrastructures, like masts and feeders, but only on a voluntary basis. Sharing core net components, instead, is not allowed).

6. *What is your general experience with the agreements in place in your country? Has infrastructure sharing impacted on the market to some extent (i.e. retail market competition, technological and service innovation, costs)? Can you provide a (broad) evaluation of cost reductions at industrial level? Was efficient use of resources increased? If possible, please distinguish the various sharing scheme, and notably passive vs. active sharing.*

The answers received in most questionnaires (NL, DE, FI, SE, FR, IT) point out that it is easier to install new sites, experiencing cost reductions and better network coverage too: as found in Italy, tower sharing can reportedly reduce overall cost of ownership after accounting for the tower lease costs, by 16 to 23 per cent; other similar figures are offered by Germany (up to 30% of total costs) and by literature (between 20% and 40%). Infrastructure sharing is likely to save capital costs (CAPEX), leading to further operational cost savings (OPEX) too. Portugal mentions that it has experienced a sensible increase in shared sites over the last years. Other respondents (UK, Denmark, Netherlands and Lithuania), acknowledge that while it can be difficult to evaluate actual benefits, such agreements might have a positive impact on efficiency and retail competition if resources previously allocated to network development are invested in competitive services. Only Hungary explicitly considers that the impact on retail market might be negligible.

7. *Is there, in your country, a public register for network infrastructures sharing agreements including spectrum sharing agreements? If such register does not exist, please provide the reasons.*

The necessity of having a public register for mobile sharing agreements has been identified only in some Member States: in the Netherlands (public register for sites and antennas), Italy (the agreements are notified to the Authority and then published yearly) and Germany (where there are two registers, one on broadband availability and the other on network infrastructures). In Denmark, sharing agreements of mast and sites are under the supervision of municipalities, therefore NITA (the Danish regulator) has no information on it. In 2010, a public consultation regarding the set up of a register for network infrastructure in general, namely ducts, inspection chambers, manholes and associated infrastructures was conducted in Portugal. This process led to the definition of a centralized information system. The implementation phase is currently under way and the system is expected to become operational by the end of 2011.

8. *Do you co-operate with the National Competition Authority (NCA) on the topic of sharing? How are competences [if applicable] divided between NRA and NCA in your country in this regard?*

Even if, in most cases, the modalities are not explicitly specified, NCA/NRA co-operation is acknowledged in almost all answers (sometimes in the form of a simple request of an opinion or, as in Denmark, a co-operative action with strict specifications of which competences belong to each actor), with a clear distinction between the role of NCA (ex-post) and NRA (mostly ex-ante). Only in UK, OFCOM is a “concurrent competition authority” and thus can intervene single-handedly on cases.

9. *Do you have specific dispute settlement mechanisms in place or are disputes settled on a case by case basis within the existing judicial framework?*

Hereby we chiefly refer to the legal framework and specific rules governing the dispute settlement. Where possible, also the jurisdiction (= which authority is responsible) is mentioned.

Clear and predictable rules and an efficient judicial framework, where rules are applied and decisions are fully enforced, are essential tools for the functioning of the system. Most of the answers indicate a case by case mechanism (NL, FI, RO, FR, CH, LT, DE, IT, HU, UK), while in Spain and Sweden there is a managed scheme if parties do not find an agreement. In DK and Finland, the settlement mechanism is operated by municipalities; in Finland in particular they are the first-instance administrative authority in case of mandated sharing of masts and sites (when parties cannot reach an agreement). In Portugal the Electronic Communications (Law nr. 5/2004) foresees that the NRA, at the request of either party, intervenes in any dispute connected to the obligations arising under this law.

10. *Does your country currently offer incentives of some sort to share network infrastructure?*

There are mainly three ways to induce operators to act according to the policy target set up by the Authorities: one is by the use of force, thus mandating an action that have to be executed from the other side; else the public entity might act by incentives, therefore changing the convenience of some choices; or else inducing a decision by the use of monetary subsidies. No clear incentives are mentioned in the replies, except in the Netherlands where small antennas are exempted from building authorizations and in Portugal where infrastructure sharing has been part of the analysis criteria used in a public bid based on proponents' characteristics (*beauty contest*). Together with the provisions from other applicable Portuguese regulation, the more recent Decree n.123/2009 (specific regime that governs the construction, access to and set up of communications networks and infrastructures) also conveys a legal incentive to the infrastructure sharing.

In Italy, a Law passed in 2008 has simplified civil works procedures.

In Finland, “Best Practices on Joint Construction of Infrastructure Networks” were published in December 2010. These guidelines¹⁹ provide information on the experiences, best practices and the acquired benefits in the joint deployment of infrastructure networks.

11. *Do incentives to invest in the roll-out of the network exist, taking into account state aid issues?*

This topic is important for the future development of mobile broadband. In fact, the interaction between investments, risks and regulation will be relevant for the deployment of the network. As a consequence, this will impact on the modalities of infrastructure sharing, therefore on business models and competitive issues. There are, in some cases, incentives to develop a fixed network in rural areas: in France there were public aids for rolling out 2G mobile network and fixed network in rural areas, while in Finland, Italy and Hungary there are policies to fill the digital divide. and in Portugal there are incentives to develop several NGA (speed higher than 40 Mbps) in rural areas with the aim of promoting social and territorial cohesion. In Spain (at national and regional level) there are incentives (legal and budgetary subsidies) for the deployment of mobile networks.

12. *Do you consider that infrastructure sharing could support a regulatory policy to complement fixed coverage with mobile systems (e.g. mobile broadband). And, if so, in which case would you or did you resort to such a solution?*

Most NRAs do not answer to this question. Anyway, some answers (Netherlands) point out that the interaction between fixed and mobile becomes less crucial if, in that country, there is already a high penetration of DSL/cable. Other answers show that integration between fixed and mobile does not seem to be a primary objective.

13. *Do you believe that the number of sharing agreements will increase in the future?*

Most NRAs appear positive on this: the trend experienced in the last few years, in fact, testifies the increased use of sharing opportunities to achieve better coverage and reduce costs for the operators. Lithuania alone deems unlikely an increase in the number of agreements.

14. *Are you planning to promote sharing agreements in the future (e.g. by mandating spectrum sharing within an assignment procedure)? If yes, how?*

¹⁹ http://www.lvm.fi/c/document_library/get_file?folderId=964900&name=DLFE-11791.pdf&title=Julkaisu%2041-2010.

In defining a general policy on sharing agreements, regulators have to take into considerations both benefits and drawbacks (as already mentioned): so, if infrastructure sharing might reduce costs and have benefits at retail level, on the other side there is the risk of hampering competition. For instance, in France, as regional development is the primary objective in the attribution of spectrum in the 800 MHz band, high levels of national coverage obligations should be set, combined with the utilization of wide channels to ensure the provision of high rates in the overall territory. Network sharing schemes are considered to foster and facilitate the roll-out of mobile networks in these conditions. Other networks (2G and 3G) are expected to remain under current rules. The opinions contained into the questionnaire show that, according to some countries, sharing agreements should be encouraged without being imposed (Italy), while they are mandated by law in Spain, in case of non-agreement between parties. In Germany mobile operators will share on a voluntary-only basis.

Annex I

This table summarises answers provided by NRAs and Administrations and it provides information about sharing agreements in place, percentages of shares sites and regulatory provisions.

| Country | Sharing solution by Operators | | Sites involved | Operational method and/or regulatory provisions |
|---------|--|---------------|--|--|
| | Site sharing between | RAN Sharing | | |
| AT | Yes | Yes | Ca. 50% (refers to site sharing) | Leasing of shared sites |
| CH | Yes Swisscom-Sunrise-Orange | | | RAN sharing on a case by case basis |
| DE | Yes | | Ca. 15% | |
| DK | Yes | Yes | | License holders must ensure that conditions in the license is fulfilled i.e. coverage obligations and sole control of the network (e.g. capacity, QoS, roll-out). |
| ES | Yes Vodafone-Orange | Yes | Ran sharing in towns < 25000 inhabitants | Frequency sharing not allowed |
| FR | Yes Orange-Bouygues-SFR, and Free mobile in the future | Yes (3G only) | RAN sharing for the covering of about 3000 smaller towns | 1,3% of population concerned by RAN sharing MNOs must favour passive infrastructure sharing when they roll out new sites ; Legal obligation of RAN sharing in specific areas |
| FI | Yes | | | |
| ITA | Yes TIM-Vodafone TIM – H3G Vodafone- Wind | | Ca 20% (15000 out of 70000) | |
| NL | Yes | | | |
| NO | Yes Telenor – Netcom –Mobile Norway | | | Obligation to give access to radio masts or sites may be imposed as an SMP remedy |
| PT | Yes | No | Confidential | |
| RO | Yes Vodafone-Orange- Orange Vodafone-Orange- Cosmote Orange - Orange- Cosmote RCS&RDS & RCS & RDS-Tele mobil | No No | <15%15% | Shared sites Shared sites |
| SE | Yes Telia –Tele2 Telenor H3G Telenor-Tele2 | | | Sharing topped at 70% of network infrastructure for 3G |

| | | | | |
|----|---|--|--|---|
| UK | Yes H3G- T-Mobile O2- Vodafone Orange-Vodafone | | | <p>3UK and T-Mobile UK have a full network sharing agreement in operation via the JV MBNL, which is run by Ericsson under an outsourced managed services contract.</p> <p>Cornerstone is a JV between O2 and Vodafone</p> |
|----|---|--|--|---|

Table 1. Type of sharing solutions in place. Source: BEREC/RSPG research and responses to internal questionnaire

ANNEX II -Glossary

BSC = Base Station Controller; the network entity controlling a number of Base Transceiver Stations

BTS = Base Transceiver Station; the network entity which communicates with the mobile station

Node B = The element in a UMTS network which interfaces with the mobile station, analogous to a BTS in a GSM network

RAN = Radio Access Network

RNC = Radio Network Controller; the element which controls the Node Bs within a UMTS network.

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