Telecommunications Regulatory Affairs Advisory Committee

Mobile Network Sharing

PURPOSE

This paper provides Members with an overview of various types of sharing arrangements for public mobile networks and sets out the existing regulatory requirements in Hong Kong regarding mobile network sharing.

BACKGROUND

2. The mobile telecommunications service markets in Hong Kong and other advanced economies are characterised by fast technology evolution and vigorous competition. Among others, network sharing is an effective means for mobile network operators ("MNOs") all over the world to reduce the cost of building and operating mobile network infrastructure as well as to make more efficient use of radio spectrum for providing high speed mobile data services.

3. Mobile network sharing which serves to lower capital and operational expenses and to expedite the rollout of mobile network infrastructure for better coverage is generally permitted and facilitated by regulators in overseas jurisdictions in different ways. Some overseas jurisdictions may in fact have put emphasis on encouraging or mandating sharing of base station facilities with a view to efficiently using the space occupied and thus reducing over-construction of base stations facilities (including antenna, masts, shelters, power supply and air conditioning inside shelters, base station equipment, backhaul transmission equipment, etc) in densely populated areas. A summary of overseas experience on mobile network sharing is set out at the **Annex**.

4. In Hong Kong, mobile network sharing has been implemented by MNOs in a number of forms such as site sharing, radio equipment sharing, capacity leasing, etc. Recently, the Office of the Communications Authority ("OFCA") has received enquiries from some MNOs relating to other forms of mobile network sharing such as co-site equipment sharing, carrier aggregation, and pooling of spectrum resource among different MNOs. There would be a need to set out in this paper some known forms of mobile network sharing, the relevant regulatory regimes in Hong Kong, and the need for MNOs to consult OFCA when they are contemplating any novel form of mobile network sharing.

VARIOUS FORMS OF MOBILE NETWORK SHARING

5. Drawing on the overseas experience and based on OFCA's understanding of the practices which have been considered in the local environment, mobile network sharing arrangements among MNOs may take the following forms –

(a) Antenna Sharing

MNOs may share the use of a single antenna and other relevant peripheral supporting equipment including masts, antenna frames, antenna, combiners, couplers, feeder cables, mounting poles and ducts, cabinets, amplifiers, etc. in establishing their respective base stations at a particular location. These antenna facilities may be installed and operated by the MNOs on a cost-sharing basis, or by other third party infrastructure providers. Each participating MNO may operate its own base station equipment separately.

In Hong Kong, antenna sharing among MNOs is very common and is usually employed in indoor coverage enhancement projects with Integrated Radio Systems ("IRS") which are installed in shopping malls, railway premises and road tunnels. For many of these projects, site sharing (as mentioned below) between MNOs may also be involved.

Figure 1 below illustrates an example of antenna sharing.

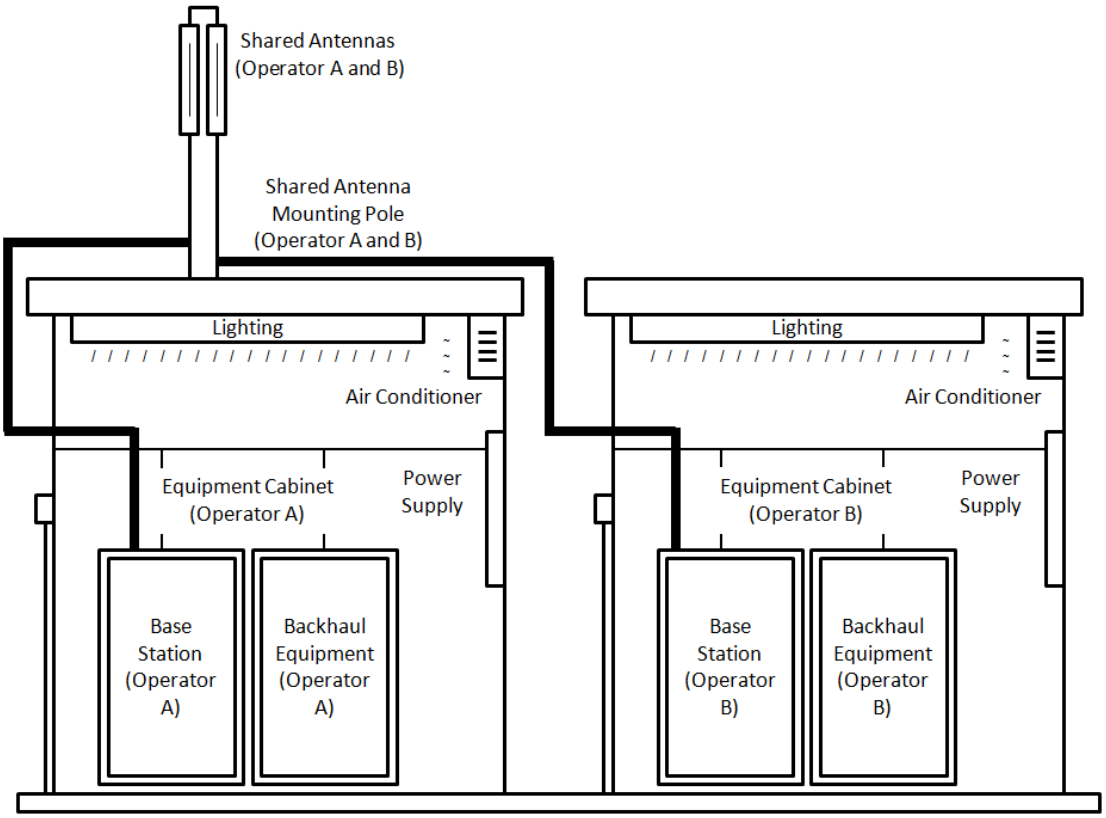

Figure 1 - Antenna Sharing

(b) Site Sharing

MNOs may share the same physical site location when establishing base stations to provide service coverage to a particular area, i.e. co-location of sites. They may share the same physical compound (e.g. shelter, equipment room or equipment cabinet) for installation of their own base station equipment, antenna and cabling facilities separate from one another. Relevant building services / facilities such as electricity supply, air conditioning, lighting, fire service installation, security facilities, etc. can be used by all the participating MNOs on a shared basis.

In Hong Kong, typical examples of site sharing are those installations of base stations at rooftops and common equipment rooms, where multiple MNOs may share the same physical

compound while installing their individual base station equipment and antenna.

Figure 2 below illustrates an example of site sharing.

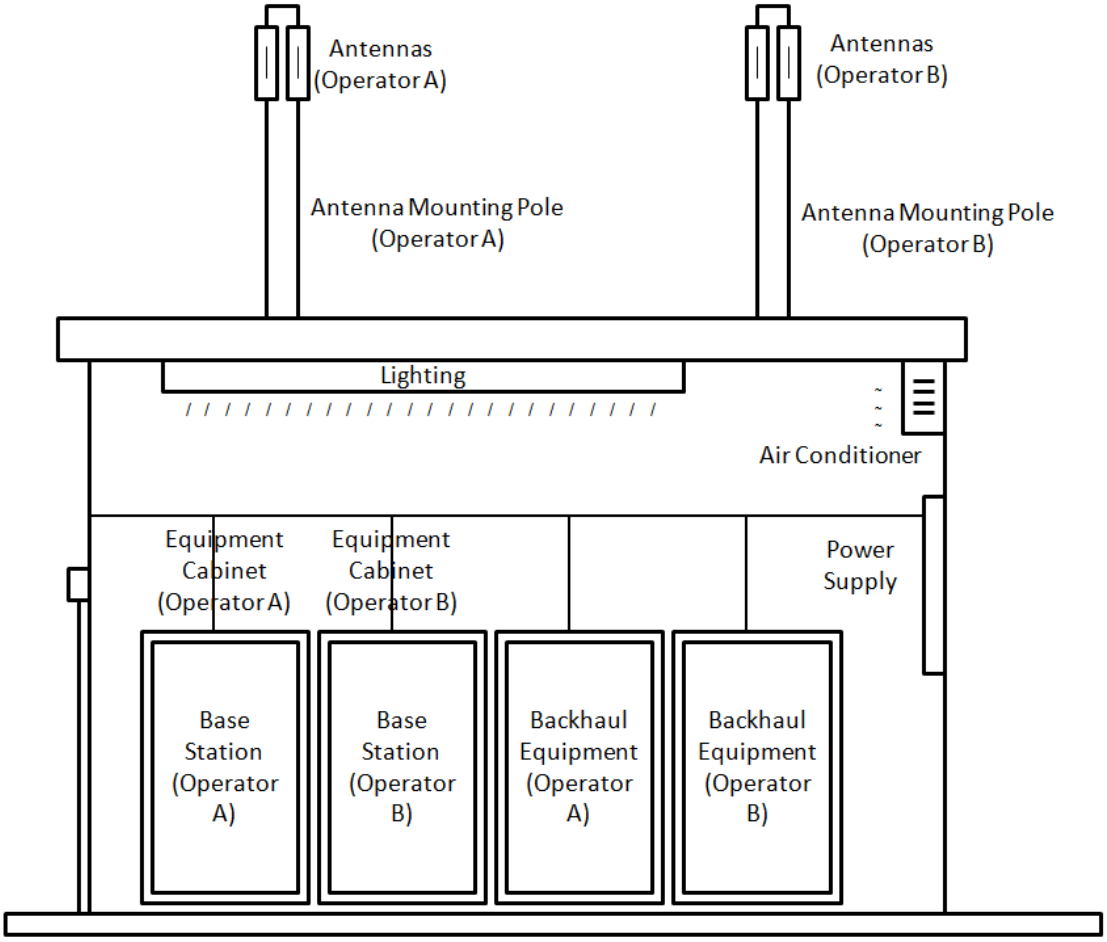

Figure 2 - Site Sharing

(c) Radio Access Network ("RAN") Sharing

MNOs may choose to have shared use of all or part of the RAN equipment and facilities including base stations, radio network controllers, backhaul transmission equipment, etc. The shared RAN can be seen as a single radio network which is connected to the core networks of different MNOs through the point of interconnection. For legitimate RAN sharing scenarios in Hong Kong, each participating MNO will maintain its own separate logical RAN using its own assigned spectrum even if they share the use of the same RAN equipment and facilities with others

and there should not be any pooling of spectrum by the participating spectrum assignees (see paragraphs 13 and 14 below). The participating MNOs may also enter into operation and maintenance ("O&M") agreements under which the shared RAN will be managed and operated by one of the participating MNOs, or any other third party O&M service providers.

In Hong Kong, it is understood that RAN sharing has not yet been implemented in practice.

Figure 3 below illustrates an example of RAN sharing.

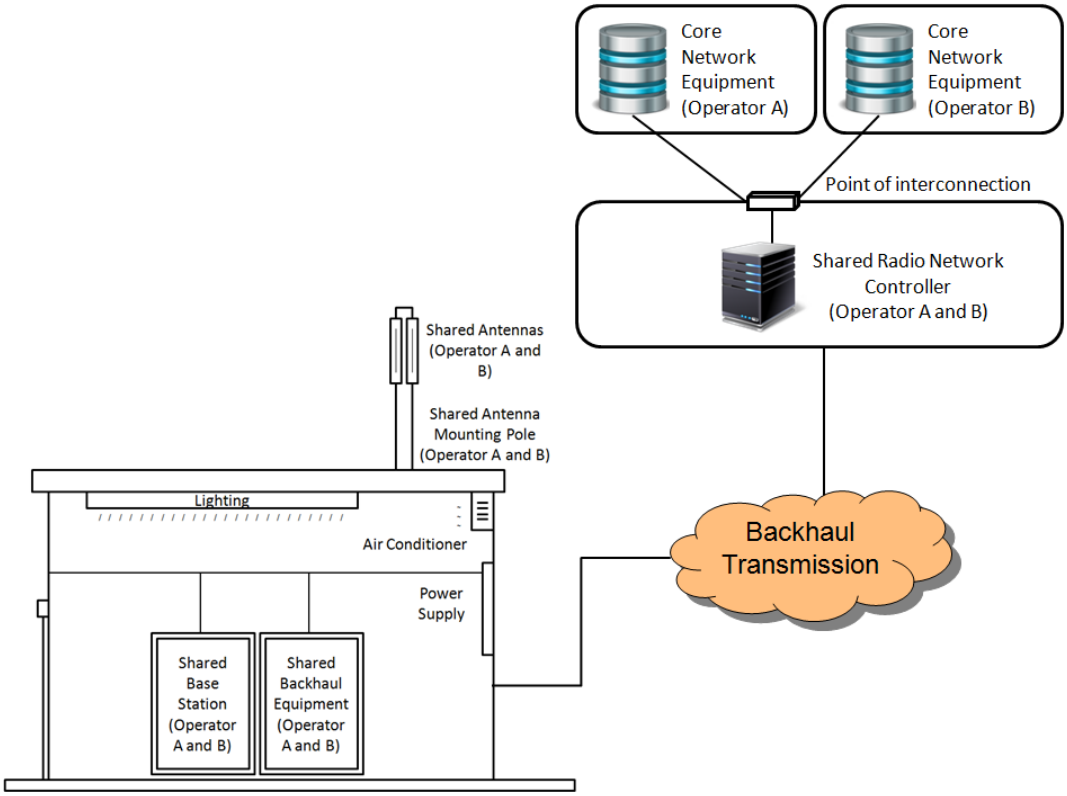

Figure 3 - RAN Sharing

(d) Domestic Network Roaming

Another form of mobile network sharing involves agreement among MNOs such that users of one MNO will be permitted to roam into the network of another MNO when their home network is not available at a particular geographical location. The arrangement is useful for those MNOs who may not have

established a territory-wide network and may therefore rely on network roaming agreements with other MNOs to extend network and service coverage to their subscribers.

In Hong Kong, there is no domestic roaming being implemented for the time being.

(e) Capacity Leasing

Apart from physical sharing of the base station facilities, an MNO may also lease the radio access capacity from other MNOs in order to expand its service coverage for a particular area or enhance its network capacity. An MNO may enter into a capacity leasing agreement with another MNO to acquire a specified amount of mobile voice and data capacity from the RAN established by the latter party.

For instance, if an MNO intends to provide service coverage at a particular geographic area outside the coverage of its own network, or at a particular frequency band it is not assigned with, it may enter into a capacity leasing agreement with other MNOs to acquire the relevant radio access capacity instead of building its own RAN in that particular area or acquiring the concerned frequencies.

With the advancement of carrier aggregation technology, an MNO may also lease another MNO's radio access capacity and aggregate that capacity with its own to enable the provision of higher speed mobile data services to its subscribers, provided that each MNO will continue to operate its own separate RAN using its assigned spectrum.

At present, there are capacity leasing agreements between some of the MNOs in Hong Kong. In fact, similar agreements have been common between MNOs and mobile virtual network operators ("MVNOs") and resellers under which the MNOs provide wholesale of radio access capacity, and in some cases also core network switching capability, to the MVNOs / resellers

to enable the latter to provide retail services to mobile customers without establishing or operating all or some of the telecommunications facilities required for network operation.

RELEVANT REGULATORY REGIMES IN HONG KONG

6. Consistent with a market driven regulatory approach adopted by the Communications Authority ("CA") for the telecommunications sector in Hong Kong, MNOs may negotiate and agree among themselves on mobile network sharing arrangements such as those described above without intervention by the CA, as long as they are not in breach of the restrictions and obligations imposed by the law and their carrier licences. In particular, there is currently no restriction for an MNO to outsource the O&M of its networks including core network and RAN to other MNOs or other third party O&M service providers. That notwithstanding, the CA has the power under the Telecommunications Ordinance ("TO") to direct the sharing of facility between MNOs and will exercise that power accordingly if it is in the public interest to do so.

7. At present, in considering whether a specific form of mobile network sharing should be allowed or facilitated, OFCA will draw guidance from the following provisions –

(a) Relevant provisions under the TO and other statutes
(b) Obligations under licence conditions
(c) Restrictions on spectrum assignments

Relevant Provisions under the TO and Other Statutes

8. As far as the provisions of the TO are concerned, sections 36AA and 36B may be relevant to mobile network sharing. Section 36AA gives the CA power to direct under section 36B a licensee to cooperate with another licensee specified by the CA in the public interest to use any facility owned or used by it. The CA has a legal duty to take into account relevant matters listed under section 36AA when considering whether a direction should be issued to a licensee to share a facility.

9. Permission of mobile network sharing does not generally prejudice the CA's power to investigate anti-competitive behaviour. Possibility of anti-competitive behaviour due to mobile network sharing will be dealt with under the Competition Ordinance (Cap. 619) ("CO") or the competition provisions of the TO primarily depending on the time period during which the concerned conduct occurred.

Obligations under Licence Conditions

10. As far as mobile network sharing is concerned, a number of licence conditions of the unified carrier licence ("UCL") may be relevant including –

(a) General Condition ("GC") 2 on transfer of right etc. under licence;
(b) GC 7 on confidentiality of customer information;
(c) GC 8 on records and plans of network;
(d) GC 9 on control of interference;
(e) GC 11 on compliance with licence conditions;
(f) GC 12 on requirements of radiocommunications equipment; and
(g) GC 13 on use of frequencies.
(h) Special condition ("SC') 6 on requirement to furnish information to the authority

11. The above licence conditions impose general restriction and control on licensees for serving the following purposes –

(a) Prevention of unauthorized transfer of rights and benefits from one licensee to another;
(b) Prevention of harmful radio interference; and
(c) Effective enforcement of the licensee's obligations for meeting the general objectives of the TO such as protection of customer information, adherence to technical standards, compliance with codes of practices, guidelines etc. and generally to make better provision of telecommunications service to the public.

12. It is worth noting that pursuant to the terms and conditions of the 3G auction held in 2001, in order to promote facility-based competition

during the initial stage of 3G network deployment, the unified carrier licences of those MNOs assigned with the relevant spectrum in the 1.9 – 2.2 GHz band have since 2001 been imposed with the licence condition that the licensees shall not share the use of the network or any part of it with any other MNO unless prior written consent has been given by the CA or such network sharing is in conformity with guidelines issued by the CA from time to time. In view of the extensive 3G networks rolled out by MNOs over the years, such a condition will not be carried forward to the next term of the frequency assignment in the band when the existing frequency assignments expire in October 2016.

Restrictions on Spectrum Assignments

13. Irrespective of the form of mobile network sharing, the MNOs participating in the sharing arrangement should only transmit radio signals using their own assigned spectrum as specified in the relevant Schedule of their respective carrier licences. As each MNO has the exclusive right and obligation in respect of the spectrum assigned to it, the radio signal should be identifiable to be transmitted by a single responsible licensee within its spectrum holdings. For the avoidance of doubt, spectrum pooling is prohibited. To illustrate, two MNOs should refrain from pooling together some of their assigned spectrum to form a single carrier for radio transmission by either party. While equipment sharing is allowed, the radio signal transmitted must still be identifiable and held responsible by respective spectrum assignees. In implementing a certain form of RAN sharing, each MNO should continue to keep a separate logical RAN using its own assigned spectrum despite any sharing of RAN equipment.

14. As a guiding principle, any form of mobile network sharing should not result in *de facto* sharing, swapping, leasing or trading of spectrum which has not been approved by the CA or is not permitted under the existing legal and regulatory regimes. Furthermore, the sharing arrangement should not affect the on-going compliance with the rules of auctions through which the licensees acquired the spectrum in the respective frequency bands.

WAY FORWARD

15. In view of the technical and operational benefits brought by mobile network sharing, MNOs may explore new forms of mobile network sharing so as to deliver services in more cost effective manner. While OFCA is prepared to facilitate mobile network sharing under the existing regulatory regimes, MNOs have the duty to ensure their compliance with the relevant regulatory requirements, in particular the restrictions on spectrum assignments as illustrated in paragraphs 13 and 14 above, before implementation of any mobile network sharing arrangement.

16. If MNOs have any proposals to adopt potentially new forms of mobile network sharing (other than those prevailing in the market), they should furnish relevant technical and operational information on network implementation and operation to OFCA for advice of whether the proposals are fully compliant with the relevant regulatory requirements. For example, when an MNO leases radio access capacity from another MNO and perform carrier aggregation together with its own assigned spectrum, the concerned MNOs should show to the satisfaction of OFCA that they are continuing the use of their own assigned spectrum for radio transmission only, and radio signals of the frequency carriers involved in the carrier aggregation arrangement can be identifiable in respect of transmission by the respective MNOs using their own assigned spectrum. MNOs should also provide in their submission the measurement methodology based on which their compliance with relevant regulatory requirements can be verified.

VIEWS SOUGHT

17. Members are invited to take note of the content of this paper. Any views or comments from Members would be welcome.

Office of the Communications Authority
January 2016

Annex

Overseas Experience on Mobile Network Sharing

Different overseas jurisdictions have adopted different approaches regarding the regulation and facilitation of mobile network sharing. A summary of the overseas practices is set out in the following paragraphs.

European Union (EU)

2. The EU has issued directives to require its member states to take on measures to facilitate network sharing. Back in March 2002, the European Parliament and the Council of European Countries issued the Directive 2002/21/EC [1] on a common regulatory framework for electronic communications networks and services ("Framework Directive"), and the Directive 2002/19/EC [2] on access to, and interconnection of, electronic communications networks and associated facilities ("Access Directive"). Article 12 of the Framework Directive provides that national regulatory authorities shall encourage the sharing of electronic communications network facilities installed on, over or under public or private property. National regulatory authorities may impose the sharing of facilities or property (including physical co-location) on network operators or take measures to facilitate the coordination of public works after public consultation. Such sharing or coordination arrangements may include rules for apportioning the costs of facility or property sharing.

3. Article 12 of the Access Directive further provides that a national regulatory authority may impose obligations on operators to meet reasonable requests for access to, and use of, specific network elements and associated facilities, in situations where the national regulatory authority considers that limited access may hinder the

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[1] The Framework Directive is available from "http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0021&qid=1450234221381&from=EN".

[2] The Access Directive is available from "http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0019&qid=1449215995649&from=EN".

development of a competitive market or may affect the interest of end-users. In particular, the directive states, *inter alia*, that operators may be required -

(a) to provide specified services on a wholesale basis for resale by third parties;

(b) to provide co-location or other forms of facility sharing, including duct, building or mast sharing;

(c) to provide specified services needed to ensure interoperability of end-to-end services to users, including facilities for intelligent network services or roaming on mobile networks; and

(d) to interconnect networks or network facilities.

4. In the meantime, MNOs in the EU have entered into various network sharing agreements out of their own commercial decisions. In June 2011, the Body of European Regulators for Electronic Communications ("BEREC")[3] and the Radio Spectrum Policy Group ("RSPG")[4] published a joint report[5] which reviewed the infrastructure and spectrum sharing situation in the mobile/wireless networks in Europe. 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.

[3] BEREC was established by the European Parliament and the Council of European Countries in January 2010. It replaced the European Regulators Group for electronic communications networks and services which was established as an advisory group to the Commission in 2002. For details, please refer to the website "http://berec.europa.eu/eng/about_berec/what_is_berec/".

[4] RSPG is a high-level advisory group that assists the European Commission in the development of radio spectrum policy. For details, please refer to the website "http://rspg-spectrum.eu/about-rspg/".

[5] The joint report by BEREC and RSPG is available from "http://berec.europa.eu/eng/document_register/subject_matter/berec/reports/224-berec-rspg-report-on-infrastructure-and-spectrum-sharing-in-mobilewireless-networks".

5. It was found that in all 27 EU member states, there were agreements based on passive network sharing (i.e. at the level of site sharing) at the time of the report. In the meantime, active network sharing was increasingly deployed by operators in the EU following the availability of enabling technologies. The most common form of active network sharing was RAN sharing, which included the sharing of base station facilities, deployment of shared backhaul transmission systems, establishment of joint operation support systems, etc. Annex 1 of the report provides a summary of the responses made by the EU member states regarding the current status on sharing agreements in place, percentages of shared sites and relevant regulatory provisions.

Germany

6. In 2010, the Federal Network Agency for Electricity, Gas, Telecommunications, Posts and Railway issued a paper entitled "Shared Use of Wireless Infrastructures and Spectrum Resources"[6] to set out the conditions on the shared use of wireless infrastructures and spectrum resources.

7. In respect of site sharing, shared use of properties, masts, antennas, cables and combiners is permitted, provided that shared use of these components will not affect the independence of the spectrum assignees as competitors.

8. In respect of site support cabinet ("SSC") sharing, it is mentioned that shared use of SSCs with more than one physically separate base station transmitting and receiving the digital payload independently on the frequencies assigned is permitted, provided that the independence of the spectrum assignees as competitors is not affected.

9. For RAN sharing, the use of logically separate base stations in a shared physical unit is permitted if the individual cooperation agreements guarantee that each spectrum assignee will retain independence as a competitor, with the following conditions -

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[6] The paper is available from "http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/Areas/Telecommunications/TelecomRegulation/FrequencyManagement/InfrastructureSharing/InfrastructureSharingThesispaperpdf.pdf?__blob=publicationFile&v=2".

(a) independent control by spectrum assignees of their own logical base stations so that each assignee can use only the frequencies assigned to them (*de facto* control; no spectrum pool);

(b) no exchange of competition-related data beyond operational information (e.g. customer data);

(c) separation of operation and maintenance centres;

(d) possibility of operating additional own base stations (planning autonomy guaranteed); and

(e) no regional division of coverage areas that rules out network and coverage area overlap for the parties to the cooperation agreement.

United Kingdom (UK)

10. The Office of Communications ("Ofcom") encourages mobile network operators to share masts and/or sites where possible, in order to minimise the environmental impact of networks.[7] Operators may also enter into site-sharing agreements based on their commercial considerations. A number of major networks have therefore entered into agreements to share their radio networks in order to provide wider coverage to customers and to reduce costs. In some areas this may lead to the decommissioning of sites where individual network coverage overlaps.

Everything Everywhere ("EE") and Three UK

11. In 2007, T-mobile (now part of EE) and Three UK signed an agreement[8] to combine their 3G access networks (the mobile masts and infrastructure that connects to operator's separate core network) and

[7] Please refer to "http://licensing.ofcom.org.uk/radiocommunication-licences/mobile-wireless-broadband/cellular-wireless-broadband/policy-and-background/site-sharing/".

[8] Press release of T-mobile and Three UK in December 2007 is available from "http://www.hutchison-whampoa.com/en/media/press_each.php?id=2166".

formed a joint venture company called Mobile Broadband Network Limited to supervise the construction and operation of the joint network. However, the sharing agreement did not include sharing of each operator's core network and their 2G networks. Both parties would be responsible for delivering services to their respective customers and using their own frequency assignments. The integration of these 3G access networks was intended to expedite the roll out of 3G services, with a view to reducing the duplication of costs and proliferation of masts.

12. In 2014, EE and Three UK updated their sharing arrangement for 4G network roll out.[9] Only passive infrastructure such as masts and backhaul links from the site would be shared. Such changes may be due to different pace of 4G roll out by EE and Three UK.

O2 and Vodafone

13. In 2009, O2 and Vodafone established a joint team called Cornerstone to share their sites for 2G and 3G networks. In 2012, O2 and Vodafone announced their intention to strengthen their network collaboration, by pooling the basic parts of their network infrastructure to create one national grid running each operator's independent spectrum for the roll out of 4G network. As described in the press release among O2 and Vodafone[10], both companies would retain complete control over their wireless spectrum, intelligent core networks and customer data. They would compete with each other through their products and services, which were enabled through the "intelligent" parts of their network.

14. A new joint venture company would be created to consolidate both O2 and Vodafone's existing basic network infrastructure, including towers and masts. The company would also be responsible for the building of new sites that are for the coverage extension to rural and remote areas.

[9] News dated 3 February 2014 on 4G network sharing arrangement between EE and Three UK is available from "http://www.mobileworldlive.com/featured-content/top-three/ee-three-take-passive-route-4g-network-sharing/".

[10] Press release of Telefonica UK on 7 June 2012 is available from "http://www.telefonica.com/en/shareholders-investors/pdf/hr_20120607.pdf".

15. For the design, management and maintenance of the radio equipment and local transmission (that connects to each operator's intelligent backbone network), they have split the responsibility geographically. Vodafone is responsible for the west of the UK and O2 maintains the network in the east of the UK and Northern Ireland.

Sweden

16. In the paper entitled "3G rollout status" prepared by Northstream for the Swedish National Post and Telecom Agency ("PTS") issued in 2002, it highlighted the regulatory requirements related to network sharing in Sweden.[11] In particular, the paper mentioned that in Sweden, there was no restriction on sites and masts sharing. According to another paper entitled "3G Mobile Policy: The case of Sweden"[12], PTS imposed relevant licence conditions to require the 3G licensees to provide at least 30% of population coverage through establishment of their own radio infrastructure. For the rest of the population, the licensees can meet the coverage requirements by national roaming arrangements with others.

17. In 2002, Tele2 and TeliaSonera formed a joint venture called SUNAB for planning and building a new 3G network.[13] While TeliaSonera did not get any 3G licence, Tele2's 3G licence was transferred to SUNAB for shared use. As a result, Tele2 and TeliaSonera could buy wholesale capacity off SUNAB like mobile virtual network operators.

18. On 14 April 2009, Telenor and Tele2 announced an agreement to build a joint 2G and 4G network in Sweden. The agreement included the formation of a joint venture for network construction and spectrum sharing in the 800 MHz, 900 MHz, 1800 MHz and 2600 MHz frequency

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[11] Please refer to Table 3 of the paper which is available from "https://www.pts.se/upload/Documents/EN/3G%20rollout%20status%20-%20a%20report%20about%20the%203G%20status%20in%20Europe%20-%20PTS-ER-2002-22.pdf".

[12] Please refer to the paper entitled "3G Mobile Policy: The case of Sweden" which is available from "https://www.itu.int/osg/spu/ni/3G/casestudies/sweden/Sweden_fin3.doc".

[13] Please refer to the paper entitled "Network Cooperation between Mobile Operators – Why and How Competitors Cooperate?" which is available from "https://www.kth.se/social/upload/528377c5f276543fa03519a4/IMP2013-%20Markendahl%20Ghanbari%20Molleryd%20-%20July%201.pdf".

bands. Tele2's and Telenor's current GSM networks were merged, resulting in improved voice coverage for all customers. In December 2013 an agreement was reached between Telenor and Tele2 to densify and increase area coverage from approximately 70% to more than 90%, implying a rollout of 1,450 new sites.[14, 15]

United States (US)

19. Network sharing in US usually deals with passive sharing of masts, although the masts and sites are generally owned and managed by third parties rather than by mobile operators themselves.

20. Another type of sharing commonly found in US is national roaming, where the regional and local operators make roaming agreements with nationwide facilities-based providers to extend the geographic reach of their network. In 2007, the FCC clarified that mobile service providers must provide automatic roaming on a reasonable and non-discriminatory basis to other technologically compatible providers. In 2011, the FCC adopted a requirement that mobile service providers shall offer data roaming arrangements on commercially reasonable terms and conditions.[16]

21. In 2013, the FCC approved with conditions a proposal by GCI Communication and ACS Wireless to transfer substantially all of their spectrum licences to a jointly owned subsidiary. The subsidiary would also receive substantially all of the two companies' respective wireless infrastructures across the state of Alaska. The subsidiary would use these assets to provide wholesale wireless services to CGI and ACS Wireless. The FCC approved the transfer of licenses and infrastructure to the jointly owned entity subject to certain conditions to protect competition and foster universal service, including a commitment by the parties to maintain and extend their network in remote parts of Alaska.

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[14] Press release of Telenor on 14 April 2009 is available from "http://www.telenor.com/media/press-releases/2009/telenor-and-tele2-to-build-joint-4g-network-in-sweden/".

[15] Press release of Telenor in June 2015 is available from "http://www.telenor.com/investors/company-facts/business-description/telenor-sweden/".

[16] "Wireless Market Structures and Network Sharing", page 57, OECD Digital Economy Papers, No. 243, OECD Publishing is available from "http://dx.doi.org/10.1787/5jxt46dzl9r2-en".

Australia

22. In 2013, the Australian Competition and Consumer Commission ("ACCC") issued a Code of Access to Telecommunications Transmission Towers, Sites of Towers and Underground Facilities.[17] This code is introduced to encourage carriers to co-locate their mobile transmission towers and other facilities where possible, and aims to make it easier for carriers to install their equipment on or in facilities owned by other carriers in a timely and fair manner.[18] It governs the following areas:

(a) Mandatory conditions of access;

(b) General procedures concerning applying for facilities access;

(c) General procedures for negotiating a facilities access agreement; and

(d) General procedures governing the implementation of access.

23. In 2004, Telstra and Hutchison 3G Australia ("H3GA") announced establishment of a 50/50 enterprise to jointly own and operate H3GA's existing 3G radio access network. Under the agreement, H3GA radio access network became the core asset of the joint enterprise.[19, 20] This agreement ended in 2012.

24. Separately, in 2013, Vodafone announced extension of the joint venture agreement with Optus, under which both companies have shared

[17] The code is available from "https://www.comlaw.gov.au/Details/F2013C00823".

[18] Please refer to the ACCC media release on 23 September 2013 which is available from "http://www.accc.gov.au/media-release/accc-varies-the-facilities-access-code".

[19] Please refer to the 2005 Annual Report of Telstra which is available from "https://www.telstra.com.au/content/dam/tcom/about-us/investors/pdf%20C/annual-report-05-overview.pdf".

[20] Please refer to the announcement made by ACCC on 10 December 2004 which is available from "http://www.accc.gov.au/media-release/accc-not-to-oppose-3g-radio-access-network-sharing-arrangement-between-hutchison-and".

cost of building and running 500 brand new mobile sites across Australia.[21]

[21] Press release of Vodafone on 30 May 2013 is available from "http://www.vodafone.com.au/doc/VodafoneExtendsRegionalCoverage.pdf".