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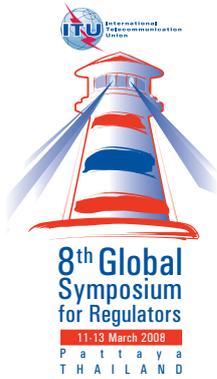
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Comments are welcome and should be sent by 13 April 2008 to GSR08@itu.int



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MOBILE SHARING

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1 INTRODUCTION

The present paper aims to describe the various options available for governments and regulators in connection with the sharing of mobile telecommunication networks in developing countries.

Mobile telecommunication services have shown an impressive take up in the last decade. In particular in developing countries, mobile telephony has played a vital role in making telephony services available to a part of the population that did not have access to such services previously. However, there is still a lot to be done to enhance competition in the mobile sector and for increasing the penetration of mobile services, in particular in rural areas in developing countries. The roll-out of mobile networks requires high sunk investments and the need to recover those by charging high fees for mobile services. This often makes mobile services less affordable and may discourage operators to innovate and migrate to new technologies. It may also cause licensed mobile operators to try to block the entry of new operators in the market. In addition, it may be too costly for single operators to roll out mobile networks in rural and less populated areas, resulting in the exclusion of a part of the population or a certain region from access to mobile telecommunication services.

Mobile infrastructure sharing is an alternative for lowering the cost of network deployment, especially in rural and less populated or marginalized areas. Mobile infrastructure sharing may also stimulate the migration to new technologies and the deployment of mobile broadband, which is increasingly seen as a viable means of making broadband services accessible for a larger part of the world population. Mobile sharing may also enhance competition between mobile operators and service providers, at least where certain safeguards are used, without which concerns of anti-competitive behavior could arise. Accordingly, policy makers and regulators are examining the role that mobile network sharing can play in increasing access to information and communication technologies (ICTs), generating economic growth, improving quality of life and helping developing and developed countries to meet the objectives established by the World Summit on the Information Society (WSIS) and the Millennium Development Goals established by the United Nations.

There are a variety of options that may be considered by regulators when assessing the viability of mobile sharing. Those options range from the sharing of towers and other building facilities to sharing an entire mobile network. This paper identifies a number of options, dividing them into two basic categories: (i) passive sharing and (ii) active sharing. Passive sharing refers to the sharing of space in passive infrastructure, such as building premises, sites and masts. Passive sharing is typically a moderate form of network sharing, where there are still separate networks that simply share physical space. Active sharing is a more intensive type of sharing, where operators share elements of the active layer of a mobile network, such as antennas, radio nodes, node controllers, backhaul and backbone transmission, as well as elements of the core network (such as switches). Active sharing includes mobile roaming, which may probably be considered as the most far reaching option for sharing infrastructure, since one operator would make use of another operator's network in a certain geographical area where it has no coverage or no infrastructure. Active mobile sharing also has a number of risks, the biggest one being the limitation of the ability of operators to distinguish their service offerings from one another where the elements which determine network quality and transmission rates are identical.

Governments and regulators are faced with a number of dilemmas when dealing with mobile sharing. Network sharing arrangements may have an impact on the ability of operators to compete and differentiate themselves based on network quality. In addition, obligations relating to network sharing may influence the willingness of operators to make efficient investments in infrastructure and innovative services. This paper identifies the different forms of mobile sharing and discusses various regulatory issues involved in each of the options. The paper also deals with backhaul sharing, which is the sharing of transmission from the radio node to the node controller prior to entering into the core network. Backhaul sharing may be necessary in certain cases, in particular

when operators have difficulties in rolling out transmission links to their radio nodes. Finally, this paper identifies a number of best practices for governments and regulators.

2 PASSIVE MOBILE SHARING

2.1 Site sharing

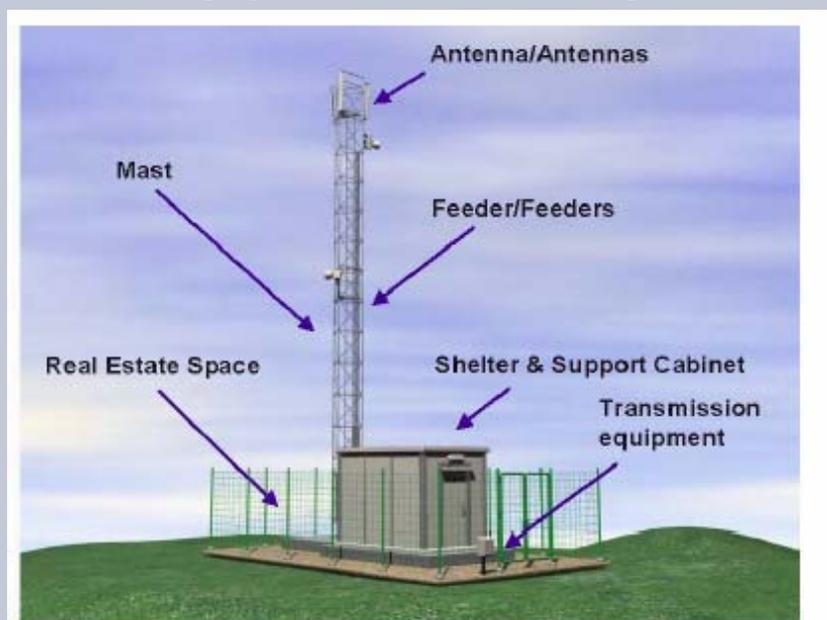
This section identifies the options available for mobile operators that wish to share passive elements in their radio access network.¹

For the purpose of this chapter, the passive elements of a mobile telecommunications network are considered to be the physical components of the radio access network that may not necessarily have to be managed or controlled by the operator after their installation. Instead, these components could be shared among operators and provided either by one operator or a business entity designed to provide such components, such as a tower company. The passive infrastructure in a mobile network is composed mainly of:

- Electrical or fiber optic cables;
- Masts and pylons;
- Physical space on the ground, towers, roof tops and other premises;
- Shelter and support cabinets, containing power supply, air conditioning, alarm installation and other passive equipment.

The assembly of passive equipment in one structure for mobile telecommunications is generally referred to as a “site”. Therefore, the form of cooperation where one or more operators agree to put their equipment on the same structure such as a tower, a roof-top or a mast fixed on the ground, will be referred to as “site sharing” or “collocation”.

Figure 1: Passive mobile sharing: options available in site sharing



Source: Telecom Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing

In site sharing arrangements, operators may share several elements of the passive infrastructure needed to provide mobile services. Operators may share space on the ground or on a tower or roof top. Depending on the location, operators may place their antennas directly on the structure (water tower or roof-top) or share a mast. Secondly, operators may share technical facilities available on the site such as power supply and air conditioning (generally integrated in a site

support cabinet, or SSC) and feeders. Antennas and transmission equipment may also be shared, but are considered to be part of the active (or transmission) infrastructure and will be dealt with in the next section.

Site sharing is often welcomed by operators because of its cost effective aspects. Putting up new sites may be a very costly (i.e., capital intensive as well as operationally expensive) and cumbersome operation for operators, not in the least because of the environmental aspects involved (see below).

2.2 Policy reasons for encouraging passive mobile sharing

2.2.1 Environmental and public health considerations

Mast and antennas for wireless communication are generally considered to have a negative impact on the landscape. Local communities may object to the construction of new sites in their vicinities, because of the visual impact or because of other inconvenience caused, such as interference with electronic equipment (such as television and radio).

Public exposure to electromagnetic fields around masts and antennas may also raise public health concerns, when communities worry about the health effects of exposure to such radiofrequency fields.² Site sharing may be beneficial to limit such concerns and negative effects since it limits the number of necessary sites in order to achieve the required coverage.³

Another beneficial aspect of site sharing is the level of energy that can be saved if operators share electricity resources such as feeders and power supply, the latter of which is often a major concern in developing countries.⁴

While site sharing reduces the number of sites marking the landscape, it can also have adverse impacts. Mast sharing means that there will be more than one set of antennas and other telecommunication equipment on a mast. Antennas generally have to be separated from each other by a minimum distance in order to avoid interference. For this reason, mast sharing usually requires taller masts, more robust and visually intrusive. Local planning authorities and communities may prefer several smaller masts rather than a larger one. More discrete structures (such as a lamppost style mast, see Figure 2) reduce visual intrusion, but cannot support antennas of more than one operator.

Figure 2: Lamppost style mast



Source : <http://dras-photos.fotopic.net/c976876.html>

2.2.2 Facilitate rollout

There are significant costs involved with civil engineering activities when the number of building sites is relatively high as compared to other individual elements of a mobile network. Operators also encounter practical difficulties in acquiring and commissioning adequate sites, obtaining the appropriate regulatory licenses and overcoming other obstacles, such as public concerns about the presence of mobile masts.

Site sharing allows operators to reduce capital and operating expenditure by reducing their investments in passive network infrastructure and in network operating costs. It may also be a way of overcoming planning and other regulatory restrictions and to meet environmental concerns. Accordingly, site sharing may serve as an encouragement for rolling out networks in a faster and more affordable way. Site sharing may facilitate rollout, bringing more wireless services to low populated and rural areas. Because of the cost saving aspects, site sharing may also contribute to making wireless services more affordable.

2.2.3 Technology upgrade: from 2G to 3G

Infrastructure sharing may be an effective option for upgrading second generation (2G) mobile services to third generation (3G) mobile communications and broadband wireless access technologies.

Operators that provide 2G mobile services may upgrade to 3G by collocating the required 3G equipment on their existing towers and masts. This may be a very cost effective option for operators, even if building a 3G mobile network would require a significantly larger number of sites. In the European Union, many 2G networks were deployed providing services in the 900 MHz spectrum band while 3G licenses were assigned in the 1900-2000 MHz band. Rolling out mobile networks in the 1900-2100 MHz-band requires a significantly higher number of sites than rolling out a mobile network in the 900 MHz band. The 900 MHz operators must erect a large number of towers in migrating to 3G, reducing their ability to realize savings by co-locating 3G equipment on 2G sites. However, those 2G operators running their network in the 1800 MHz-band are well positioned to co-locate 3G equipment on their existing 2G infrastructure and to enjoy significant savings as a result.

In countries with largely developed 2G networks, the collocation of 3G equipment on 2G infrastructure may provide a substantial advantage to incumbent 2G operators compared to new entrant 3G operators.⁵ Therefore, regulators may consider imposing non-discriminatory infrastructure sharing on existing 2G operators, requiring those to provide access to their facilities to new 3G operators under the same conditions as they provide to their own business. If new entrant 3G operators are not provided access under these conditions, they may not have a fair chance of competing on the 3G market with incumbent 2G operators. Other countries may be faced with this issue when 3G services are upgraded to 3.5 or 4G mobile services -- especially where 2G infrastructure has been deployed later and 3G infrastructure is intended to be used as a predominant type of technology for mobile services⁶. When dealing with this situation, regulators will wish to consider whether the existing infrastructure of incumbent operators would actually support more infrastructure than its own 2G and 3G equipment. There may be situations where the space available in the existing infrastructure may be exhausted.⁷

Infrastructure sharing may also be an alternative for other wireless broadband technologies, such as WiMax. WiMax was created as a broadband technology for metropolitan areas, to be a substitute for fixed broadband technologies such as cable, DSL and fiber. WiMax is also suitable as a technology for mobile telephony, although handsets suitable for WiMax are not yet widely available. There is currently a lot of uncertainty about the development of WiMax technology and the availability of equipment suitable for WiMax. However, once the technology is more developed and widespread, collocation of WiMax equipment in towers or masts used for other wireless services, such as 2G or 3G mobile, radio and television transmission, may be a serious alternative for increasing the availability and affordability of wireless broadband services. The economical benefits of collocating WiMax equipment in sites used for 2G (GSM) and 3G (UMTS) mobile services will depend generally on the operating frequencies used for WiMax, GSM and UMTS.

Wimax is primarily used in frequencies in the 2.6 GHz and the 3.4 GHz range, operating at a significantly higher frequency than 2G GSM (900 MHz and 1800/1900 MHz) and 3G UMTS (2100 MHz). In general, a WiMax cell would have significantly larger range (1.5 to 2 km) than a GSM or UMTS (0.4 to 0.7 km) range in a comparable urban environment. Accordingly, WiMax operators may achieve rather high savings by sharing infrastructure with GSM and UMTS operators. The shared infrastructure may include cables, cabinets, steel construction, antenna pole and battery back-up units.

2.3 Competitive aspects of site sharing arrangements

There are several types of site sharing agreements that may be contemplated by operators. Such agreements may be unilateral (one operator agrees to provide access to its facilities to another operator), bilateral (two operators agree to provide mutual access to facilities) or multilateral (several operators agree on the terms on which they will provide access to facilities to each other). In addition, such agreements may concern one individual site or be a framework agreement for several sites or for all of the sites in a certain geographical region.

Bilateral agreements for regional site sharing may be particularly interesting for operators from an economical point of view. Operators agree to use each other's passive infrastructure in certain regions, to avoid having to build new masts or sites where they agree to site share. This enables operators to offer service coverage in a larger geographical area, which is particularly attractive for operators subject to geographical coverage obligations. Regional site sharing allows operators to save a considerable amount of capital and operating expenditures and is an alternative for national roaming arrangements.⁸ Regulators should also be careful in order to avoid collusion between operators, especially in highly concentrated markets and where incumbent or dominant operators are involved in bilateral sharing agreements.

Most site sharing agreements do not restrict competition between operators. Site sharing arrangements generally allow operators to keep independent control of their respective networks and services. As a result, site sharing agreements generally do not lead to the harmonization of networks making the service offerings and prices charged by the site sharing operators indistinguishable. Full competition is assured where operators retain independent control over their radio planning and the freedom to add sites, including non-shared sites. In that way, operators are free to increase their network capacity and coverage. Better coverage and capacity may be a competitive parameter, as operators may be able to distinguish themselves based on network quality and transmission capacity. It is also important that site sharing agreements do not contain exclusivity clauses, prohibiting operators from concluding similar agreements with third parties.. Site sharing arrangements that fulfill these conditions are not likely to restrict competition between operators.⁹ In fact, site sharing agreements may have a positive impact on competition, since the savings achieved may be passed on to consumers, increasing quality of service and decreasing price.

Finally, it is important to ensure that exchange of information between site-sharing competitors is limited to information strictly necessary for this purpose, such as technical information and location data for individual sites. Additional exchange of confidential information should be avoided.

2.4 Regulatory measures to promote passive mobile sharing

2.4.1 Mandatory vs. optional sharing

In order to speed deployment of mobile networks to rural areas, policy makers and regulators may consider adopting regulatory measures to promote site sharing. These could include options to stimulate, but not require, site sharing as well as adopting mandatory site sharing options.

Mandatory sharing

Policy makers may choose to make site sharing mandatory for companies operating a mobile network. In countries where site sharing is mandatory, operators are generally required to allow

third parties to share their facilities upon request. In this case, there are several measures that can be imposed by governments or regulators. Such measures may vary in the degree that they intervene in the freedom of operators to negotiate site sharing agreements independently.

- **Policy objectives:** The first step policy makers or regulators will take is to determine the policy objective to be achieved in requiring site sharing. This will include geographic and population coverage objectives, environmental concerns and the promotion of competition.
- **Determining facilities subject to sharing:** The next step is determining what kind of facilities will be subject to mandatory site sharing. For example, should site sharing only be imposed for masts and pylons, or also for roof tops and other buildings (such as water towers)? Another possibility is to impose mandatory sharing only in such areas where alternative sites are not available or where regulatory restrictions apply, limiting the ability of operators to construct sites, affecting coverage and quality of mobile services.¹⁰ Such critical infrastructure sites¹¹ may be pre-defined by the competent authorities in a transparent, predictable and expeditious way. Once those sites have been identified, operators should only be granted permission to set up a mast or tower if they agree to share the site with other service providers.¹² Regulators will also wish to take into account that certain facilities may not have been designed to support site sharing or that the space on facilities may be exhausted due to the use made by the facility owner.
- **Tariffs and other terms and conditions:** regulators may choose to set the price to be paid for sharing facilities or to impose a price when operators do not reach an agreement. The price of sharing may have an important impact on the willingness of operators to roll out their infrastructure. Operators may be reluctant to roll out infrastructure if they know they will be obliged to provide access to competitors at cost-oriented levels. Certain operators may be inclined to deny access to other operators despite the availability of space for site sharing on their own infrastructure. Those operators may argue that they need to reserve space for their own use, because the space will be necessary in the future in order to improve capacity on their networks. Regulators may also consider setting up other access conditions, such as the time that operators would be allowed to reserve space on their infrastructure for their own use.
- **Information supply:** operators requiring site sharing must have access to technical information relating to the sites, including site coordinates and certain technical specifications. It is important to establish whether operators should provide coordinates of all sites, or only of those sites that those operators consider adequate for site sharing.¹³
- **Time limits:** regulators may also consider imposing time limits for providing the relevant information and for negotiating agreements. A time limit of thirty days for negotiation between the first request and the time when actual access is provided is often considered reasonable in many developed countries, such as the UK. Other countries may choose a longer period, for example of sixty days, in order to take account of administrative and other difficulties that operators may encounter when negotiating site sharing agreements.¹⁴

In all cases, the existence of pre-determined, clear **policy objectives** is crucial. Regulators can be guided by those policy objectives when setting up rules for mandatory or optional site sharing. For example, if the principle policy objective is to reduce visual intrusion and environmental interference, regulators may choose only to impose site sharing for those facilities that are more intrusive, such as towers and pylons and not for roof tops. On the other hand, if the policy objective is to promote roll out, regulators may choose to impose site sharing for all facilities, including roof tops¹⁵ and water towers.¹⁶ Regulators can also take policy objectives into account when setting tariffs and other terms and conditions.

Optional sharing

Policy objectives also play an important role when deciding whether site sharing should be mandatory or optional. When the policy is aimed at stimulating operators to invest in the roll out of their own infrastructure,¹⁷ optional sharing may be applied. In many cases, operators may voluntarily opt for site sharing, in order to reduce costs. Regulators that wish to be less interventionist may take measures to stimulate site sharing, without mandating it. Regulators may consider the following measures for stimulating site sharing arrangements:

- **Model agreements:** regulators may draw up model agreements for site-sharing, including standard terms and conditions to be applied by operators that wish to site share. Regulators may choose to provide suggestions for standard terms and conditions, but to leave material provisions (such as tariffs) to operators. In general site sharing agreements should include the following standard clauses:

Standard terms and conditions in site sharing agreements	
1	Objective of the agreement
2	Obligations of both parties
3	Term of the agreement
4	Applicable tariffs
5	Billing conditions
6	Service description
7	Implementation and coordination
8	Access to facilities and cooperation
9	Operations and maintenance
10	Subletting conditions (such as no subletting without the consent of the facility owner)
11	Term and termination
12	Penalties
13	Liability
14	Confidentiality
15	Representations and warranties
16	Amendments to agreement
17	Force Majeure
18	Governing Law and jurisdiction

Source : Author

- **Stimulate self-regulation:** the setting up of self-regulating bodies is a common practice in many countries. Self-regulating bodies (such as associations of operators) play an important role in stimulating site sharing by establishing uniform conditions for site sharing, for redevelopment of existing sites for site sharing and for joint development of new sites.¹⁸ Such bodies may also be an important factor in the communication between local authorities and operators, in order to address concerns of the population about the installation of masts and antennas in their communities.
- **Guidance on types of sharing allowed:** operators may contemplate site sharing arrangements between themselves, for example regional sharing as discussed above.

Regulators can provide clear guidance to operators on the type of arrangements that are allowed under the applicable laws and regulations. It is very important for operators that contemplate these kinds of arrangements, to have legal certainty about the status of their plans. Regulators can provide this legal certainty, e.g. by publishing guidelines on the subject.

- **Encourage sharing on government-owned facilities:** many towers, masts and other facilities that can be used for wireless transmission are often owned by government authorities or government owned companies. Site sharing on such facilities could be encouraged. This will be further addressed in Section 2.5.
- **Financial incentives for sharing:** regulators may also consider several ways to encourage site sharing by providing financial incentives. This will be further addressed in Section 2.6.

2.4.2 Dispute settlement mechanisms

Whether governments choose mandatory or optional sharing, efficient dispute settlement mechanisms for the resolution of disputes in connection with site sharing should be put in place. The dispute resolution body should be composed of individuals with expertise in the field, who understand the technical and legal issues involved.

Dispute resolution bodies should have sufficient powers to take the necessary action in order to make site sharing possible. Such bodies should be able to impose interim measures in urgent cases, for example when new entrants depend on site sharing for rolling out their networks and entering the market.

In principle, dispute resolution bodies should be independent and have no connections with operators or other interested parties. Dispute resolution bodies could be formed by members of national regulatory authorities. It is natural that national regulatory authorities be guided by their objectives when settling disputes between operators, such as promoting market entry. Independent courts, however, should be able to review the decisions of regulatory authorities in an efficient and expeditious way. The ability to effectively promote site sharing and its important policy objectives, however, will suffer where decisions can be too easily appealed, and even suspended during appeal.

2.4.3 Authorization and licensing conditions: the role of local authorities

The possibility of constructing sites in certain areas may be limited due to regulatory restrictions. In most countries, the installation of masts and towers for wireless communications will be dealt with by local authorities, such as municipalities and townships. Local authorities often require a permit or authorization for the construction of a mobile mast.

Local authorities may take part in promoting site sharing, e.g. by requiring new masts or towers to be designed and engineered in order to accommodate more than one operator. Local authorities may also require operators to place their equipment on existing masts, unless this is not possible for technical reasons.

In order to be successful in the promotion of site sharing, it is crucial that local authorities work closely with operators and their representatives. Disputes between operators and local authorities are harmful for the roll out of networks and increase concern by communities, which may often be unfounded and unnecessary. Associations of operators may be an important factor in establishing a dialogue between local communities and operators, increasing awareness about the presence and the location of masts in their communities and the possible health or environmental effects of those masts. Such associations may also develop, in cooperation with local communities, common guidelines for the installation of new sites or new equipment on existing sites. This will increase local participation, improve the availability of information and create legal certainty for operators willing to roll out their networks.¹⁹

It is also possible that central or national authorities develop rules or guidelines to be followed by local authorities when addressing the authorization of site construction in their communities. For example, regulators could develop standard conditions for the authorization of the construction of towers or masts, to be applied in rural or less populated areas by local authorities, after evaluating the local environmental and other concerns.

2.5 Ownership and other structural aspects

Telecommunication operators that own towers, masts or other infrastructure may have incentives to prevent competitors from placing their equipment on their towers or masts. However, entities known as tower companies have every incentive to sell their services to as many telecommunication service providers as possible.

Where operators' towers or masts are to be considered as non-replicable and as a vital resource for wireless transmission, government authorities may consider ordering structural separation of those towers and masts as a separate entity. This new entity should have an obligation to allow all operators on its towers on a non-discriminatory basis.²⁰ Recently, the European Commission has introduced the concept of functional separation of telecommunications networks, as a remedy to be imposed in order to promote competition on the market.²¹ The concept of functional separation of mobile networks will be addressed in Section 3.3.

Government intervention is not always necessary to separate the tower infrastructure from other activities of a mobile operator. Operators may contemplate outsourcing their tower operations to a tower company, which may be an interesting option from a business perspective. Operators may transfer the ownership of towers, masts and other passive equipment to an independent company, the so-called 'tower company'. The tower company would own the towers and masts (or possibly the whole site) and provide a variety of services to the outsourcing operator, such as (i) radio and transmission planning (ii) site acquisition (iii) site construction and equipment installation and (iv) site maintenance. Outsourcing deals may create considerable financial savings for operators and allow operators to focus on their core business, which is providing wireless services to their customers. Outsourcing of site infrastructure has been particularly successful in North America and is considered to be one of the key enablers of the roll out of mobile networks in the United States.²² Although it is not as developed as in the United States, the concept of tower companies is becoming more common in Europe.²³ Government authorities may contribute for the roll out of wireless networks, by promoting and authorizing tower companies to sell their services to mobile operators.²⁴

Government authorities may also promote multiple use of towers and other structures by making their own infrastructure available for wireless transmission. In many countries, infrastructure which may be used for the installation of wireless equipment is owned by government authorities or is the property of government owned companies.²⁵ Government authorities may promote the roll out of wireless networks, by offering this infrastructure for the installation of equipment by multiple operators. In particular, electricity companies,²⁶ as well as railway and highway companies, often own infrastructure that can be used for wireless transmission. Government authorities can contribute, by making this infrastructure available whenever possible and by promoting multiple usage of this infrastructure by operators.

Other issues that may be addressed by governments relate to the ownership of the towers and masts and of equipment placed on such towers. In certain jurisdictions, especially those governed by the civil law system, towers and masts that are installed on a long term basis on land or buildings, may be deemed to be owned by the land or building owner by way of "accession". Accession is a legal concept governing the acquisition of property of objects that have a close connection with or dependence on another object. According to this concept, the owner of a principal object (the land) may acquire property of the accessory (the tower or mast). Operators may have to take very costly and cumbersome measures to avoid losing the property of their infrastructure, such as establishing rights of "superficies" for each of their towers or masts.²⁷ Government authorities may contribute to avoiding uncertainty about ownership issues, by

promulgating laws and regulations excluding acquisition of telecommunications equipment installed on land, buildings, towers and masts by way of accession.

In addition to ownership issues, lease agreements between operators and real estate owners should facilitate site sharing. Preferably, such agreements should not contain exclusivity clauses. In addition, lease agreements should allow other operators to place their equipment on the site, without requiring further consent of the real estate owner. Government authorities may help by making information available to real estate owners about the benefits of site sharing as well as their rights and obligations when contracting with operators. Government authorities or self-regulating bodies may also provide standard documentation (such as model lease agreements), which would facilitate negotiations between operators and real estate owners.

2.6 Financial incentives for passive sharing

There are several measures that may be considered by government authorities in order to provide financial incentives to encourage operators to share sites.

Depending on the taxation and licensing system applicable in a certain jurisdiction, authorities may consider exempting earnings from sale and lease of passive infrastructure for site sharing from certain taxes and levies, whether or not in connection with the applicable licenses. However, in the absence of structural or functional separation of these activities from other segments of the telecom business, it may be difficult to segregate revenue arising from those activities from other revenues. This may be resolved by providing a report by an independent auditor or by providing a statement of those incomes on which the authorities could rely.

In addition, charges levied by local authorities for the installation of masts and towers in their towns or villages may be reduced in cases where the infrastructure is shared with other operators. Local authorities may consider exempting operators from those charges or limiting those charges to recovering administrative costs. Local authorities should consider at least reducing those charges in cases where the site is shared.²⁸ Local communities that wish to promote the deployment of wireless telecommunications or broadband may consider leasing space or buildings for mast sites for a reduced price in order to reduce the cost of deployment, making the service available and more affordable for the local community. Local communities that provide such subsidies may require operators to provide a minimum level of service or to provide wireless broadband services to the community, e.g. at minimum speed levels. In addition to installing radio equipment for wireless transmission, operators can also be required to install sufficient backhaul facilities, which will allow the required broadband speed to be provided.

Government authorities may also consider making a distinction between site sharing in urban areas and site sharing in rural or remote areas. Rolling out a mobile network in rural or remote areas, where population density is much lower than in urban areas is usually very costly for operators because of low traffic volume.²⁹ Financial incentives for site sharing in rural areas may help bring wireless services to the population in those areas. In countries where the population depends on wireless technologies to have access to telephony services, authorities may contemplate using universal services funds to provide financial incentives for the roll out of shared infrastructure. This is the case in India, where the government has established a subsidy support scheme for shared passive wireless infrastructure in rural areas with a target to set up about 18,000 towers by 2010 and to increase sharing in urban areas to 70 per cent by 2010.³⁰ The Indian example is further dealt with in Section 4.

Subsidized infrastructure could be used initially for mobile telephony, but may be subsequently used to provide wireless broadband services. If subsidies are provided as loans to operators, government authorities may require some form of security for payment of the loan, such as a mortgage or pledge on the towers and mast or other equipment. If the subsidies are not paid back, the government may acquire the towers and mast and outsource them to a tower company (see Section 2.5).

Of course, governments will wish to examine carefully whether providing subsidies for wireless deployment in rural or urban areas is an adequate measure in order to stimulate the roll out of

wireless networks. Sharing arrangements will often reduce costs and make wireless deployment in the respective areas viable. Moreover, the price of site leases in rural areas may be extremely low, especially if compared to site leases in major urban areas. Governments can therefore seek to analyze the cost of site deployment in rural areas before deciding on a subsidy scheme. Governments can consider the costs of site deployment and analyze what type of subsidy scheme would be adequate for achieving the goals stipulated by them. Governments may also decide to use pro-competitive subsidy schemes, such as minimum subsidy auctions. These methods will reduce the amount of subsidies given, while helping operators to deploy services in rural or less populated areas. Depending on the costs of site deployment, other kinds of commercial agreements between operators (such as national roaming) may resolve coverage problems in rural or remote areas, without the necessity for subsidies. Policy makers can balance concerns about the costs of subsidies against possible negative effects of roaming agreements, such as anti-competitive effects.³¹ Alternatively, relaxing regulatory requirements may often be sufficient for promoting deployment in certain areas, without the need for subsidies. Governments may decide that providing subsidies is necessary when the installation of passive infrastructure is a main bottleneck for providing wireless services in a certain region.³²

3 ACTIVE MOBILE SHARING

3.1 Options for active mobile sharing

In addition to sharing passive infrastructure, operators may also share active elements of their wireless networks. The “active elements” of a wireless network are those elements that can be managed by operators, such as antennas, antenna systems, transmission systems, channel elements and others. Operators may share those elements and keep using different parts of the spectrum assigned to them. Although active infrastructure sharing is more complex, it is technically possible and equipment manufacturers can supply packages which have expressly been designed for active mobile sharing. This section will describe a number of options available for active mobile sharing. Most of the examples used in this section are based on sharing of a 3G network for mobile telecommunications, but could be applied for broadband wireless or 2G networks.³³

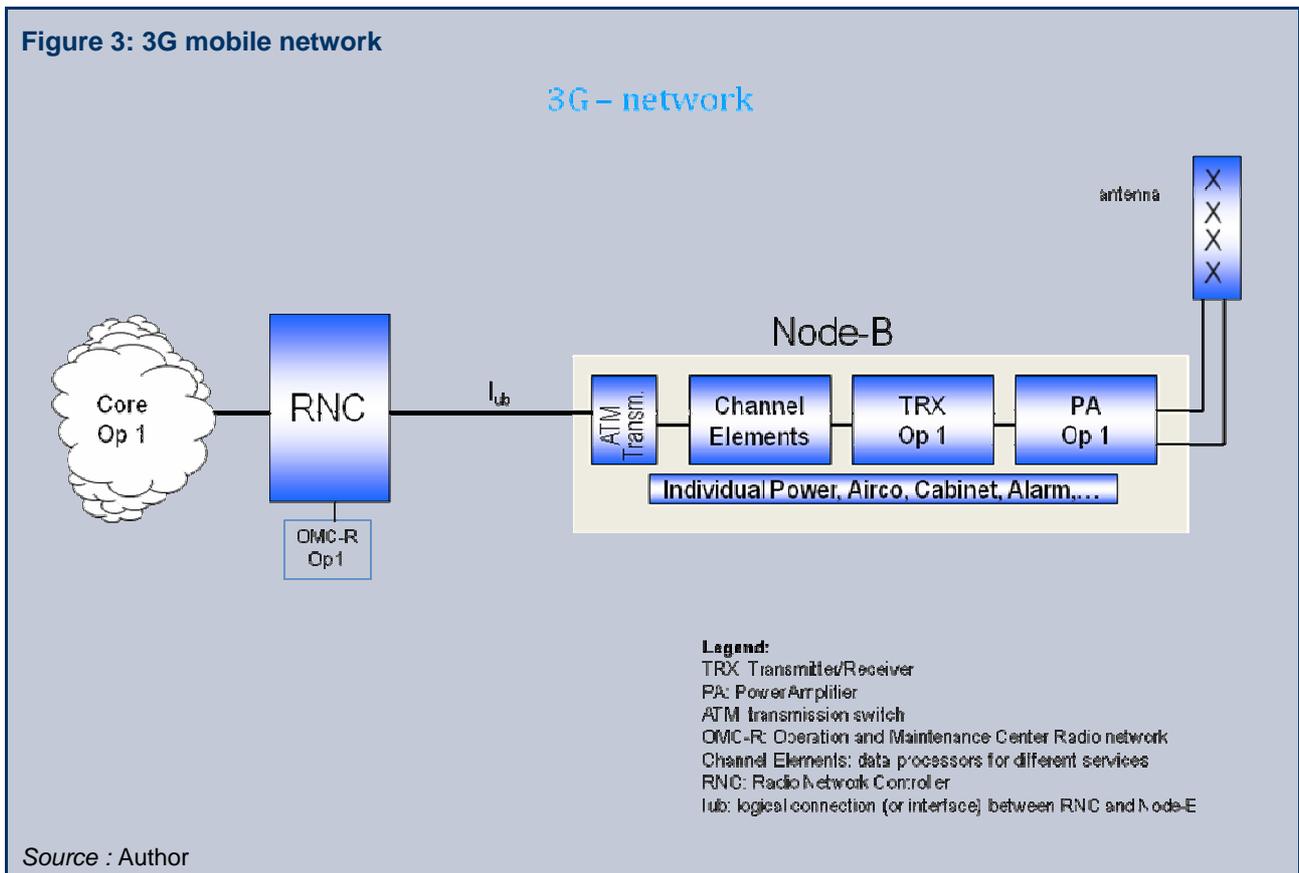
Active mobile sharing may not be permitted under the licensing regime in certain countries.³⁴ Other national authorities may allow active sharing only subject to strict conditions. Those restrictions are generally based on the idea that competing operators should utilize their own infrastructure independently. However, there are indications that many authorities are reconsidering this,³⁵ as operators increasingly compete based on the quality of their services and not on the features of their networks. The competitive aspects of active infrastructure sharing will be dealt with in Section 3.2.

This section will elaborate on the different options available for operators that wish to share their 3G mobile networks. This information is also relevant for sharing of networks based on other technologies, since their basic configuration is similar. The following figure provides a graphical overview of the elements of a 3G mobile network that could be shared.

There are several elements of a 3G mobile network that may be share among operators:

- **Node-B:** is a term used in 3G mobile networks to denote the base station which is placed next to an antenna. The Node-B contains a number of devices that are necessary to control the transmission and reception of signals, such as: power amplifier, power supply, air conditioning, support cabinet, alarm installation, transmission switch (which, in case of UMTS is based on ATM-technology) and the TRX. The **TRX** (or transceiver) is a device which contains both a transmitter and a receiver and is responsible for sending and receiving signals at the frequency assigned to the operators concerned. The TRX is a very important device, since it enables communications with mobile handsets.

- **RNC (Radio Network Controller):** is responsible for the control of the Node-B. One RNC is usually connected to several Node-Bs (100 to 200). The RNC performs several important functions in a mobile radio access network, such as traffic and mobility management. The RNC tracks where the subscribers of a mobile network are located and assigns them to the base station closest to them. The RNC also controls the so-called handover between cells. If the subscribers are moving from place to place, they also have to change from cell to cell in order to avoid interruption of the call. The RNC is responsible for the coordination between the cells and for transferring an ongoing call from one cell to the other.



- **Core network:** is the intelligent part of the network. It includes the mobile switching centers (MSC's). In modern mobile network architecture, the MSC is physically split into a Mobile Gateway (MG) and a Mobile Switching Server (MSS). The MG switches the traffic to and from the radio network and from external networks (PSTN and other mobile operators). The MSS controls the traffic and customer services. In addition to the switching and control components the core network contains several databases, such as the subscriber data base or HLR (Home Location Register). The HLR is responsible for identifying the subscribers that are authorized to use the mobile network. Another element of the core network is the Operations & Maintenance Center (OMC). Part of the OMC controls the radio network components, such as the RNCs and Node-Bs, and is responsible for traffic management on the network. In more intensive network sharing agreements (such as full RAN Sharing, see below), parties may have to share the OMC. This may raise competitive concerns, because operators would be able to access information relating to traffic and volume. Regulators may require operators to create an independent OMC to ensure information separation from the sharing parties. This would also allow independent network optimization ensuring competitive differentiation. Because of these regulatory requirements, OMC may be one of the elements that should not be shared by operators.

3.1.1 Extended site-sharing (including antenna sharing)

Extended site sharing is where operators share not only the passive elements of a site, but also active equipment such as antennas, combiners and transmission links. In extended site sharing arrangements, operators may also share the TRX (transmitter and receiver). This will demand that the parties share the spectrum too. Although, spectrum sharing is technically possible (see the GSR paper on spectrum sharing) it may raise regulatory challenges, in particular because of rules dealing with spectrum optimization.³⁶

This option may increase capital and operating savings by operators as compared to simple site sharing. However, the amount of additional savings may be limited, since the additional costs of antennas and transmission equipment are relatively small. While it is technically possible for operators using different sets of frequencies to share an antenna, this option involves a number of technical challenges. It may not be recommended when radio optimization strategies are not aligned between operators. While an antenna can be shared, it is usually directed to a certain position, which is based on the operator's own radio optimization strategy. The optimization strategy of the sharing operator may require it to change the position of the antenna, which may be difficult or impossible when the antenna is shared.³⁷

3.1.2 Sharing of radio access network

- **Rack sharing:** in addition to sharing the elements shared in the extended site-sharing option, operators install their individual active equipment in a shared cabinet or rack (i.e. the housing frame encompassing the electronic and other hardware). Other elements such as channel elements, TRXs and power amplifiers remain physically separated, as well as the transmission networks and other elements of the radio access, such as the RNCs. Power supply, air-conditioning, ancillary cabinet and alarm installations can be shared.³⁸ Depending on the actual situation, rack sharing may provide up to 5 per cent capital expenditure saving for an operator per Node-B. If battery back-up is used and is shared in a rack sharing situation, rack sharing may provide between 10 per cent and 0 per cent savings in capital expenditure. Figure 4 graphically illustrates this option:

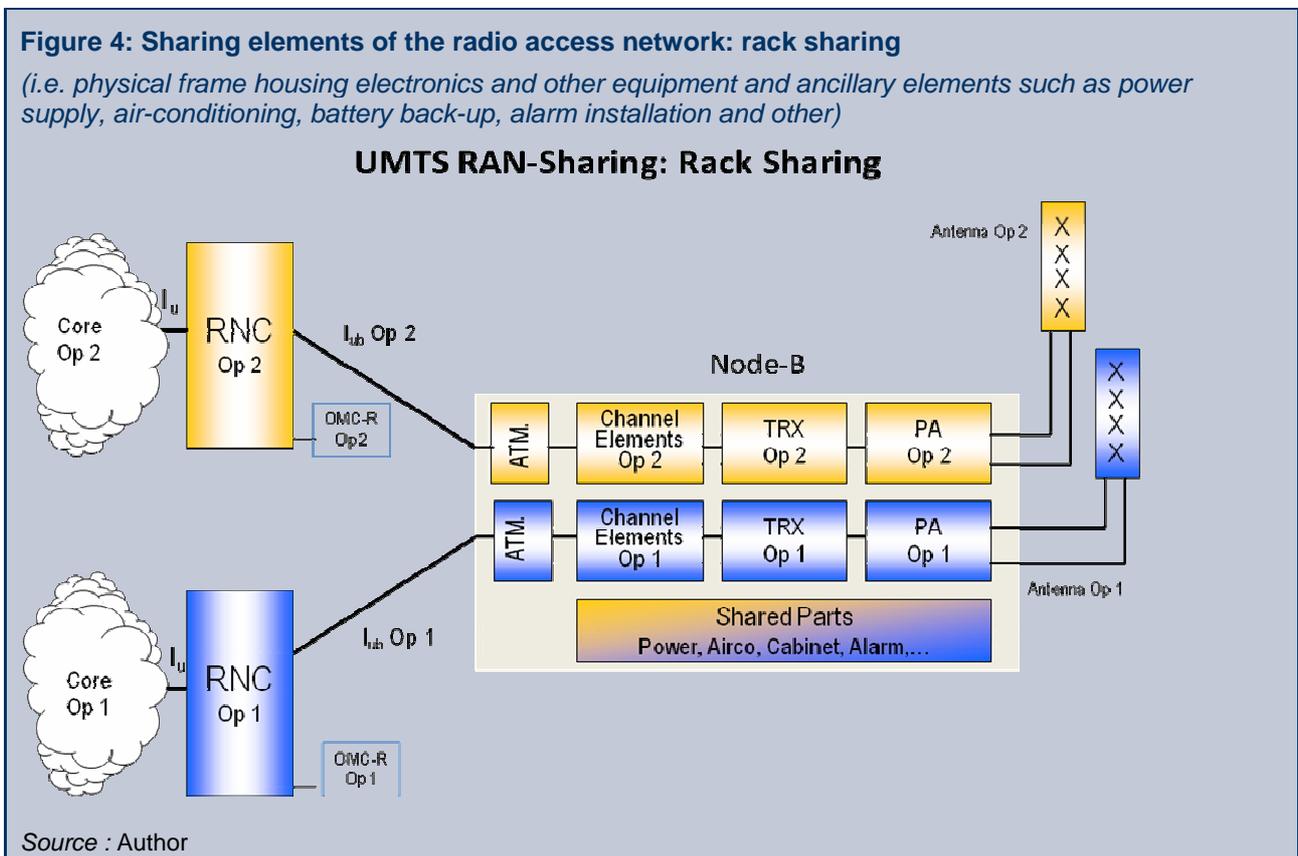
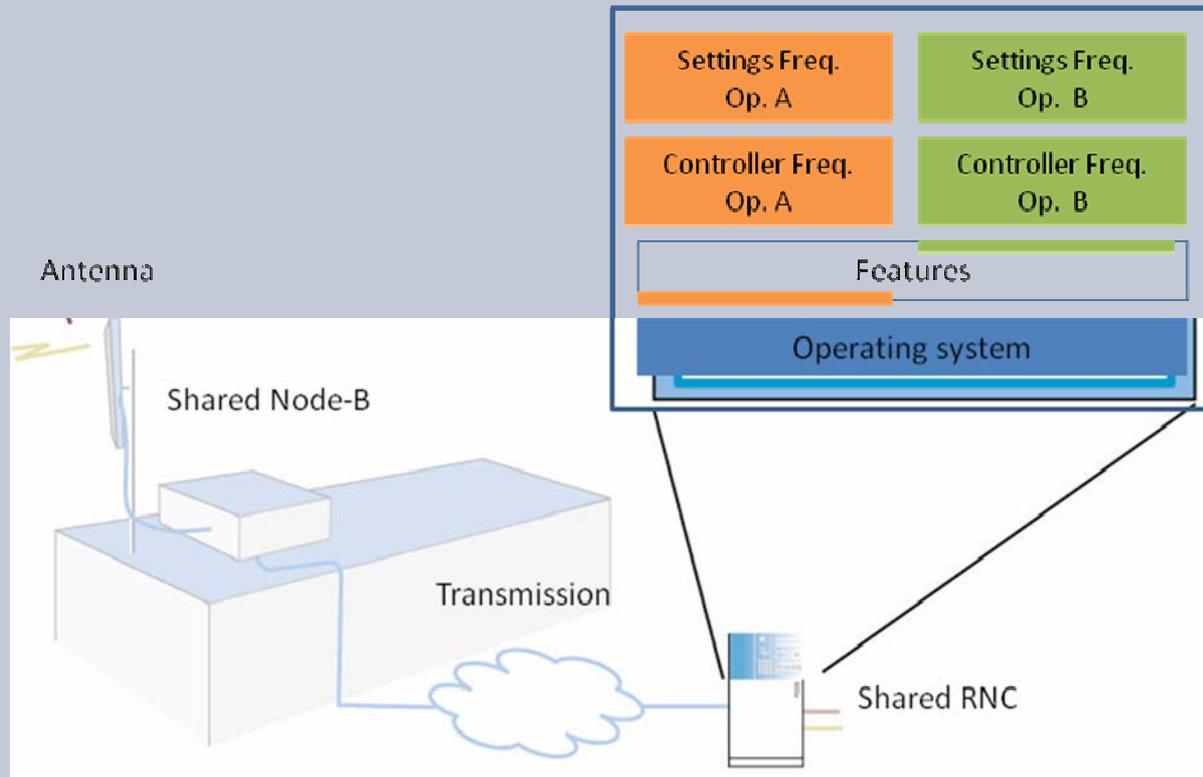


Figure 6: Functionally separated RNC

Functionally Separated RNC



Source : Author

3.1.3 Core network sharing

Sharing of the core network is technically possible. However, the core network performs several functionalities that are essential for the performance of an operator's service, such as the billing system. The core network also contains a large amount of confidential information concerning the operator's business. Accordingly, it may be complicated for competing operators to share a core network. However, there are other varieties of sharing according to which operators may use the same core network to provide their services, such as national roaming, or through an MVNO-construction. In addition, with the emergence of so-called next-generation core networks in which the switching and the control and service functionality is physically separated, network sharing may move into the domain of core network switching while enabling service differentiation and confidentiality.

National roaming

National roaming refers to the situation whereby operators agree to cover different parts of a country with their own networks and to use each other's network to provide services in the areas where they have no coverage. Such arrangements usually provide for the assignment of certain parts of the country to operator A and other parts to operator B, C or D. Operators then allow each other to use their networks (including the core network) in the areas where they have built their respective networks. There are several options for the geographic division of a country for the purpose of national roaming. A common alternative is to assign a number of cities (and the areas around them) to different operators. Another alternative is to assign a larger geographical region (such as a state or province) to a certain operator.

Operators normally pay a wholesale roaming charge (usually a charge per minute of use) in order to use each other's networks. National roaming is generally simpler and less costly to manage than active infrastructure sharing. However, national roaming may lead to a greater degree of uniformity at the retail level between operators. The roaming operator will rely, for all network matters, on the choices made by the visited operators. Although the visited operator will have the possibility to define and set the Quality of Service (QoS) to the roaming party, in most instances the roaming operator will demand the best QoS and is likely to get it because of the reciprocal character of most national roaming agreements. Therefore, in the roaming areas, the roaming operator will not be able to distinguish itself from the visited operator as far as coverage, quality and transmission speeds are concerned. In addition, price competition may be restricted since the retail tariffs charged by the roaming operator will be determined, to a large extent, on the basis of the wholesale charges charged by the visited operator.

Despite the concerns expressed above, national roaming may be an effective means for operators to provide coverage in rural or remote areas. In those cases, all operators roll out their networks in urban areas, but allow each other to use their networks in rural areas. In certain cases, national roaming may be the only alternative to bring coverage to a certain area. In any event, national roaming is very likely to make services available and more affordable in areas that would otherwise only be at a very high price or not covered at all.⁴⁰

Wholesale mobile access: MVNO-model

MVNOs (Mobile Virtual Network Operators) offer mobile telecom services to customers by reselling wholesale minutes that they have purchased from an existing infrastructure owner (a mobile network operator, or MNO). Most MVNOs have their own core network (including a billing and identification system) and only require access to the mobile operator's radio access network. MVNOs avoid the need to own and operate their own end-to-end mobile radio access networks. Others, the so-called Service Providers, do not have a core network and simply buy and resell minutes to their end-users. The number of MVNOs in Europe has increased substantially since 2002-2003. Many well known consumer brands (such as Virgin and Tesco in the UK) have launched services. However, the degree of success of MVNOs and the business models adopted by them vary considerably from case to case and from country to country.⁴¹ In the UK, there are a number of successful MVNO's, the largest one being Virgin Mobile, with over 4 million subscribers in 2006.⁴² In the Netherlands, there are approximately 50 MVNOs and other service providers without a network that are active in the market. Together MVNO's and service providers reach a market share of approximately 17 per cent of the Dutch market, with Debitel and Tele 2 being the largest ones.⁴³ Recently a new concept called MVNE (mobile virtual network enabler) has been introduced in certain European countries. An MVNE does not have a relationship with the end-user, but provides administration, operation as well as infrastructure services to MVNOs or service providers.

Although the presence of MVNOs may boost competition in certain markets, it is not a solution in markets where mobile networks have not been widely rolled out. MVNOs depend on the existence of previously deployed networks in order to provide their services. However, when operators do not utilize their full capacity, providing access to MVNOs may be a good alternative to bring more affordable services to the market. In some countries, MVNO access has been imposed by regulators.⁴⁴ Regulating MVNO access involves introducing a number of regulatory measures concerning, among others: the type of access, pricing, transparency and non-discrimination. In many countries where MVNO access has been introduced successfully, operators have entered into MVNO agreements on a voluntary, non-mandatory basis. Entering into MVNO agreements may be commercially interesting when operators have spare capacity on their networks. Operators have an incentive to make this spare capacity available for alternative operators and boost their revenues. New entrants, possibly with a strong brand,⁴⁵ may want to enter the mobile market. Accordingly, regulators may consider facilitating the entry of MVNOs, whether or not through regulated access, in order to boost competition and affordability of services.

3.1.4 Backhaul sharing

In certain rural or remote areas, backhaul may be a bottleneck facility. In areas where mobile traffic is low, the full capacity of backhaul is not used and may be shared by operators. Accordingly, in areas with no capacity problem, when passive or active infrastructure is shared on a tower or roof top, backhaul may also be shared by operators. Backhaul sharing is possible, either where operators use fibre cables or microwave links as backhaul. Although it is technically possible to share backhaul facilities, regulatory or licensing conditions may preclude operators from sharing backhaul facilities, especially when radio waves (such as microwaves) are used as backhaul, which is the case in most rural or remote areas.⁴⁶ When backhaul radio facilities cannot be shared, operators have to install separate antennas on the towers in addition to the antennas used to communicate with the handsets. This increases the weight of the antenna on the tower, requiring higher and heavier towers, increasing the cost of construction and visual intrusion. Therefore, it may be more practical to share fibre and limit the sharing of radio backhaul facilities to low traffic regions. In addition, regulators and policy makers intending to foster wireless broadband deployment may wish to encourage mobile operators to replace microwave links with fibre links to carry broadband traffic.⁴⁷

3.2 Competitive impact of active mobile sharing

When government authorities take a decision regarding the number of licenses or authorizations to be issued for mobile services, they usually consider the level of competition that they wish to achieve. Many government authorities intend to create the maximum level of competition between all market players.

Sharing of active mobile equipment may raise concerns by public authorities (such as regulators and competition authorities) about restricting competition between the sharing operators. Sharing active network infrastructure usually leads to operators offering similar network coverage, quality and transmission speeds. Regulatory authorities may be concerned that this would lead to a greater uniformity of conditions, restricting the ability of operators to differentiate themselves at the retail level. Regulators may also be concerned that network sharing would lead to uniformity of tariffs, since the wholesale price paid by operators may determine the tariffs charged at the retail level. In addition, regulators may be concerned that sharing arrangements may lead to collusion as operators exchange confidential information, increasing the predictability of commercial behavior by operators and restricting competition. For example, the UK regulator Ofcom has adopted a reluctant approach towards network sharing so far:

Network sharing could also have undesirable consequences for competition. For example, MNOs could collaborate on network development and gain information about each other's costs and plans which may have a chilling effect on competition in the retail market. Dynamic efficiency may also be lower with fewer networks able to provide high quality mobile broadband services. End-to-end competition, i.e. at both the network and service level could lead to greater innovation, which could bring significant benefits for consumers. We note that the competition concerns would be amplified if the 900 MHz operators were themselves to decide to share a single UMTS 900 network in response to the actions of their competitors.

While it is difficult to quantify the potential impact of these effects, Ofcom's initial view is that there is a significant risk that both competitive intensity and innovation in mobile broadband services would be weakened, with potentially serious impacts on consumer welfare.⁴⁸

3G sharing agreements between T-Mobile and O2

Many European mobile operators have contemplated national roaming agreements following the 3G auctions between 2000 and 2001. However, 3G mobile sharing got off to a slow start in the EU as a result of delays caused by legal uncertainty as to the regulatory status of sharing agreements. The European Commission set the standard for what was permitted under EU regulatory law when it assessed the network sharing agreements for 3G mobile communications between operators T-Mobile and O2 in Germany⁴⁹ and in the UK⁵⁰. National regulators in EU countries generally

followed the Commission's approach when assessing 3G sharing arrangements in their own jurisdictions. As a result of the Commission's approach, operators' liberty to enter into network sharing agreements was restricted. As discussed below, the Commission's decision was later successfully appealed before the European Court of First Instance, which opened the way for new sharing arrangements in the EU. However, because of this early restriction, there is not much practical experience of 3G mobile sharing at this time.⁵¹

In Germany, the parties agreed that O2 would roam on T-Mobile's network (but not vice versa) within the area corresponding to O2's coverage obligation for a period of 6 years (between 1 January 2003 and 31 December 2008). The parties agreed that in certain areas, roaming would be phased out according to a certain timetable. Outside the areas falling under the coverage obligation, the parties agreed to provide each other national roaming on a reciprocal basis. O2 committed to purchase a minimum volume of such roaming services from T-Mobile. T-Mobile was not under an obligation to buy roaming services from O2. The agreement also contained the possibility of RAN sharing (sharing of Nodes B and RNCs) if the parties would consider it feasible in the future. Since the parties did not conclude any further agreement on RAN sharing, the Commission only assessed the aspects involving national roaming.

When assessing these agreements from a competitive point of view, the European Commission took the view that national roaming agreements by definition restrict competition. The Commission considered that national roaming would affect key competition parameters, such as coverage, call quality and transmission rates. According to the Commission, the roaming operators would be restricted by the coverage, network quality and transmission rates available to it on the visited network, which were a function of the commercial choices made by the visited operator. The visiting operator would be restricted in the nature of the services that it could provide to its end-users, because the types of services available were determined to a large extent by the transmission speeds available. In addition, the Commission deemed that the timing of the introduction of a particular service would be determined by the moment when certain transmission speeds would be available.

Finally, the Commission was concerned that the wholesale charge arrangements made would lead to coordination on retail price levels. For voice communication, the roaming operator would be charged a per-minute rate, based on termination rates and for data services according to a retail-minus pricing model. According to the Commission, O2 would be restrained in its ability to determine its own retail price by the wholesale charges paid to T-Mobile.

However, the Commission believed that the agreement satisfied the conditions necessary to receive an exemption of the prohibition to conclude restrictive agreements, because of its benefits to consumers.⁵² According to the Commission, the agreement would contribute to improving coverage, quality and transmission rates, promoting economic progress. The benefits of the agreement were likely to be passed on to consumers, since consumers would benefit from a greater range of new and technically advanced 3G services, making price competition more likely. The restrictions agreed were essential for the achievement of the respective benefits and the agreement would not lead to elimination of competition in the market. Accordingly, the Commission granted an exemption but only for such time as was justified to promote competition during the initial roll-out phase of the network and to promote the commercial launch and take-up of 3G services. Depending on the area concerned, the parties received an exemption for periods of 4, 5 or 6 years.

The agreement between T-Mobile and O2 relating to the UK contained similar provisions about site sharing and national roaming. This agreement involved the allocation of a number of UK cities to each party, in which they would roll out their network. Operators would provide each other national roaming in the cities where they did not have coverage. The Commission took an opinion similar to its opinion in the German case, granting an exemption for periods of 5 and 6 years.

T-Mobile and O2 appealed against the Commission's decision before the European Court of First Instance (CFI). The CFI found in favor of T-Mobile and O2, considering that the Commission had wrongly concluded that national roaming agreements were restrictive of competition by their very

nature.⁵³ According to the CFI, the Commission had failed to carry out an objective analysis of the impact of the agreement on the competitive situation. The CFI criticized the Commission for not presenting concrete evidence of the restrictive effects of the agreement:

A fortiori, the Commission has failed to show that the agreement seeks to slow down, if not to limit, the roll-out of the applicant's network, as it submits in its pleadings. The letters submitted during the proceedings by the defendant [...] show on the contrary that the agreement seeks to enable the applicant to roll out its 3G network in a profitable way in accordance with the requirements imposed by its license in terms of the timetable and coverage.

In the present case, it cannot therefore be ruled out that a roaming agreement of the type concluded between T-Mobile and O2, instead of restricting competition between network operators, is, on the contrary, capable of enabling, in certain circumstances, the smallest operator to compete with the major players, such as in this case T-Mobile but also Vodafone on the retail market, or even dominant operators, as T-Mobile is on the wholesale market.⁵⁴ (emphasis added)

The CFI also rejected the Commission's view on the impact of the agreement on price competition:

As regards, first, the impact of wholesale prices paid to T-Mobile on the wholesale and retail prices charged by O2, the applicant is, from that point of view, in a situation analogous to that of any undertaking vis-à-vis its suppliers. O2 and moreover T-Mobile both depend upstream on the prices charged to them by suppliers of goods and services which they use and may be led to pass on those costs to their customers. In addition, the price dependence alleged has not been demonstrated. [...] Moreover, in response to the questions put by the Court of First Instance, referred to in paragraph 36 above, concerning O2's price structure, the applicant has supplied information from which it is apparent that, by means of different types of products and services, a variety of subscription packages and pricing formulae combining many variables, it attempts to differentiate itself from T-Mobile.⁵⁵

This decision by the CFI may serve as a reference for regulators and other policy makers in developing countries when they seek to balance anti-competitive concerns with the objective of deploying networks in a quick and efficient way. Firstly, regulators may wish to make an objective assessment of the implications of national roaming for the competitive situation on the market. As indicated by the CFI, national roaming (and, by consequence, other types of network sharing) may actually increase competition because it enables operators to compete in areas where they would otherwise have no coverage. Before reaching a conclusion, competition and regulatory authorities must assess the competitive situation in the absence of the network sharing agreement. Such agreements may lead to a situation that is more competitive than the situation where such agreements do not exist.⁵⁶

Regulators will aim to ensure that all operators comply with the applicable regulatory obligations, including coverage. Availability of service with minimum quality levels is the least that the consumer should expect to receive. Whether or not the service is available should not be a key competitive parameter but rather a basic requirement. Network sharing agreements may help operators to make the service available and leave operators to compete on more important parameters from a consumer perspective, such as brand, price and customer service. This applies in particular to rural and remote areas. Authorities may also wish to distinguish between urban and rural areas when judging network sharing agreements.⁵⁷ In particular, authorities that have anti-competitive concerns may choose to limit sharing for a period of time until operators have acquired a substantial customer base in rural areas in order to satisfy their business case. Subsequently, operators may be required to deploy their own network.

Regulators will seek to have a thorough awareness of the competitive situation of the market, when judging network sharing agreements. Such agreements should not affect important competition parameters, such as price and service packages. Cooperating operators should not be allowed to exchange commercially sensitive information that may influence their future competitive behavior.

Where regulators impose conditions or limitations (such as requiring part of the infrastructure to be functionally separate), regulators may wish to impose only those obligations that are strictly necessary in order to preserve a situation of sustainable competition in the market.

3.3 Functional separation of mobile networks

The ultimate remedy that authorities may impose in order to insure competition in the telecommunications market is to require a vertically integrated operator to separate its infrastructure services (passive and active network elements) from its services. This can be done in two ways: (i) structural separation or (ii) functional separation.

The term “structural separation” refers to the situation whereby the ownership of and control over network elements on the one hand and service activities on the other belong to different entities. This is similar to the situation described above, whereby an operator outsources its towers and masts to an independent company (see Section 2.5.). In the case of structural separation, the operator would outsource its whole network and network activities to a different company and would concentrate on providing services to its customers. In the case of functional separation the operator establishes operationally separate business entities, but there is no change in the ownership situation.

The European Commission has proposed to introduce functional separation as a new remedy under the European regulatory framework for the electronic communications sector, in particular for legacy fixed line networks being upgraded to next-generation access networks.⁵⁸ The Commission sees functional separation as an instrument necessary to ensure fair competition in markets dominated by one operator. Functional separation should allow network access to new entrants and the incumbent's own retail division on the same terms with the purpose of giving new entrants a fair chance to build services using the incumbent's existing infrastructure.⁵⁹ Functional separation should reduce the incentive of dominant network operators to discriminate between third parties and its own retail activities, making it easier for compliance with non-discrimination obligations to be verified and enforced. The Commission proposes to apply functional separation only in exceptional cases, where there has been persistent failure to achieve effective non-discrimination and where there is little or no prospect of competition between several infrastructure providers within a reasonable timeframe.⁶⁰

Functional separation may not be a very appropriate measure to introduce in the mobile sector. The mobile sector is generally characterized by competition between different infrastructure providers. Government authorities usually issue several licenses (at least two or three) for mobile operators to compete in a given market, building their own infrastructure and providing their own services. Functional separation may be more appropriate for fixed markets in developed countries with a legacy network (usually built under monopoly by state owned companies), where new entrants have not had a chance to compete with the incumbent on the same terms.⁶¹ However, functional separation could be used in areas where mobile operators do not have commercial incentives to roll out their networks or to upgrade their networks to wireless broadband, such as in rural or remote areas given adequate regulatory capacity to calculate access costs and effective dispute resolution mechanisms. Given however that functional separation is a new and drastic measure, regulators in developing countries may wish to focus on more practical alternatives such as open access to passive mobile infrastructure based on the tower company model.

How might functional separation work to bring affordable services to rural areas? Government authorities could consider issuing only one license for building a wireless network in certain rural or remote areas, with the condition that the licensed operator would functionally separate its network from its service activities and would provide access to its own retail activities and to competing service providers on a non-discriminatory basis. This kind of functional separation may be interesting for operators from an economic point of view. The wholesale activities of the functionally separated network division may be very profitable, especially when there is a large interest on the part of service providers to purchase access.⁶² Before imposing functional separation, however, authorities must take into account the effect of functional separation on investment in infrastructure. The network operator must have an incentive to innovate and to invest

in new technologies in order to upgrade its network. Usually, new technologies are developed from a *services* point of view, in order to make faster and innovative services available to the end-user. If the network operator does not have a direct relationship with the end-user, it may have no incentives to make its network adequate for providing new services. For this reason, functional separation should not prevent appropriate coordination mechanisms between the network and the services division of the operator. The network division should take account of the interests of the service division and vice versa. This way, the network division should have an interest in investing in its network in order to make it adequate for providing new services. This is the reason why functional separation is probably more appropriate than structural separation in the telecommunications sector.

Functional separation may, in theory, be an efficient way of promoting the roll out of wireless networks in developing countries, especially in those countries with a high percentage of rural and remote areas that are less interesting for operators. However, government authorities in developing countries should bear in mind that introducing functional separation requires a number of complex regulatory measures, such as determining the type and price of access charges. Promoting extensive roll out of network and affordable access requires the network operator to charge cost-oriented tariffs to service providers. On the other hand, the network operator should have sufficient incentives and receive enough income to invest in its network. Setting the right price of access, taking account of all these factors, is a complex task that requires a large amount of expertise by regulatory authorities or their consultants. This kind of expertise may be lacking in certain countries that have just begun developing their telecommunications policies. In addition, introducing such far reaching measures requires a fast and efficient judicial system. Operators are expected to appeal against such measures because of the high interests involved and the large amount of investments usually made by operators when entering a new market. Imposing complex regulatory measures may not be a good solution when judicial systems do not work quickly, or allow regulatory measures to be suspended for a long time.

4 CONCRETE EXAMPLES AND POLICIES ADOPTED

4.1 European Union

Most European countries allow and promote passive infrastructure sharing between mobile operators. Many European operators have also contemplated agreements for sharing active infrastructure for 3G mobile services, but such agreements have been subject to conditions imposed by regulatory authorities in order to promote competition between networks (see above, the examples of T-Mobile and O2, described in Section 3.2). Some operators have implemented infrastructure sharing agreements, but have closed down the shared operations, apparently because the business case for implementing the agreement under the conditions imposed by the regulatory authorities was not satisfactory.⁶³

More recently, new network sharing agreements for 2G and 3G infrastructure have been announced, such as the agreement between Orange and Vodafone to share 2G and 3G infrastructure in the UK and in Spain. In February 2007, Orange UK and Vodafone UK have announced their intention to share their radio access networks (RANs) for 2G and 3G mobile services. The two RANs (including masts, antennas, sites, support cabinets and power supply, as well as BTSs and Node Bs and RNCs) would be combined over a number of years, exploring opportunities as technical solutions become available. The proposal would allow both companies to continue managing their own traffic independently, retaining full responsibility for the quality of the service and remaining competitors at wholesale and retail level.⁶⁴ According to public statements made by Vodafone, it expected the UK sharing agreement to reduce capital and operating costs by 20-30 per cent across both its 2G and 3G networks.⁶⁵

Orange and Vodafone also agreed to share their 3G RANs in rural areas in Spain. The agreement is said to relate to towns with fewer than 25,000 people in 19 provinces across the country. The network sharing arrangement would allow operators to reduce the number of sites by around 40

per cent, increasing the number of shared base stations to 1,500 by the end of 2007 and to 5,000 within four years.⁶⁶

In December 2007, T-Mobile UK and 3UK announced their intention to share their 3G networks.⁶⁷ T-Mobile and 3 will combine their radio access networks. T-Mobile and 3 will make use of the so-called Multi Operator RAN (MO-RAN),⁶⁸ which enables the sharing partners to share all site equipment with exception of both parties' TRXs, which will remain independent since the parties will not share spectrum. Accordingly, each Node-B will have two sets of TRXs (one using T-Mobile's frequency and another one using 3's frequency). The parties will also share feeders, antennas, ancillary and transmission equipment. The RNC is also shared in the MO-RAN construction. According to the parties, this construction enables the parties to retain responsibility for the delivery of services to their respective customers and to remain full competitors on the market. Although antennas are shared, parties maintain flexibility to control their own radio optimization allowing for coverage differentiation. Although the RNC is also shared, the architecture developed by the equipment supplier reportedly allows for service differentiation.⁶⁹

It is not clear whether all agreements mentioned above have been implemented successfully. However, it seems that after the decision of the CFI (see Section 2.5 above) European regulators have less space to impose restrictions on network sharing agreements based on competitive concerns. In any event, it seems that both agreements, given technical developments and availability of new equipment promoting network sharing, would allow both operators to control important parameters independently and remain full competitors in all aspects.

Now that the EC's restrictions on national roaming have been lifted, it will be interesting to watch if more 3G sharing agreements are implemented going forward.

4.2 United States

Other countries have adopted a slightly more liberal approach to infrastructure sharing than the European Member States. The United States federal regulator FCC has assessed a number of individual cases relating to infrastructure sharing, such as the joint venture between AT&T Wireless and Cingular for GPRS and Edge services.⁷⁰ In general, the US approach has been not to intervene in voluntary infrastructure sharing arrangements.

4.3 Canada

In Canada, the government has recently announced a new policy framework for the auction of advance wireless services (AWS) radio spectrum in the 2GHz band.⁷¹ The government has decided to reserve part of the newly auctioned spectrum to new entrants and to mandate network sharing as a means of promoting market entry. The new policy framework will require incumbents to provide "out-of-territory" roaming for licensees seeking to operate outside of their licensed territory for at least 10 years. It will also require incumbents to provide "in-territory roaming" to new entrants inside the new entrant's licensed territory for a period of five years, with the intention of facilitating market entry by those new entrants. The new framework also includes mandatory sharing of antenna towers and sites and the prohibition of most exclusive site sharing arrangements.

4.4 Brazil

In the beginning of 2008, the Brazilian government issued 44 licenses for the provision of 3G mobile services in the whole national territory. The country was divided in 11 licensing areas. In each area, four operators were licensed to provide 3G mobile services. Regulator ANATEL took several measures to ensure that communities with fewer than 30,000 inhabitants (a large percentage of all Brazilian municipalities) would receive wireless broadband coverage.⁷² In each licensed area, the total of the municipalities with fewer than 30,000 inhabitants was divided in four parts. Each part was allocated to one of the four licensed operators. This operator is required to

roll out its network and provide coverage in the assigned area (which corresponds to 25 per cent of all municipalities with fewer than 30,000 inhabitants in the area). The other three licensed operators are allowed to use the other operator's network to provide services to their clients, provided that they roll out their networks in their assigned area. Accordingly, operators are allowed to share each other's infrastructure in order to provide services in communities with fewer than 30,000 inhabitants. Although the regulator has not made completely clear what is meant by "network sharing", it is believed that it includes sharing passive (masts, towers, site equipment as well as active network elements (antennas, transmission system, RNCs). Spectrum sharing is also allowed, provided that the operator requiring spectrum sharing is licensed to provide services according to the respective technology. The total population in the areas under this coverage obligation is 17.3 million. The intention of the regulator is that the whole Brazilian territory be covered by broadband wireless by 2016.

4.5 India

In India, regulator TRAI has recommended passive and active infrastructure sharing to be allowed in the country in order to promote roll-out and increase availability and affordability of services.⁷³ The Indian Department of Telecommunications has set as a government target to establish a subsidy support scheme for shared passive wireless infrastructure in rural areas with about 18,000 towers by 2010 and to increase sharing in urban areas to 70 per cent by 2010.⁷⁴

Recently, the Indian Universal Service Obligation Fund has launched a scheme to provide subsidies for setting up and managing around 8,000 towers for the provision of mobile services in remote areas with no wireless coverage. The condition for receiving the subsidy is that the infrastructure built be shared by at least three operators. According to the India Department of Telecommunications, operators have already entered into sharing agreements and the mobile services provided through these shared towers should be operational by May 2008.⁷⁵

4.6 Malaysia

The Malaysian Communications and Multimedia Commission (MCMC) has identified infrastructure sharing as one of the criteria for issuing licenses for 3G mobile spectrum. In its invitation to submit applications for IMT-2000 spectrum, the MCMC required applicants to demonstrate their capacity to provide commitments in infrastructure sharing, including (a) sharing of physical facilities (tower, floor space, antenna) and (b) sharing of network capacity and capabilities (traffic volume and access conditions) and to maximize the use of existing network facilities, including network capacity, base stations and backbone facilities. Applicants should also demonstrate its commitment and capability to provide domestic roaming.⁷⁶

4.7 Jordan

In Jordan, all licensees are required to provide infrastructure sharing and collocation to other licensees, subject to availability. The Jordan Telecommunications Regulatory Commission (TRC) issued a statement on the implementation of infrastructure sharing and national roaming for mobile telecommunications operators in Jordan.⁷⁷ In this statement, TRC reserves the right to intervene whenever service providers fail to reach an agreement on infrastructure sharing. If TRC determines that infrastructure sharing is feasible, it will determine the terms and conditions under which it must take place. Operators are also required to provide each other national roaming agreements that need to be deposited with TRC for agreement.

5 CONCLUSIONS AND BEST PRACTICES

5.1 Conclusions

It is clear that network sharing agreements may entail benefits for operators and the general public. Such agreements may entail significant financial benefits for operators by avoiding the costs of building or upgrading overlapping sites and by consolidating existing sites. Operators may achieve considerable savings in rent, maintenance and transmission costs. They may also achieve economies of scale by combining operating and maintenance activities. Network sharing may further help operators in attaining better coverage, since they may choose to use only those sites that provide deeper and better coverage, decommissioning sites with poor coverage possibilities. Operators may reinvest those savings in upgrading their networks and providing better roll out and coverage to end-users. Network sharing agreements may also bring substantial environmental benefits, by reducing the number of sites and improving the landscape.

There are also a number of obstacles to be overcome when dealing with network sharing agreements. From an economical and practical point of view, network sharing is a large and complex process that requires a number of managerial resources. Therefore, the concrete benefits generated by network sharing should be analyzed by regulators and policy makers on a case-by-case basis, taking into account the specific characteristics of each market involved.

As shown above, promoting network sharing is a useful tool for regulators and policy makers that want to encourage network deployment and coverage improvement in un-served or under-served areas. There are several instruments that can be used to promote network sharing. National roaming arrangements are probably the most simple and effective arrangements. While national roaming leads to a certain level of uniformity between operators, it is important to analyze to what extent this uniformity leads to a significant restriction of competition. National authorities that have anti-competitive concerns may allow network sharing for a limited period (for example for a period of one or two years) of time in order to promote roll out in an initial phase of network deployment. After such an initial phase, operators would be required to provide coverage using their own networks. Other types of arrangements, such as active infrastructure sharing, an open access model (allowing and promoting the entry of MVNO's) and functional separation, may also work well to promote roll-out of wireless infrastructure and the advancement of competition. However, these types of arrangements may be difficult to enforce. Such measures require a strong regulator and efficient judicial system, with appropriate powers to impose the necessary measures.

When analyzing the examples of network sharing agreements around the world, regulators and policy makers can consider the way in which the respective markets have worked and have developed. For example, it is relevant to note that a number of network sharing agreements mentioned in developed countries have preceded later mergers between the companies involved.⁷⁸ In other cases, the companies involved in network sharing arrangements have not merged between themselves, but have seen consolidation take place in the market.⁷⁹ In the past few years, there has been a large consolidation wave in the telecommunications market across the globe.⁸⁰ It is possible that this consolidation wave could have been avoided if operators would have been allowed more freedom to share their infrastructure and to concentrate on competing as far as their services are concerned.

5.2 Best practices

This paper has identified a number of best practices to promote competitive passive and active mobile infrastructure sharing, including domestic roaming:

- ✓ Establish clear, objective and transparent policy goals involving network sharing.
- ✓ Provide guidance on types of sharing allowed.
- ✓ Establish clear guidelines for the conclusion of voluntary sharing agreements, including time limits to conclude agreements and to provide actual access.

- ✓ Create efficient dispute settlement mechanisms and judicial review, including specialized dispute settlement bodies.
- ✓ Allow and stimulate self regulation.
- ✓ Promote dialogue between authorities, community members and operators about the installation of infrastructure.
- ✓ Allow network sharing, in particular site sharing and national roaming, in rural and remote areas.
- ✓ Make thorough and objective assessment of the competitive situation, including research on consumer preference and consumer choice.
- ✓ Only impose restrictions that are strictly necessary to promote competition and proportionate to the policy goals established.
- ✓ Consider whether an open access model (such as the entry of MVNOs) or even functional separation would be viable, depending on the actual situation
- ✓ Consider providing subsidies related to network sharing in rural and remote areas calculated to cover real costs and distributed in a competitive fashion .
- ✓ Monitor compliance with the requirements established, by requiring operators to provide information on compliance on a regular basis and by creating an open dialogue with operators.
- ✓ Consider establishing websites publicizing the location of towers and antennas in a country.

In addition to the above mentioned general guidelines for best practices, this paper has identified a number of practical cases that may serve as examples to be followed with regard to network sharing:

- ✓ **United Kingdom: the Mobile Operators Association (MOA)** (www.mobilemastinfo.com), an association between the five UK mobile network operators (3, O2/Telefonica, Orange, T-Mobile and Vodafone) plays an important role as representative of the operators on radio frequency health, scientific research and town planning issues associated with the use of mobile phones. MOA is a key element in sharing relevant information with local authorities, elected councilors, resident groups, amenity bodies and the public in general. MOA has developed ‘Ten Commitments to best siting practice’ aimed at ensuring transparency in building mobile phone networks, providing information to the public and local authorities and increasing the community’s role in the siting of radio base stations.
- ✓ **The Netherlands: National Antenna Registry** (www.antenneregister.nl). The Dutch government has created a national registry of all towers and antenna installations in the country. Operators are required to provide the information to the so-called Antenna Bureau, a government institution that makes the information available to the public. Via a website, members of the community can enter their postal code and find information about the presence of antennas in their neighborhood. The Antenna Bureau provides information to the public about health, technical and legal issues relating to the presence of antennas, increasing the involvement of the community on the roll out of mobile networks.
- ✓ **The Netherlands: efficient judicial review:** all decisions by the Dutch regulator OPTA involving network sharing or other regulatory issues, are subject to judicial review in only one instance by the Trade and Industry Appeals Tribunal (CBB). The CBB is a highly specialized tribunal, with a number of judges specialized in telecommunications regulation. The CBB usually issue judgments on highly complicated issues in a fast and efficient way, providing legal certainty to the parties involved. Judgments of the CBB are not subject to appeal.
- ✓ **Spain: network sharing agreement between Orange and Vodafone:** Orange and Vodafone have agreed to share their mobile networks in order to provide 3G wireless services to 19 provinces in rural areas of the country.

- ✓ **India:** using universal services funds to subsidize network sharing arrangement in rural and remote areas.

¹ Please note that it is also possible to share passive elements of the core network, such as ducts or dark fiber. This chapter will deal only with sharing of passive elements of the radio access network.

² Current scientific evidence indicates that exposure to radiofrequency fields, such as those emitted by mobile phones and antennas, is unlikely to have negative health effects. In response to health concerns raised by certain communities, the World Health Organization (WHO) established a project to assess the scientific evidence of possible health effects of electro magnetic fields. See www.who.int/peh-emf/en/index.html. The International Commission for Non-ionizing Radiation Protection (www.icnirp.de) has established guidelines for the maximum level of radiofrequency levels in areas of public access from antennas and for users of mobile handsets.

³ This principle is established in the European Union Directive [Framework directive], consideration 23: "Facility sharing can be of benefit for town planning, public health or environmental reasons, and should be encouraged by national regulatory authorities on the basis of voluntary agreements. In cases where undertakings are deprived of access to viable alternatives, compulsory facility or property sharing may be appropriate. It covers inter alia: physical collocation and duct, building, mast, antenna or antenna system sharing. Compulsory facility or property sharing should be imposed on undertakings only after full public consultation."

⁴ Today's standard 3G equipment consume ca. 4,000 KWh of Grey energy per year per Node which corresponds to 2.5 tons of CO₂ or equivalent need of 120 trees per Node to compensate for the environmental effect. In a developing country with no or little alternative Green energy network sharing can significantly reduce the environmental impact.

⁵ This is mainly the case in Western European countries, where 2G networks have been deployed in a relatively early stage and where incumbent operators have gained a substantial advantage over new comers.

⁶ This is the case in Brazil, where regulatory authorities are betting on the 3G mobile technology to provided universal mobile services in the whole Brazilian territory. The Brazilian case is dealt with in Section 4.

⁷ This is more likely to be the case in roof-top constructions than in towers or mast.

⁸ National roaming concerns a situation where the cooperating operators do not share any network elements as such but simply use each others' network to provide services to their own customers. National roaming arrangements allow the roaming operator to rely completely on the infrastructure of the operator providing national roaming, instead of building its own infrastructure in the roaming area. According to certain competition authorities, national roaming agreements may restrict competition between the roaming operators. This will is addressed in Section 3.2.

⁹ This was the opinion of the European Commission when it judged the site sharing arrangement for 3G mobile communications between T-Mobile Deutschland and O2 Germany: Commission Decision of 16 July 2003, Case COMP/38.36.

¹⁰ For example, in India restrictions apply for building wireless sites in certain areas, such as government areas like Lutyens zone in New Delhi and in military areas such as Cantonments. The Telecom Regulatory Authority of India (TRAI) recommended identifying such areas as Critical Infrastructure Sites (CIS) and to mandate sharing. See TRAI Recommendations on Infrastructure Sharing, 11 April 11 2007. In the European Union, the Framework Directive of 11 March 2002 (Directive 2002/21/EC), requires Member States to impose facility sharing only where undertakings are deprived of access to viable alternatives because of the need to protect the environment, public health, security, or to meet town and country planning objectives (Recital 23 and Article 12).

¹¹ See TRAI Recommendations on Infrastructure Sharing, 11 April 11 2007, p. 12.

¹² TRAI recommended having service providers make a commitment that the site would be shared by at least three service providers.

¹³ TRAI recommended introducing an obligation for licensees to announce on their web sites the details regarding the existing and future infrastructure installations available for sharing with other service providers. TRAI Recommendations on Infrastructure Sharing, 11 April 11 2007, p. 42.

¹⁴ The Brazilian regulator ANATEL has established a term of sixty days for the completion of a site sharing agreement, after the owner of the infrastructure has replied positively to a site sharing request. See Regulation on Infrastructure sharing between telecommunication service providers, Anex to resolution 274 of 5 September 2001.

¹⁵ Regulators should also bear in mind that roof tops may be less adequate for site sharing, usually due to lack of space or limitations imposed by landlords.

¹⁶ The Dutch Regulator OPTA imposed an obligation on incumbent KPN to provide coordinates of all its sites to new entrant Dutchtone, within five days after request by Dutchtone. This applied to all sites, regardless of whether KPN considered certain sites to be inadequate for site sharing. According to OPTA, Dutchtone needed that information in order to determine the sites for which it would like to make a request for site sharing. OPTA took into account that one of the principle objectives of the Dutch Telecommunications Act was to promote competition and that site sharing should allow Dutchtone to roll out its network in order to compete with KPN (OPTA's decision of 3 November 1999, available in Dutch on www.opta.nl/asp/nieuwsenpublicaties/achtergrondinformatie/document.asp?id=236)

¹⁷ Cf. Article 8 of the European Framework Directive, according to which one of the principle policy objectives of the European electronic communications policy is to promote efficient investment in infrastructure.

¹⁸ In the UK, the Mobile Operators Association (MOA) plays an important role regarding infrastructure sharing. For example, MOA has developed guidelines for site sharing, called "Ten Commitments of best Siting Practice", which include guidelines for involving local communities in the process. See www.mobilemastinfo.com. Among other things, MOA has created a cross industry operated data base website for mast and site sharing. Using this data base, operators can handle sharing applications and monitor their progress online. The data base is also used to provide information on mast and site sharing to the government authorities.

¹⁹ According to the common guidelines developed by the UK Mobile Operators Associations (MOA), when submitting a new permit application for a new mobile site, operators that cannot utilize an existing mast or structure must demonstrate the reason why to the local planning authority.

²⁰ One example of structural separation occurred in the Netherlands. The Dutch government ordered the national radio broadcasting company (Nozema) to be split in two separate entities: (i) Novec, a state owned company that owns the towers and masts and (ii) Nozema Services, a company which only provides transmission services to television and radio broadcasters. Nozema Services was later sold to KPN, the Dutch telecommunications incumbent. The Dutch competition authority (NMa), that reviewed the acquisition of Nozema by KPN, ordered KPN to divest its towers to an independent third party, because KPN would have incentives to prevent third parties from putting their infrastructure on the towers (NMa's decision of 7 March 2003, Case No. 5454) See: www.nmanet.nl/nederlands/home/Actueel/Nieuws_Persberichten/NMa_Persberichten/Persberichten_2006/NMa_KPN_mag_Nozema_overnemen_mits zendmasten verkocht worden.asp. The NM'a decision related mainly to the market for FM-transmission, that

require higher masts and towers, making the infrastructure more difficult to replicate. However, the decision introduced a new type of company into the Dutch market, i.e. a private company which owns transmission towers and leases space and other facilities (such as power supply, air conditioning and alarm installation) to different wireless operators, such as mobile operators and broadcasters. Currently, the former KPN towers are owned and operated by Alticom B.V., a subsidiary of TDF (Teledifusion de France) S.A., a large French broadcasting and tower operator.

21 See Press Release of 13 November 2007, IP/07/1677, Commission proposes a single European Telecoms Market for 500 million consumers.

22 In the United States, the majority of mobile sites are owned by tower companies, and not by mobile operators. Among successful tower companies in North America are: American Tower, Crown Castle and Spectra Site. See on outsourcing of sites a short paper published by the consulting firm Arthur D. Little:
www.arthurdittle.de/downloads/artikel/sharing_outsourcing_mobile_network_infrastructure.pdf.

23 The company Alticom B.V., which is a subsidiary of the French company TDF S.A., has recently entered the Dutch market in order to operate a tower business for wireless transmission. TDF also operates a tower business in other European countries.

24 In fact, this model is comparable to the situation where the whole infrastructure (or a substantial part of the infrastructure) is owned or operated by a different operator. These models (functional and structural separation) are briefly dealt with in Section 3.3.

25 One illustrative example is the famous Eiffel Tower in Paris, France. The Eiffel Tower is owned by the City of Paris. It is largely used for broadcasting of radio and television, but also of mobile telecommunications and other forms of wireless transmission.

26 In the Netherlands, the manager of the national high tension electricity network, Tennet, owns certain towers that are used for radio, television, and other forms of wireless transmission. In the UK, [National grid and Arqiva] make their infrastructure available for wireless transmission and participate in discussions and agreements about site sharing.

27 A right of superficies is an encumbrance that guarantees ownership of the object on which it rests, avoiding acquisition by accession.

28 TRAI recommended civic authorities in India to charge such amounts from all service providers sharing infrastructure so that the total amount charged per tower should not be more than 1.2 times of the amount being charged from individual service providers when towers are not shared. See Telecommunication Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 29.

29 An average mobile operator would spend approximately 60% of all its technology expenses in site infrastructure. Possible 50% of these costs may be attributed to rural or remote areas, that generate much less traffic – and consequently less revenue - than urban areas.

30 See www.dot.gov.in/osp/Brochure/Brochure.htm.

31 Section 3.2 deals with the competitive impact of national roaming agreements.

32 This option may not be available for the Members States of the European Union, providing subsidies to firms that may affect competition, can constitute a State Aid and may be illegal. Subsidies for deployment of broadband in certain remote areas may be permitted, but only after prior approval by the European Commission.

33 Many European mobile operators have contemplated active sharing of their 3G mobile networks. This was triggered, among others, by the high license costs paid for 3G licenses in Europe, the economic downturn that followed the 2000 3G-auctions and the increasing doubt about the development of the UMTS-technology and the availability of adequate handsets. The need for an much larger number of base stations for 3G as compared with 2G also made operators contemplate infrastructure sharing in order to reduce costs.

34 This is the case in India, where the licensing regime for mobile telecommunications does not permit active sharing. See Telecommunication Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 16.

35 TRAI recommended a re-look in the existing licensing regime in India as far as active infrastructure sharing is concerned. See "Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 17.

36 For example, the Brazilian regulatory Anatel has expressly allowed spectrum sharing in case operators decide to share their networks in order to provide coverage in rural or remote areas (communities with less than 30,000 inhabitants). See Tender Document for 3G mobile services of October 2007 (Tender No 002/2007SPV-Anatel, available at www.anatel.gov.br), clause no 4.13 (p. 11). Section 4 deals further with the Brazilian example.

37 Certain equipment manufacturers supply antennas that are adequate for antenna sharing. Nokia is one of the equipment suppliers that provides equipment intended for network sharing. See Nokia's press release on the solution provided to Optus' 3G network in Australia (http://press.nokia.com/PR/200511/1020905_5.html).

38 This situation may also be called "ancillary sharing".

39 This was required by the Dutch regulatory authority, when judging the proposed network sharing arrangement for 3G mobile services between operators Ben and Dutchtone. See Decision of NMa of 11 October 2002, Case No. 2816/35.

40 The French government launched a programme called "programme zone blanche" or "dead zone programme" aimed at providing mobile coverage in rural zones where operators had no coverage. The intention was to provide mobile coverage to 99% of the French population by the end of 2007, covering more than 3,000 rural communities in France (see ARCEP, annual report 2006, p. 359-360, available at www.art-telecom.fr). Coverage may be achieved either through site sharing or through roaming.

41 Ofcom, the UK telecommunication regulator, has published an extensive survey on MVNO's in the UK. See Ofcom, Interim Communications Report, February 2006 (available at www.ofcom.org.uk/research/cm/interim/feb06_report/comms_mkt.pdf).

42 Ofcom, Interim Communications Report, February 2006.

43 This was recently confirmed by a market research done by the European Commission, when assessing the competitive impact of the merger between two Dutch mobile network operators, T-Mobile and Orange. See Decision of the European Commission of 20 August 2007, Case No. Comp/M.4748 – T-Mobile / Orange Netherlands.

44 This is the case in Spain, where the telecommunications regulator, CMT (Comision del Mercado de las Telecomunicaciones) imposed regulated MVNO access on the three mobile operators Telefonica Mobiles, Vodafone and Amena. See Notification of Adopted Measure pursuant to Article 7(5) of Directive 2002/21/EC, available at http://circa.europa.eu/Public/irc/info/ecctf/library?!=/espaa/adopted_measures/es20050330/adopted_measure/_EN_1.0_&a=d.

45 Cf. the success of Virgin Mobile, in the United States and the United Kingdom.

46 For example, sharing of radio backhaul is not permitted under the licensing conditions of mobile operators in India. See TRAI, Recommendations on Infrastructure Sharing, 11 April 11, 2007, p. 21.

47 This is covered in the GSR Discussion Paper, Extending Open Access to National Fibre Backbone Networks in Developing Countries.

48 Application of spectrum liberalization and trading to the mobile sector (p. 86). Ofcom, public consultation published on 20 September 2007, available at: www.ofcom.org.uk/consult/condocs/liberalisation/liberalisation.pdf.

⁴⁹ Commission Decision of 16 July 2003 relating to a proceeding under Article 81 of the EC Treaty and Article 53 of the EEA Agreement (Case COMP/38.369: T-Mobile Deutschland/O2 Germany: Network Sharing Rahmenvertrag), OJ 2004, L 75/32.

⁵⁰ Commission Decision of 30 April 2003 relating to a proceeding under Article 81 of the EC Treaty and Article 53 of the EEA Agreement (Case COMP/38.370: 02 UK Limited / T-Mobile UK Limited: Network Sharing Agreement), OJ 2003, L 200/59.

⁵¹ In the US 3G sharing was pre-empted by the merger of companies that initiated sharing arrangements.

⁵² It is no longer possible to receive a formal exemption of the prohibition to conclude restrictive agreements under Article 81(3) of the EC Treaty. Under the current regime, firms have to make their own assessment of whether their agreement qualifies for an exemption.

⁵³ European Court of First Instance 2 May 2006, Case T-328/03, O2 (Germany) & Co OHG vs. European Commission, available at <http://curia.europa.eu/juris/p/>.

⁵⁴ European Court of First Instance 2 May 2006, Case T-328/03, O2 (Germany) & Co OHG vs. European Commission, recitals 108 and 109.

⁵⁵ European Court of First Instance 2 May 2006, Case T-328/03, O2 (Germany) & Co OHG vs. European Commission, recital 101.

⁵⁶ In fact, depending on market conditions, the competition parameters influenced by network sharing (such as coverage, network quality and transmission speed may be a minor factor influencing consumer choice. A study made in the United States (see JD Power and Associates, 2006 Wireless Prepaid Customer Satisfaction Study, press release available at: www.jdpower.com/corporate) showed that pre-paid consumers base their choice to a large extent on aspects that are not related to the quality of the network, but rather to the level of the service provided such as price, brand, customer service and account management. Accordingly, in markets with those characteristics, network sharing arrangements may have a limited impact on the competitive situation, or no impact at all,

⁵⁷ This approach was chosen by Brazilian regulator Anatel when it issued licenses for the provision of 3G mobile services in 2008. Anatel allowed mobile network sharing in communities with less than 30,000 inhabitants. The Brazilian example is described further in section 4.

⁵⁸ Press Release of 13 November 2007, IP/07/1677, Commission proposes a single European Telecoms Market for 500 million consumers. The Commission has not proposed to introduce structural separation in the European electronic communications sector. Structural separation is a remedy that is being considered in the energy sector (see Press Releases IP/07/26 and IP/07/29).

⁵⁹ Proposal for a directive of the European Parliament and the Council, amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and services, and 2002/20/EC on the authorization of electronic communications networks and services. Presented by the European Commission on 13 November 2007, COM(2007)697 final.

⁶⁰ Proposal for a directive of the European Parliament and the Council, amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and services, and 2002/20/EC on the authorization of electronic communications networks and services, para. 43.

⁶¹ This topic is discussed in the GSR paper on functional separation.

⁶² The UK introduced functional separation of fixed incumbent BT in 2005. Following the announcement of functional separation, BT's share price increased. Functional separation has allowed for substantial deregulation and for a significant boost of competition: when it was introduced in 2005, only 105,000 unbundled lines existed. Since then, the number has grown to 3 million. See European Commission, 2007 Telecoms Report # 2, More competition for a stronger Europe, available at http://ec.europa.eu/information_society/doc/factsheets/tr2-morecompetition.pdf.

⁶³ T-Mobile and Orange have agreed to share their 3G infrastructure in the Netherlands (the actual implementation of the agreement was limited to sharing of passive infrastructure). The operations have started as a joint venture in 2001. However, the joint venture was closed down in December 2004. The reason given by the parties was that they both could acquire UMTS equipment on a more attractive basis by using deals organized by their respective parent companies (Deutsche Telekom and France Telecom). See www.planet.nl/planet/show/id=118880/contentid=532135/sc=ba371f. Orange Netherlands was eventually not able to introduce 3G services on the market on an independent basis and was acquired by T-Mobile in October 2007, reducing the number of independent network operators in the Netherlands to 3. Although the Dutch authorities had issued five 3G licenses, KPN acquired Telfort in 2005 and T-Mobile acquired Orange in 2007.

⁶⁴ See Press Release by Orange UK and Vodafone UK of 8 February 2007, available at: www.vodafone.com/start/media_relations/news/local_press_releases/uk_press_releases/2007/vodafone_uk_and_orange.html

⁶⁵ Vodafone's non-confidential response to Ofcom's consultation Application of spectrum liberalization and trading to the mobile sector (p. 86). Ofcom, public consultation published on 20 September 2007, available at: www.ofcom.org.uk/consult/condocs/liberalisation/responses/Vodafone.pdf

⁶⁶ Press release by Orange and Vodafone of 10 October 2007, available at: www.francetelecom.com/en/financials/investors/news/CP_infos/att00041022/071010_CP_Vodafone_Orange_sharing.pdf

⁶⁷ Press release of 18 December 2007, "T-Mobile and 3 create Britain's largest 3G network", available at: www.t-mobile.net/CDA/07-12-18_tmuk_3gnetwork,20,,newsid-6011,en.html

⁶⁸ The MO-Ran concept was developed by Nokia, which is reported to be the original equipment supplier by both T-Mobile and 3.

⁶⁹ See press release by both parties available at: www.t-mobile.net/CDA/07-12-18_tmuk_3gnetwork,20,,newsid-6011,en.html.

⁷⁰ FCC Public Notice – February 12, 2003, DA 03-418: "Wireless Communications Bureau grants consent for the full and partial assignment and transfer of control of licenses to implement GSM corridor". This network sharing agreements no longer has any significance, after the merger between ATT Wireless and Cingular Wireless in the beginning of 2007.

⁷¹ Policy Framework for the Auction of Spectrum Licences for Advanced Wireless Services and other Spectrum in the 2GHz Range, Industry Canada, November 2007, available at the website of Canada's Department of Industry: [http://strategis.ic.gc.ca/epic/site/smt-gst.nsf/vwapj/awspolicy-e.pdf/\\$FILE/awspolicy-e.pdf](http://strategis.ic.gc.ca/epic/site/smt-gst.nsf/vwapj/awspolicy-e.pdf/$FILE/awspolicy-e.pdf)

⁷² These measures are included, inter alia, in Tender Document of October 2007 (Tender No 002/2007/SPV-Anatel, available at <http://sistemas.anatel.gov.br/SAE/Edital/Download/Tela.asp?SISQsmodulo=6376>.

⁷³ Telecommunication Regulatory Authority of India (TRAI), Recommendations on Infrastructure Sharing, 11 April 2007.

⁷⁴ See www.dot.gov.in/osp/Brochure/Brochure.htm.

⁷⁵ See Universal Service Obligation Fund, Implementation Status, available at www.dot.gov.in/uso/implementationstatus.htm.

⁷⁶ Malaysian Communications and Multimedia Commission, Applicant Information Package No. 1 of 2005. Available at: www.mcmc.gov.my/what_we_do/spectrum/pdf/3G%20round%202%20AIP_final.pdf

⁷⁷ TRC Statement on the implementation of infrastructure sharing and national roaming for mobile telecommunications operators in Jordan, 15 March 2005. Available at TRC's website: www.trc.gov.jo/index.php?option=com_content&task=view&id=309&Itemid=424&lang=english.

⁷⁸ This was the case with T-Mobile and Orange in the Netherlands and ATT and Cingular in the USA.

⁷⁹ After its network sharing arrangement with T-Mobile in the UK and in Germany, the company O2 was acquired by Telefonica.

⁸⁰ Worth mentioning are: the acquisition of Bell South by AT&T; the merger between Verizon and MCI; the acquisition of O2 by Telefonica of Spain, the acquisition of Orange Netherlands by T-Mobile; the acquisition of a controlling interest in Telecom Italia by Telefonica.