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Conference Paper

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The role of network sharing in transforming the operator business – impact on profitability and competition

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Abstract
This paper focuses on network sharing on mobile networks and examines the impact on profitability and competition. Network sharing refers to that operators collaborates with its competitors on part of the production of mobile services, and it could vary from passive sharing, like sharing of sites or basic facilities, to active sharing, like radio access networks or even entire networks. The paper takes a global scope on examining the extent of network sharing. The emergence of a sector with dedicated infrastructure or tower companies are documented through a mapping of listed companies' which facilities a detailed financial analysis. The rationale for network sharing could be grouped into three factors: 1) lower cost and reduce capital spending as well as to raise capital, 2) improve coverage and services, and 3) reduce the negative impact on the environment. The increased usage of network sharing throughout the world signals that it is going to develop and in the longer run move focus from infrastructure based to service based competition. Although operators have been able to lower network operation cost the impact on profitability varies. The dedicated tower and infrastructure companies manage considerable higher debt ratios compared to operators potentially having a transformative impact on the operator business. Despite an extensive usage of network sharing - where competitors are collaborating - competition on the retail market prevails. A potential spillover effect from network collaboration to the downstream market is a risk, but the social benefit with larger coverage and improved capacity has so far given extensive support for network sharing.

Key words: Network sharing, mobile network operators, infrastructure, tower companies, operational and capital expenditures, competition, profitability, financial gearing

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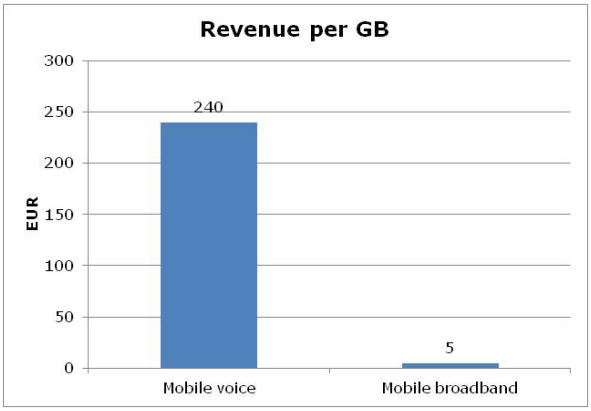
1 Introduction

1.1 A challenging transition to a data driven business

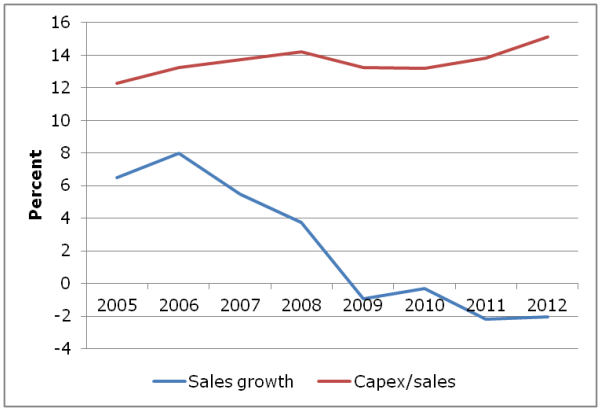
Despite that the demand for broadband communication is surging - with a rapid diffusion of smart phones, increased demand for mobile broadband with an exponential growth of data traffic - the operator business is deteriorating as the industry is maturing with declining revenues for the European operators, see figure below. The combination of declining voice revenues for fixed and mobile services and the difficulty for operators to monetize on the mobile data boom is putting pressure on the operator business. The ongoing transition of the mobile operator business could be illustrated by the sharp difference in revenues per GB when voice is recalculated as data with EUR 240 per GB for voice compared to EUR 5 per GB for mobile broadband.[2] This implies that when voice becomes an application on IP networks operators' business models are fundamentally challenged.

Figure 1 Revenue per GB for mobile in Sweden 2012



Source: PTS statistics and authors calculation

Average capex-to-sales and sales growth for European operators 2005-2012[3]



Source: Bloomberg

Consequently, operators are reporting declining cash flows as they maintain capital expenditure[4] (Capex) ratios on historical levels which put pressure on operators with large debt increasing the cost of capital, and potentially forcing operators to lower dividends. Moreover, the migration towards all-IP networks separates the transmission of communication from content and services. This turns access into a commodity as services could be provided over-the-top (OTT), granted that operators' are not blocking or discriminating traffic and thereby undermining the idea of net neutrality. Concurrently, providers of over-the-top services are thriving as end-customers are connected and going for services beyond the control of access providers which result in capacity pressure on networks, while limiting revenue opportunities for value added services provided by operators.

1.2 Challenges for operators

Altogether, the transition from a voice to a data centric business is challenging for operators and it has forced them to launch efficiency programs, cut operational expenditures, reduce headcount, and reduce network operation costs. It is no exaggeration to state that cost cutting have become an inevitable part

[2] The calculation is based on reported mobile voice minutes for Swedish mobile operators for 2012 and is recalculated to data traffic according to the following formula: = ((voice minutes)*(47*60)/8)) and divided with the revenues for mobile services. The underlying data is available at http://www.statistik.pts.se

[3] Based on a average on company ratios for the following operators: BT, DT, FT, KPN, Swisscom, Telefonica, and TeliaSonera

[4] Capital expenditures refers to investments in physical infrastructure

of the operator business and potentially paving the way for more radical measures that could re-shape the industry. A response to this development has been a growing number of network sharing[5] agreements between operators. The development of network sharing is global and the current usage of network sharing could broadly be grouped into three categories: 1) agreements between operators to share parts or even entire networks, 2) to establish separate network companies that operate on the behalf of their owners, and 3) independent infrastructure companies, which primarily are doing tower and passive infrastructure sharing, but it could also be outsourcing where operator use external partners to run their networks.

Mobile operators predominately build their macro networks with sites deployed outdoor while a growing share of the usage is taking place indoors, implying an inefficient use of energy and spectrum. Given that facility owners are reluctant to allow parallel networks in buildings, shopping centers the development of indoor systems require some sort of network sharing. All in all, network sharing has become an inevitable part of the telecom industry and it raises questions which address a broad range of issues that are critical for operators, equipment manufacturers, regulators and consumers.

1.3 Paper objective, research question and contribution

This paper focuses on the issue of network sharing by analyzing the concept and the extent of network sharing on the market. Although the incentive for operators to enter network sharing agreements primarily is to reduce operational and capital expenditures it has not yet altered the operators' fundamental strategy to deploy macro networks. Given that network sharing agreements reduces the number of networks as competitors' are collaborating on a part of the production chain for mobile services the question of competition is at the heart of the network sharing issue.

This paper examines the concept of network sharing and defines different forms of network sharing. The paper takes a global scope and presents network sharing cases, a number of mobile infrastructure companies, of which a number provides antenna space and place for active equipment. More specifically, the research question addressed in this paper is what the role of network sharing is in transforming the operator business, and what the impact of network sharing has on profitability and competition.

The contribution of the paper will be an analysis of the operators' development and an examination of network sharing and the impact on the operator business. The expected contribution of the paper is related to:

- Analyze sharing cases on a global scale in order to see overall patterns
- To analyze the emerging industry with tower and network sharing companies
- Estimate cost savings of network sharing
- Analyze the impact on competition due to network sharing

Altogether, given that the issue of network sharing is emerging and the sector for electronic communication is undergoing a transition this paper should be regarded as a work in progress giving input to further research, which is addressed in the last section of the paper.

[5] We use the concept of network sharing, which includes using common networks, and regard infrastructure sharing as a synonym

2 Related work and methodology

2.1 Network sharing – a way to lower cost and improve coverage

The interest for network sharing has gradually increased as it is on the agenda for operators, equipment manufacturers, regulators, and competition authorities around the world. This has generated a large number of reports, white papers and academic papers.

GSMA (2012) present a view on different types of network sharing, the strategic rationale for infrastructure sharing, the economic and regulatory considerations as well as technical and environmental issues. The report underscores that it is commercial considerations rather than regulatory mandates that drive the trend for mobile operators to adopt a variety of infrastructure models through infrastructure and network sharing. Based on interviews with mobile operators GSMA (2012) conclude that for mobile operators in mature markets infrastructure sharing offers a way to reduce capital and operating expenditures as well as it get access to sites. Infrastructure sharing for operators' in developing market primarily represents a way to cost efficiently increase coverage. Infrastructure sharing is increasingly being used in congested urban centers where acquisition of new sites is difficult. GSMA (2012) pinpoint that infrastructure funds are showing more interest in acquiring or establishing third party masts or radio network businesses.

Friscano et al. (2008) address the issue of network sharing and managed services, and argue that operators has to focus on critical success factors and key assets due to lower growth, and competitive pressure in combination with technology migration. Friscano et al. (2008) demonstrate that depending upon the extent of the network sharing could facilitate up to 40 percent lower operational and capital expenditures.

Losada (2009) examine whether infrastructure sharing agreements among network operators affects networks qualities, operators' profits and social welfare. Losada (2009) underscores that allowing operators to build facilities jointly facilitate increased qualities of the networks given that either firm determines the infrastructure for their networks prior to the signing of the agreement, alternatively the regulator determine the amount of facilities that could be built jointly. Losada's finds that there is a risk for decreased network quality in case the involved operators first decide about the amount of facilities that they should build jointly.

Markendahl (2011) underscores that network sharing leads to cost reduction for both network deployment and operation, and emphasize that network sharing has a large impact on green field investments, as well as having a very positive effect on new entrants or smaller operators. Moreover, Markendahl (2011) address the question of spectrum sharing and that joint utilization of spectrum leads to a number of benefits. Beckman and Smith (2005) underscores that sharing of passive Radio Access Network (RAN) will significantly extend the reach of coverage into office spaces and other indoor areas, allow outdoor coverage to be economically extended. Beckman and Smith (2005) argue that regulators must convince industry of its commitment to spur restructuring and ensuring equal, cost based, and nondiscriminatory access to the network for all existing, and potential new market entrants. Meddour et al. (2011) pinpoint that the traditional model with all the physical network elements and network layers provided by mobile network operators is beginning to be challenged. Network sharing is driven by technology migration, regulatory requirements (coverage), increased capital expenditures in combination with increased competition, commodization of telecommunication equipment, separation of network and service provisioning. Network sharing facilities, according to Meddour et al. (2011), affordable access to mobile and broadband services in developing and emerging economies. The authors' present figures that show that sharing of sites and antennas can reduce Capex with 20-30

percent and with Radio Access Network sharing network operators are able to save between 25-45 percent of Capex. But Meddour et al. (2011) underscores that the magnitude of the economic impact of network sharing is difficult to assess as it depends on the particular level of sharing and geographical deployment strategy. However, Meddour et al (2011) recommend that both fixed and mobile operators should consider network sharing as a medium to cut operational and capital costs, and to focus on innovation and differentiation in customer-facing activities. In the longer run, Meddour et al (2011), suggest that incumbent operators could leverage network sharing as a means for continued growth by structurally separating all or part of their network assets or spinning out network provider companies in competitive markets.

2.2 Co-opetition – cooperation and competition at the same time

As network sharing implies that competitiors are collaborating the concept of co-opetition is relevant. Different types of co-opetitive relationships between competitors are described in (Bengtsson & Kock, 2000), and the relationships are characterized as being cooperation dominated, equal or competition-dominated. In (Luo, 2007) co-opetition is characterized in terms of intensity and diversity. In (Gnyawli et al., 2008) a framework is described where co-opetition occurs with high or lower intensity between the partners. Mobile operators compete on a national telecom market with few other actors. Similar markets with few large actors, the dairy industry in Finland and the brewery industry in Sweden, are analyzed in (Bengtsson & Kock, 2000).

Tensions due to unstable or changing market conditions are discussed in (Luo, 2007) (Park & Russo, 1996). For network sharing a number of tensions can be identified although this type of co-operation is long-term and characterized by stability. One potential cause of tension is if one partner wants to improve its own market position by getting a greater share of the jointly created value resulting from the cooperation (Ritala & Hurmelinna-Laukkanen, 2009). These findings are also related to the value network configuration for mobile operators are used in (Andersen & Fjeldstad, 2003). Three groups of parallel activities could be identified: marketing and contract management, service provisioning and infrastructure operation.

2.3 Concluding the section of related work

The overview, which is not exhaustive, demonstrates that the issue of network sharing is generating a growing interest and that it addresses vital issues for the industrial and market development. It is underscored by the fact that it concerns the heart of the market system as competition is regarded as the primary vehicle for economic growth.

3 Research approach and data collection

3.1 Research approach

The overall research question on the role of network sharing in transforming the operator business and the impact on profitability are answered by analyzing network sharing in a number of countries and data on operators and infrastructure companies, so called tower companies. Data about the cases have been collected through a number of meetings and interviews as well as through desk research.

The business analysis is focused on the cooperation aspects and the relations between network operators. Based on Markendahl (2011) and Friscano et al. (2008) the analysis provide insights about what activities are included in network sharing, and the interaction patterns between actors. For description and analysis of patterns of cooperation and competition we use the co-opetition dynamics framework proposed by Bengtsson et al (2010). Both cooperation and competition can be weak or strong and the different combinations are used for the analysis.

3.2 Collection of primary data

One set of interviews was made in 2010 with representatives for mobile operators in Sweden: Tele2, TeliaSonera and Telenor. The objective was to collect insights and experiences of the mobile operators after 10 years of network sharing in Sweden (Markendahl, 2011). A second set of interviews was done in 2012 with representatives for the network sharing companies in Sweden. These are all joint ventures formed by the mobile operators: Swedish UMTS Network AB (SUNAB), 3G Infrastructure (3GIS) and Net4Mobility (N4M). The interviews were done with the present CEOs of SUNAB and N4M and with the former CEO of 3GIS. The questions concerned drivers for sharing, the role of the joint venture, what kind of activities that have been part of the cooperation (and not) and finally lessons learned from the cooperation.

During a trip to India in February 2012 eleven meetings were organized in order to obtain data and capture an understanding of the Indian telecom market. We met representatives of the three major mobile operators: Bharti Airtel, Idea Cellular and Reliance Communications, and the largest independent tower company GTL Infrastructure. We also had meetings with telecom manufacturers, telecom analysts, advisors at the Ministry of Communications & IT and the Telecom Regulatory Authority of India (TRAI) (Markendahl & Mölleryd, 2012), table 2.

The issue of network sharing has been the subject for a number of workshops and conferences. We presented the experience of network sharing in Sweden in May 2010 as the Telecom National Regulatory Authority and Competition Authority in Denmark were analyzing the possibility to allow network sharing.[6] Infrastructure sharing in the ICT sector was the topic at the 5th International Regulatory Workshop in Cartagena de Indias, Columbia, in October 2010. We have made a presentation about the experience of network sharing in Sweden at the Latin America EU summit on ICT regulation in November 2011. The issue of network sharing was also the topic at the European Competition Network Telecoms workshop in June 2013 where we presented the potential impact of network sharing on the mobile market.

The financial and market analysis has been carried out through desk research by analyzing company reports, and financial data retrieved from the Bloomberg system.

[6] See http://www.slideshare.net/Garry54/mobile-network-sharing-swedish-experiences

4 From passive to active network sharing

4.1 Definition of network sharing

Network sharing refers to some sort of collaboration of network resources. The following table defines different types of network sharing from passive to active sharing, with core network as well as spectrum sharing.

Table 1 Types of Network sharing

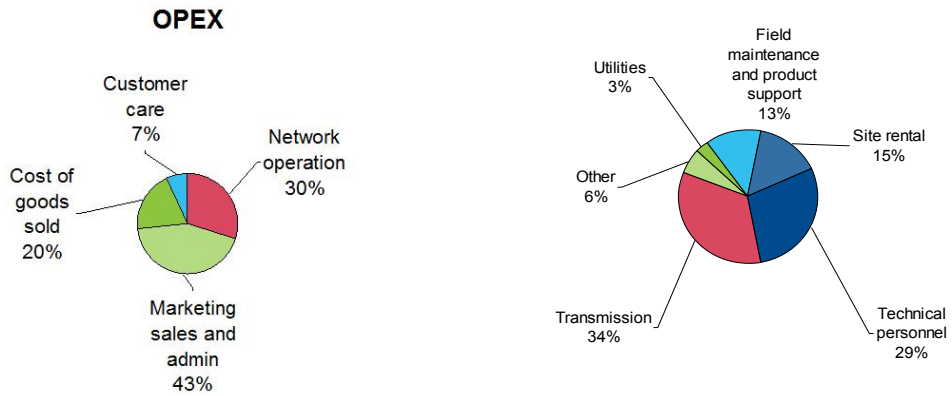
Type of network sharing	Characteristics
Passive network sharing	Sharing of passive elements of network like towers, mast, sites, cabinet, power, conditioning.
Active network sharing	Sharing of active equipments in the access network, like antenna, node, radio network controller elements, sharing of the radio access network (RAN), sharing of all access network equipment, including the antenna and the backhaul segment to the RNC (radio network controller)
Core network sharing	Share core networks relate to active equipment with switches (SGSN, MSC, HLR, and GGSN).
Spectrum sharing	Sharing of spectrum could be in the form of pooling of spectrum

A sort of network sharing is national roaming and MVNO agreements as network operators open their network for other service providers. It could also be cases where operators enter agreements to share networks in different geographical areas. Outsourcing is also a form of network sharing.

4.2 The financial impact of network sharing

Network operation represents around 30 percent of operators' total operational expenditures (Opex), according to Nokia Siemens Network (2009), and network Opex consists of transmission, technical personnel, and site rental, according to the following figure.

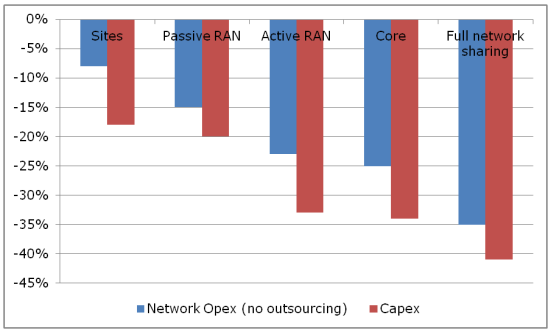
Figur 1 Opex is made up by four cost categories and Network Opex consist of a number of cost categories



Source: Nokia Siemens Networks (2009)

Friscano et al. (2008) state that network sharing can reduce network operational costs with up to 35 percent, but it depends upon the extent and depth of the network sharing arrangement. The basis for the estimates is simulations for different network options. Figure 2 show the estimated cost reduction on network Opex that different forms of network sharing can provide.

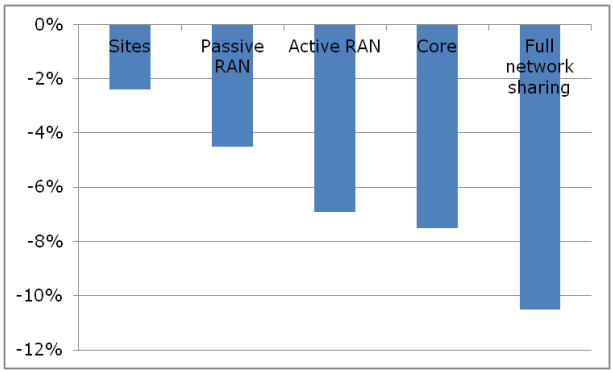
Figur 2 Cost reduction with network sharing



Source: T. Frisanco et al. (2008)

Given that the impact on total Opex is the interesting number it is motivated to combine the estimate the share of network Opex on total Opex, which is 30 percent according to Nokia Siemens Network (2009) and the estimates provided by Frisanco et al. (2008). This gives the magnitude of the potential to reduce total Opex with 7 percent with active Radio Access Network sharing, while site sharing would facilitate a 2 percent cut in total Opex, as the following figure show.

Figure 3 Reduction of total Opex by network sharing



Source: Authors' calculation based on Nokia (2009) and Friscano (2008)

4.3 Regulatory perspective on network sharing

Network sharing agreements are examined by both National Regulatory Authorities and Competition Authorities, with respectively regulatory framework. The NRA:s in Europe are subject to the regulatory framework for electronic communication which builds on a number of directives made by the EU Commission which are then transposed into national law, like the Electronic Communications Act in Sweden.

The assessments made by the regulatory authority regarding the effect on competition are based on competition law methods when assessing the need for *ex ante* regulation and applied by the Swedish Competition Authority when assessing abuse of a dominant position. The Competition Authorities base their work on national Competition Act and articles 101 and 102 in the Treaty of the Functioning of the European Union (TFEU). According to the regulatory framework network sharing is a form of horizontal cooperation (EU Commission (2011), as competitors make production agreements on a wholesale level, where the appropriate regulatory focus is on the commonality of cost in order not violate competition regulation (EU Commission (2011), and Viscusi (2005)). The underpinning is that the share of commonality of cost should not be too high in order to facilitate a differentiation in pricing and market offer. Moreover, the Competition Authority as well as DG Comp at the EU Commission closely monitors to what extent synergies or lower production cost translate into lower prices for the end-customers.

5 The diffusion of network sharing

5.1 Established practice in most countries

Network sharing is a global phenomenon, which primarily consist of sharing passive infrastructure. In the US network sharing primarily consists of site sharing where the mobile operators make agreements with tower companies to lease antenna space. India has also seen the emergence of a number of tower companies that provide tower space to the operators. A similar development has taken place in Indonesia and Africa, where a growing number of operators are using external tower companies in the network deployment.

Based on a survey to all EU 27 member states BEREC (2011) conclude that there are agreements for passive network sharing in all member states, and the whole practice of passive sharing has come a long way and it is now considered commonplace. Active network sharing is also used by operators in several countries, such as the UK.

5.2 Infrastructure and network sharing companies

The increased usage of network sharing has generated a growing number of companies dedicated to provide access to towers, sites and networks. A growing number of operators transfer their tower assets to separate tower companies, which could be in the form of joint ventures or separate infrastructure companies. The tower companies upgrade existing towers, build new towers and broaden the geographical footprint.

Tower sharing in Africa has become a way for mobile operators to reduce operating costs by locating antennas on the same towers enabling operators to benefit from shared costs of power, maintenance and security. Network build and operating costs are significantly higher in Africa, yet revenues per customer are falling and regulators are seeking additional rural coverage and improvements in quality of service. Tower sharing is growing in Africa. For example France Telecom has made an agreement to outsource more than 2000 mobile towers in Cote d'Ivoire and Cameron to HIS, which is a Nigerian company, specialized in operating mobile infrastructure.[7]

The mobile infrastructure sector is growing rapidly and we have identified 19 companies from different parts of the world, but the list is not exhaustive as the development is ongoing.

Table 2 Infrastructure/network companies

Company	Operation	Ticker	Country	Webb
American Tower Corp	A real estate investment trust that owns, operates and develops wireless communications and broadcast towers in the US.	AMT US	US	www.americantower.com
Bharti Infratel	Provides telecommunication infrastructure services. It has merged with Indus tower company	BHIN IN	India	www.bharti-infratel.com
Clarke Telecom	Wireless telecommunications infrastructure provider, designs and installs signal towers, transmitters, and receiver equipment for the broadcast of mobile telephone radio signals. Serves mobile service providers throughout	Private	UK	www.clarke-telekom.co.uk

[7] Source Financial Times April 1, 2013

	the UK and overseas.			
Crown Castle Intl Corp	Engineers, deploys, owns and operates shared wireless infrastructure	CCI US	US	www.crowncastle.com
GTL Infrastructure	Is a shared user infrastructure company, provides passive telecom infrastructure and related network infrastructure for multiple mobile operators.	GTLI IN	India	www.gtlinfra.com
Eaton Towers	African tower company, offer tower sharing on more than 1500 towers in Ghana, Uganda and South Africa	Private	UK	www.eatontowers.com
EI Towers SpA	Tower company which operates in the communication infrastructure sector.	EIT IM	Italy	www.eitowers.it/eng
Everything Everywhere	Mobile network operator		UK	www.ee.co.uk
Global Tower Partners,	Provides telephone voice and data communication services. Owns, manages and master leases numerous sites. It also leases space on towers and rooftops to telecommunication carriers.		US	www.gtpsites.com
GTL Infrastructure	Is a shared user infrastructure company, provides passive telecom infrastructure and related network infrastructure for multiple mobile operators.	GTLI IN	India	www.gtlinfra.com
Helios Towers Africa	Provides wireless telecom infrastructure throughout Africa.	Private	Dem.Rep. Congo	www.heliostowersafrica.com
IHS Nigeria	Provides telecommunications infrastructure deployment and post construction management in Africa.	IHS NL	Nigeria	www.ihsafrica.com
Mobilitie LLC	Develops, operates and leases communication towers and other infrastructure for wireless communication in the US.	Private	US	www.mobilitie.com
NEC Networks & System Integration Corp	Designs, constructs and maintains communication system.	1973 JP	Japan	www.nesic.co.jp
Net4Mobility	It is a JV between Telenor Sweden and Tele2 Sweden. The aim is to build, operate and own a GSM and LTE network with a transmission network and sell network capacity to two owners	Private	Sweden	www.net4mobility.com
Reliance Infratel	Builds, owns and operates telecommunication towers and related assets at designated sites. It is a subsidiary of Reliance Communication.	RITL IN (pending listing)	India	www.rcom.co.in
SBA Communications	Owns and operates wireless communications infrastructure in the US. It offers site leasing and site development services, leases antenna space on its multi-tenant towers to a variety of wireless service providers.	SBAC US	US	www.sbasite.com

Sarana Menara Nusantara	Through a subsidiary (PT Profesional Telekomunikasi Indonesia), builds telecommunication towers. The company constructs, operates and rents towers to mobile telecommunications service providers in Indonesia.	TOWR IJ	Indonesia	www.ptsmn.co.id
3GIS Infrastructure Services AB	It is a JV between Telenor Sweden and Hi3G Access AB. The aim is to build, develop and operate the infrastructure that facilitate for the owners to provides mobile services outside of the major cities in Sweden	Private	Sweden	www.3gis.net
Tower Bersama Infrastructure	Provides telecommunication infrastructure services to Indonesian wireless carrier.	TBIG IJ IDR	Indonesia	www.tower-bersama.com
TowerCo	Owns and leases communication towers. The company provides wireless service providers with communication towers across the US and Puerto Rico.	Private	US	www.towerco.com
Towerco	Run a single national grid of 18 500 masts previously held by Vodafone and O2	Private	UK	
Viom Networks	Provides shared passive telecom infrastructure solutions in India.	pending listing)	India	www.viomnetworks.com

Source: Bloomberg, company websites, Cullen International

5.3 Network sharing in Sweden

Network sharing has been in place since 2001 in Sweden. There are three mobile network sharing companies, which are described below. The 3G licenses issued in the year 2000 facilitated for the licensees to fulfill 70 percent of the coverage requirement through network sharing of the radio access network, including Node Bs and RNCs.

Figure 4 Network sharing agreements in Sweden

5.3.1 Svenska UMTS-nät AB (Sunab)

Sunab is owned by Svenska UMTS-nät Holding AB which is jointly owned with 50 percent each held by Tele2 and TeliaSonera. Sunab was set up after Tele2 received a 3G license in 2000. TeliaSonera made an agreement with Tele2 and founded the joint company as it did not receive a 3G license in the beauty contest held by PTS. The aim with Sunab has been to build and operate a national UMTS-

network and provide network capacity to the owners. Through Sunabs network does Tele2 and TeliaSonera share sites and mast as well as the Radio Access Network (RAN), including backhaul, but the two owners have their own core networks.

5.3.2 3G infrastructure (3GIS)

3GIS is jointly owned by Telenor and Hi3G each holding 50 percent. The company has built a 3G network outside the major cities in Sweden which has enabled Telenor and Hi3G to lower their Capex and Opex compared to if they would have been forced to build their own national networks. 3GIS is operating as an independent company and has managed the entire deployment process, operation and maintenance. Through the 3GIS network does Telenor and Hi3G share sites and mast as well as the Radio Access Network (RAN), including backhaul. The network covers around 70 percent of the Swedish population. The two owners have their own core networks.

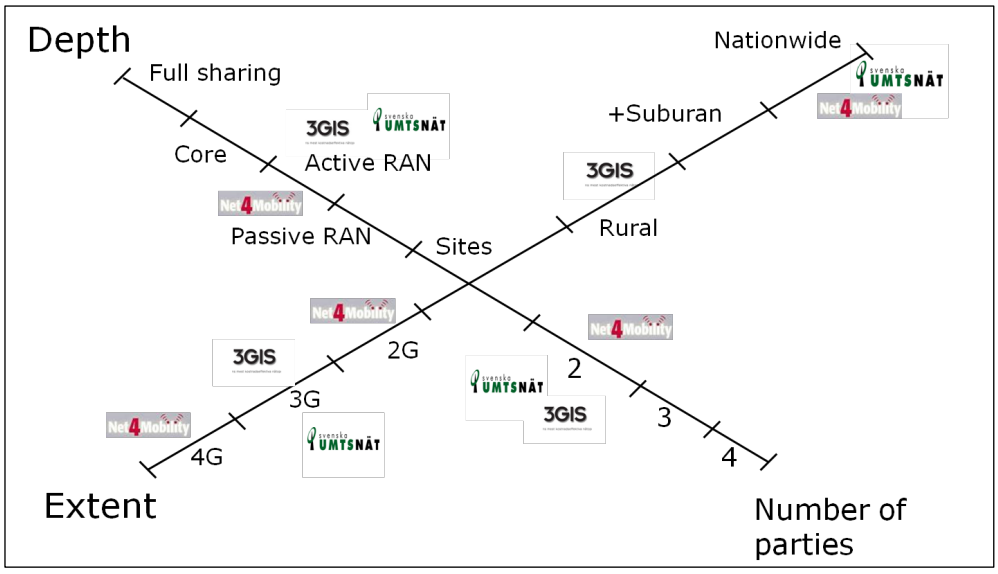
5.3.3 Net4Mobility

Net4Mobility is jointly owned with 50 percent each held by Tele2 and Telenor. The aim with the company is to build, operate and own a GSM and LTE-network with associated transmission network and sell network capacity to the owners. Net4Mobility has a national GSM and LTE network. The company acquired spectrum in the 800 MHz band in 2011, and in the 1800 MHz-band in 2011. Net4Mobility's network enables Telenor and Tele2 to share sites and mast as well as the Radio Access Network (RAN), including backhaul. The two owners have their own core network.

5.3.4 The view on network sharing in Sweden

We apply the taxonomy presented in Friscano et al. (2008) which on one axis distinguish between the depth of the network sharing arrangement, on a scale from passive network sharing regarding sites to full network sharing including core networks, and the number of involved parties in the network sharing agreement. The other axis show the extent of the collaboration regarding technology, from 2G to 4G, and the geographical coverage of the network sharing agreement, from rural areas to suburban or nationwide. The Swedish network sharing consists of active Radio Access Network sharing, besides that the operators share leases antenna space in each other base stations. Each JV consists of two parties. The collaboration is on 3G for two of the network sharing companies and 2G/4G in the Net4Mobility case. Two out of the three network sharing arrangements has a nation-wide coverage, while 3GIS only cover areas outside of the major three cities in Sweden.

Figure 5 Different network sharing agreements in Sweden

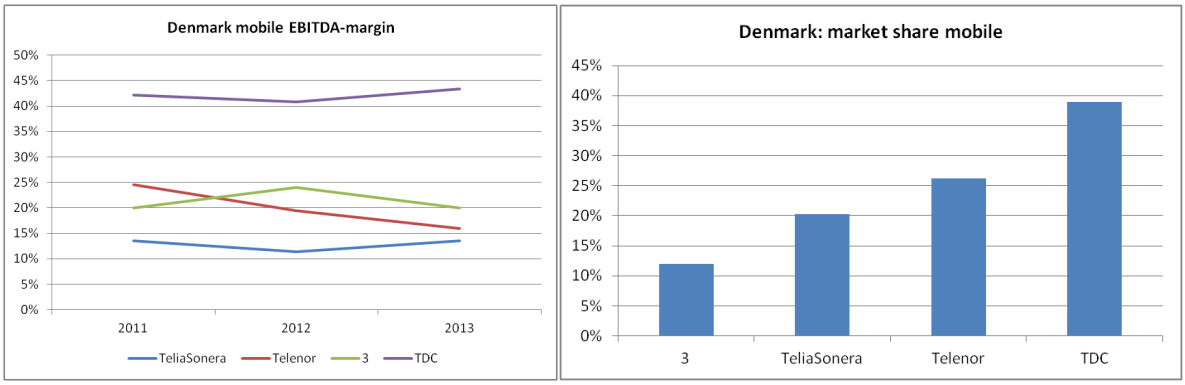


Source: Based on Friscano et al. (2008)

5.4 Denmark – competitors collaborating

TeliaSonera and Telenor have over the years never succeeded to generate any profits on the Danish mobile market, and with high churn the cost for subscriber acquisition have continuously been high. The combination of low market share and EBITDA-margins around 15 percent makes it difficult to support capital expenditures and aggressive marketing.

Figure 6 Denmark mobile – profit margin and market share



Source: Danish Business Authority, operator reports

Subsequently the two companies formed a network sharing company TT-Network JV which was cleared by the Danish Competition Council in February 2012 for a nationwide network. The JV covers site and mast sharing as well as Radio Access Network sharing. A condition for the approval was that the network sharing company has to provide mobile services and mobile broadband on a non-discriminatory market conditions to interested wholesale customers. The two owners have to pay the commonly owned JV for its supply of radio access capacity according to a cost-based tariff structure. There are strict conditions for the information flow and appointment of the management of the JV.[8] The JV owns spectrum in the 800 MHz band.

5.5 Europe

5.5.1 Austria

Besides that all mobile operators are involved in site and mast sharing, antennae and repeaters are shared in tunnels and metro.[9]

5.5.2 France

The French regulator is supporting network sharing on 3G, and with Radio Access Network sharing in rural areas. All French operators have signed an agreement to share infrastructure. Moreover, Free mobile has a national roaming agreement with Orange.[10]

5.5.3 Italy

Passive network sharing is allowed but sharing of Radio Access Network and Core networks is not permitted. Vodafone and Wind have an agreement for site sharing, Vodafone and Telecom Italia have an agreement on site sharing, and Telecom Italia and Hi3G have an agreement on site sharing besides a national roaming agreement.[11]

[8] Source: Cullen-International, table 21Infrastructure and network sharing by mobile operators, last update May 2013

[9] ibid

[10] ibid

[11] ibid

5.5.4 Spain

Besides that all mobile operators are involved in site sharing, Vodafone and Orange entered a network sharing agreement in 2006 for a nationwide 3G Radio Access Network sharing covering areas with less than 25 000 inhabitants. The plan is to share 5 000 sites.[12] Moreover, Yoigo has a national roaming agreement with Telefonica.[13]

5.5.5 UK

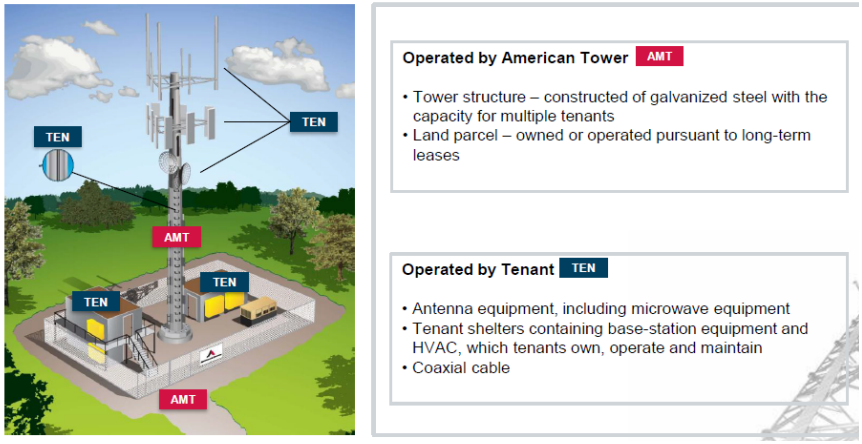
T-Mobile and Orange merged their networks and formed Everything Everywhere in 2010. The European Commission approved the JV after the companies offered to divest 25 percent of their combined spectrum. Orange and T-Mobile are remained as autonomous brands in the market with their separate shops, marketing campaigns, propositions and service centers. The two brands will be run by Everything Everywhere, which also is marketing its own brand EE4G[14].

Vodafone and O2 (Telefonica) has established JV (Towerco) that operate a national networks of 18 500 masts previously held by Vodafone and O2.

5.6 US

The emergence of separate tower companies has been part of the development of the mobile market in the US since the 1990s. The tower companies lease antenna space on multi-tenant towers to mobile operators with long-term contracts, and the target is to have at least two tenants per site and if the tower company reaches three the profitability increase considerable.[15]

Figur 7 Site sharing



Source: American Tower

The four major tower companies have 25 percent of the installed base of 302 000 sites in the US.[16] The other 75 percent are held by a large number of regional independent tower companies, mobile operators that own and operate their own towers, and alternative facilities such as rooftops, outdoor and indoor distributed antenna system (DAS) networks, billboards and electric transmission towers.

[12] ibid

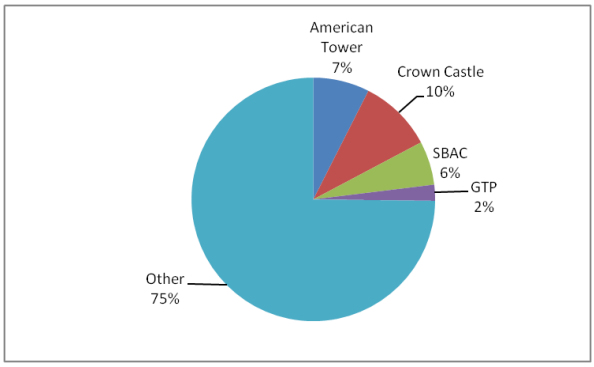
[13] Source: TeliaSonera

[14] Source: Cullen-International, table 21Infrastructure and network sharing by mobile operators, last update May 2013

[15] Financial reports from the tower companies American Tower, Crown Castle

[16] The number of totals sites are presented by CTIA, http://www.ctia.org/advocacy/research/index.cfm/aid/10323

Figur 8 Distribution of sites in the US



Source: CTIA, company reports

5.7 India

The Indian mobile market is very fragmented, operator and spectrum licenses are awarded in 22 regions (called circles) and the number of operators in each circle is up to ten. There exist state owned operators but none of them are among the largest. The high number of operators has led to an intense competition and very low prices. After 2008 when new operators entered the market the (already low) voice prices decreased by 60 percent.

Network sharing is common in India. The operators rent space and some equipment at the base stations sites that are operated by tower companies. The operators share the tower, power, cables, equipment room and other non-telecom equipment. It is passive network sharing since no active equipment, i.e. radio transmitters and receivers are involved. A key driver for network sharing is to lower the cost base. With tower companies mobile operators can avoid long term investments in costly towers and site equipment. Instead of investing capital for 20-30 years operators are tenants leasing space, capital expenditure is replaced with operational expenditures. The tower companies act as real-estate companies making investments and taking on the risk.

The rental agreements are designed so that the more tenants at a site the lower the cost for each tenant and at the same time revenues increase for the tower company. The interviews indicate that currently the focus is to increase the number of tenants per site rather than to build new sites. In one case the target was to go from "just below two" tenants to around three tenants per site.

There are a large number of base station sites (towers), more than 400 000 in total in India and many tower companies. There are also different types of ownership structures: 1) owned by a single operator, 2) owned by two or more operators or 3) independent tower companies.

Another issue for operators is the limited amount of spectrum that has been awarded. GSM operators typically have 4,4, 6,2 or 8 MHz in the 900 MHz band, and 3G services operators have been awarded 2* 5 MHz, this is more or less 1/10 compared to the spectrum available for mobile broadband for European operators. Operators pay license fees to the government, a kind of royalty (or tax), around 6-8 percent of gross revenues.

Moreover, the spectrum allocation process is complex and has caused a lot of uncertainty. In early 2012 the India's Supreme Court decided that 122 spectrum licensees that had been awarded at first-come-first-served basis in 2008 should be quashed. The decisive argument was that these licenses had been granted to companies during an arbitrary allocation process.

6 Analysis of network sharing

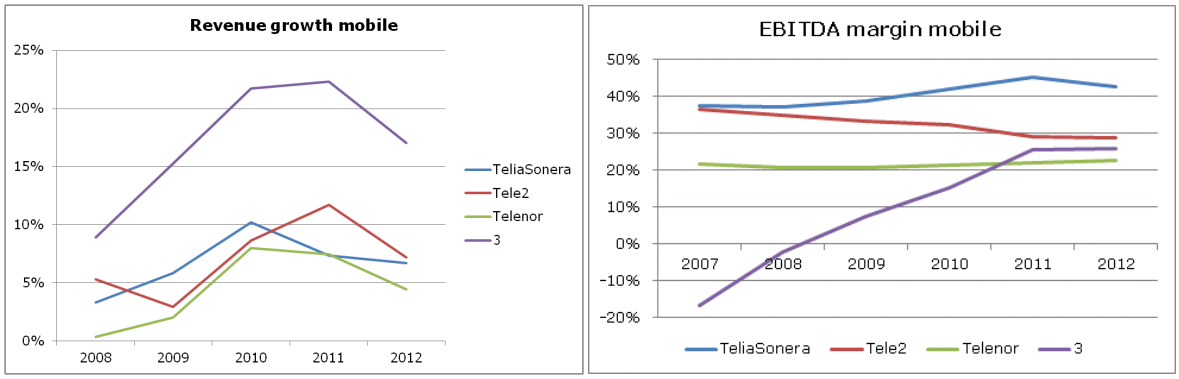
6.1 Motivation to do network sharing

Based on the cases and data presented in this paper and desk research of related work we structure the analysis into four categories that each exhibits a motivation for network sharing.

6.1.1 Lower operational and capital expenditures

It is common knowledge that network sharing reduces network operation and capital expenditures, which is underscored by a number of papers, like Friscano et al. (2008), and thereby important drivers for operators to enter network sharing agreements. But given that the impact of total operational expenditures is below 10 percent, as illustrated in figure 3, the question is if it possible to observe an impact on profit margins. The Swedish mobile operators have reported growth during the last five years and the profit margin, measured as earnings before interest, taxes, depreciation and amortization (EBITDA) has been going both up and down. This implies that, for Tele2, where the margin has decreased from 37 percent 2007 to 29 percent 2012, despite extensive usage of network sharing. However, Telenor has reported flat margins, while 3 and TeliaSonera has improved profit margins. This means that other costs have influenced the profit margin, and a contrafactual argument would be to state that if, for example, Tele2 had not been involved in network sharing the profit margin would have been lower. Moreover, this does not take capital expenditures into consideration, which through network sharing has been considerable lower than what it would otherwise had been. Moreover, the impact of Net4Mobility has not yet materialized on the results for Tele2 and Telenor, as the network being completed during 2013 and the migration of the customer base to 4G will take a couple of years depending upon the availability of 4G terminals.

Figure 9 Revenue growth for mobile and EBITDA margin in Sweden[17]



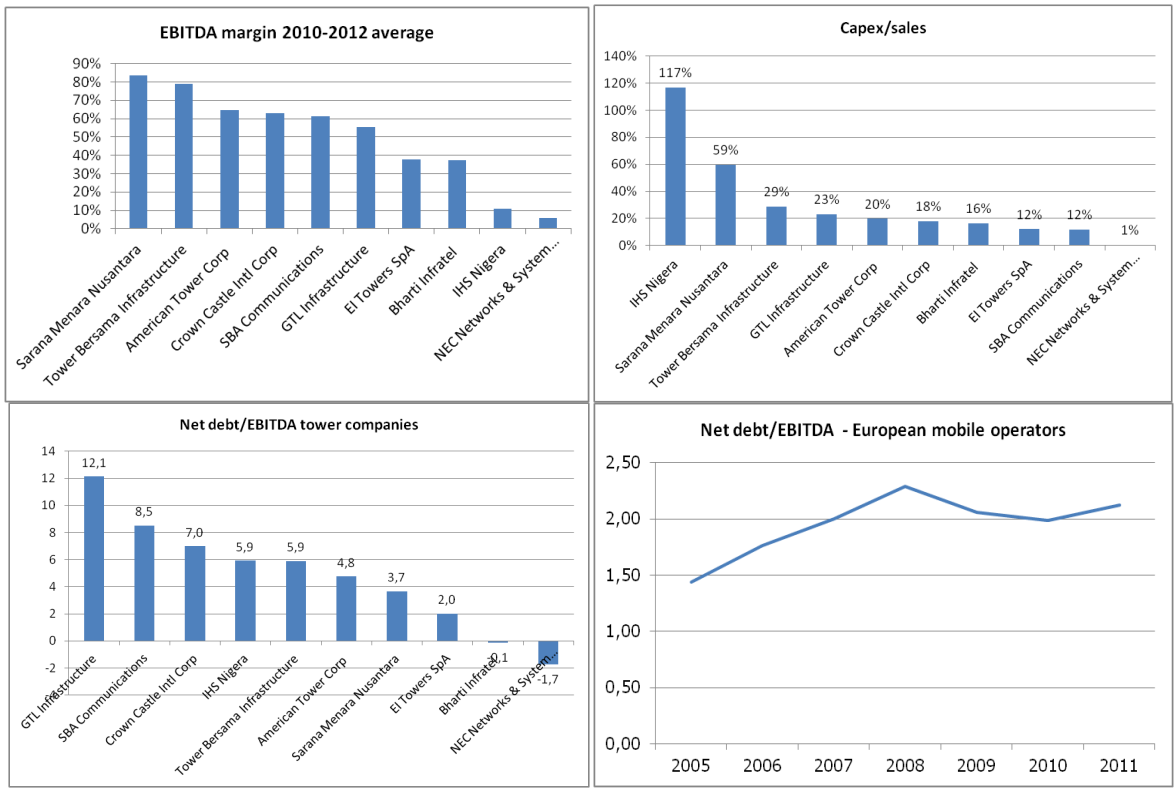
Source: Operator reports

Of the tower and network sharing companies, described in table 2, ten are listed on different stock markets. The size of the companies varies significantly. The two leading US based tower companies generate around EUR 2 bn in revenues during 2012, while HIS, a tower company based in Nigeria, report annual revenues of EUR 75 m. The average profit margin, measured as EBITDA, is over 50 percent, and the top performers, like the Indonesian tower companies, generates an EBITDA margin over 80 percent, see figure 10. The level of capital expenditures in relation to revenues varies considerable, with a median of 20 percent, compared to an average of 14 percent for European

[17] EBITDA: Earnings before interest, taxation, depreciation and amortisation

operators. Moreover, the level of gearing, measured as net debt[18] in relation to EBITDA, show a spread from negative up to 12x, with an average of 6x compared to an average of 2x for European operators. This demonstrates that tower companies are able to raise more capital compared to operators, and thereby operate with a lower share of equity. Or expressed differently, operators that offload their networks to tower companies are able to raise substantial amount of capital, all depending upon if it is a divestment, leaseback or some other form of agreement. Outsourcing would rather have an impact on operational costs while not having any impact on the balance sheet.

Figure 10 Tower companies: revenue, profit margin, Capex and gearing



Source: Bloomberg, company reports, Net debt/Ebitda ratio European operators[19]

6.1.2 Improve coverage and services

As network sharing enables operators to establish more cost efficient coverage it has contributed to an improved geographical coverage. Sweden is one example, as the 3G networks cover more than 99.98 percent of the population and reach 40-60 percent of the geographical surface.[20] Other examples are France where mobile operators are collaborating on 3G in rural areas. In Germany, Vodafone and Telefonica is pursuing network sharing, and as the National Regulatory Authority, BNetzA, could accept joint use of spectrum in rural areas it propels improved coverage.[21] In Spain, Vodafone and

[18] Net debt shows a company's overall debt situation by netting the value of a company's liabilities and debts with its cash and other similar liquid assets. Calculated as: Net debt = short term debt + long term debt – cash & cash equivalents. Source: http://www.investopedia.com

[19] Based on an average on company ratios for the following operators: BT, DT, FT, KPN, Swisscom, Telefonica, and TeliaSonera

[20] Source: PTS Bredbandskartläggning (in Swedish), available at http://www.pts.se/upload/Rapporter/Internet/2013/bredbandskartlaggning-2012-pts-er-2013_7.pdf

[21] Source: Cullen-International, table 21Infrastructure and network sharing by mobile operators, last update May 2013

Orange is collaborating and doing nationwide 3G Radio Access Network sharing covering areas with fewer than 25 000 inhabitants.[22]

6.1.3 Impact on market structure and competition

The overall trend on the market for electronic communication is consolidation. Network sharing could be regarded as a form of a consolidation as competitors are collaborating on infrastructure. How is competition impacting the different country markets?

Sweden

There are four large operators that compete on the end customer market despite that they share networks in various combinations, see Figure 4. For 4G TeliaSonera has chosen to build its own network rather than to continue its collaboration with Tele2. TeliaSonera's network strategy is not to share networks on markets where they are market leader while considering network sharing in other countries, such as Denmark where Telia cooperates with Telenor.

Tele2 and Telenor share 2G, 3G and 4G networks, but with different partners. In the marketing for 3G mobile broadband Tele2 says that they do not primarily compete with TeliaSonera when it comes to network coverage and capacity, but in the ads they state that the same network is used. Tele 2 would rather compete with offers to customers, price and help desk. However, for the 4G LTE networks built by Tele2 and Telenor the excellent network coverage is highlighted in the marketing.

The large extent of network sharing in different constellations in Sweden makes it difficult to find solutions with operators that mutually make agreements that limit competition as the operators have more than one partner. During the interviews with the operators they claim that they do not see any reduced competition due to the network sharing agreements. However, we would claim that Net4Mobility is strengthening Tele2 and Telenor in the competition as they get more competitive towards the dominating mobile operator, TeliaSonera. In the same way, we can assume that the structure with several network sharing companies is a disadvantage for the smallest operator Hi3G, especially since they do not yet have any LTE network. TeliaSonera is large enough to manage without a 4G network sharing agreement in Sweden.

Other countries

The existence of tower companies shifts the balance from agreements between operators, which potentially could form network clubs, and thereby could improve competition. The possibility for smaller operators to do network sharing improves competition, as they become stronger, and thereby improves competiveness.

6.1.4 Reduce the negative impact on the environment

The deployment of mobile base stations across towns, cities and the countryside has led to a negative visual impact on the environment.[23] Regulators therefore promote passive network sharing which reduce the duplication of passive networks in order to protect the environment.

[22] Source: Cullen-International, table 21Infrastructure and network sharing by mobile operators, last update May 2013

[23] The regulatory authority of Botswana, http://www.bta.org.bw/infrastructure-sharing

7 Conclusions

This paper examines the concept of network sharing and has strived to analyze the role of network sharing on the operator business, and the impact on profitability and competition. Altogether, we would like to highlight five aspects that the paper has covered.

Network sharing has been used for some time and the increased usage throughout the world signals that it is going to develop, and in the longer run move the focus from infrastructure based to service based competition.

Operators have been able to lower network operation cost but it has not translated into improved profits. This implies that network sharing has offset a part of a profitability tap, and without network sharing would profits have been lower.

Network sharing and outsourcing have propelled a development of dedicated tower and infrastructure companies which have released capital for operators as it is able to manage higher debt ratios than operators meaning that it has a transformative impact on the operator business.

Despite an extensive usage of network sharing - where competitors are collaborating - competition on the retail market prevails. A potential spillover from network collaboration on the downstream market is a risk, and a factor that competition authorities are monitoring very closely. However, the social benefit with larger coverage and improved capacity has so far given extensive support for network sharing which has become an established practice within the market for electronic communications.

8 Further research

This paper addresses an interesting field for research that can be extended into a number of areas:

- Network sharing could be a step in the direction towards an industrial change and generate a development where operators go in the direction towards vertical disintegration and thereby forming a new industry structure.
- For indoor networks a common approach for network sharing including network deployment and operation can be expected since facility owners do not allow multiple indoor single-operator networks.
- The combination of spectrum and network sharing should be investigated more both from a system performance as well as a competition perspective. Pooling of licensed spectrum is currently used by some operators in Sweden. Spectrum sharing with multiple license holders, so called co-primary spectrum sharing is discussed as a way to increase the use of available spectrum resources. Co-primary sharing would be especially interesting to analyze for indoor and local networks.
- Network sharing outside Europe should be investigated more thoroughly since the market conditions are different, e.g. the expansion of tower companies indicate a vertical disintegration
- The issue of spectrum aggregation or carrier aggregation relating to spectrum holding is interesting as the current regime of dividing the spectrum into slots would not make it possible to utilize the benefit of spectrum aggregation and the possibility to achieve high capacity services. This implies that issues around competition, spectrum and network sharing have to be addressed.

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