

## Shared Networks for WCDMA

August 2003

*European Competition Commissioner Mario Monti: "Such cooperation deals can bring benefits for the consumer in terms of faster introduction of services, more competition and less impact on the environment"*

## 1 Introduction

In August 2002 the European Commission announced a plan to approve sharing agreements in the UK and Germany between the operators T-Mobile and mmO2. This clearly indicates the willingness of the European Commission, competition authorities and regulators to help operators build their 3G business. In June 2001, Tele2 and Telia were the first operators in Sweden to announce their network-sharing plans. Operators in other countries are now following suit.

Should operators cooperate in sharing agreements with their competitors or build their own networks? There are different considerations operators must take into account before signing a network-sharing agreement. This white paper will highlight the pros and cons of the different shared-network solutions available today, including the potential for savings in capital expenditure (CAPEX) and operational expenditure (OPEX).

Network-sharing agreements can provide CAPEX savings of 20–40%. OPEX savings fall within the same range. The amount saved will depend on the solution and traffic volumes, with more savings for limited traffic volumes.

Likewise, the business case for 3G introductions will be enhanced by network-sharing solutions. These solutions will enable operators to cut the costs of providing coverage for 3G services or help them provide more coverage for the same cost, allowing them to address a larger market.

As a result, network sharing could bring 3G services to a broader market earlier, with an increase in sales fuelling the demand for more capacity.

Network infrastructure sharing has its limitations, however. Operators will necessarily cede some of their independence, networks will become more complex, and their ability to compete on coverage will be curtailed.

Ericsson supports different sharing solutions, depending on the market conditions, thereby enabling operators to expand 3G networks and start-up services. As soon as more 3G services are available on the mass market, more network capacity will be required.

In the long term, infrastructure volumes will therefore not be affected by sharing because there is a long-term need for more capacity.

Network sharing between operators can range from well-known Site Sharing, via radio network sharing, to sharing part of the network. It can reduce the cost of building a network (CAPEX) and especially the cost of operating (OPEX) a network.

## 2 Operator alternative

Sharing network infrastructure, an operator alternative to deploying 3G networks, has its benefits and drawbacks. Infrastructure sharing can be used both in the start-up phase to build coverage quickly or, longer term, to build more cost-effective coverage in rural areas (see Figure 1). Sharing agreements provide the highest savings in cases of low traffic demand and more efficiency is achieved by pooling resources. When network usage picks up, savings will decrease as each operator needs individual capacity.

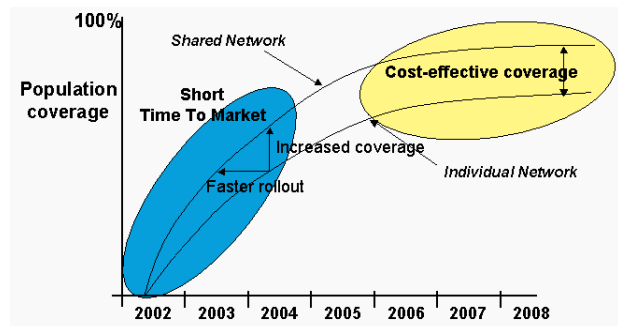


Figure 1. Illustration of the benefits of Shared Networks: shorter time to market and increased coverage. Both result in a larger potential market with more revenue.

Interest in infrastructure sharing can be expected to be at its peak in the start-up phase, when operators want to provide quick coverage in a large area while traffic demands are low and the costs for network deployment are relatively high. An application can be seen in the long run when the larger, more rural areas will be covered in a cost-effective way. Different regulator requirements are usually applicable for the initial coverage area and the additional coverage area, allowing the deployment of different solutions.

Infrastructure sharing is not new. In mobile networks based on Global System Mobile (GSM) it is utilized in several countries, including Germany and the US. One example is when a fledgling GSM operator signs a “national roaming agreement” with an incumbent operator to provide coverage in areas where it has no network (yet).

Another example is Mobile Virtual Network Operators (MVNOs), where the host network is utilized by the MVNO to offer services as well, in the process generating additional income for the host network operator.

When looking at a sharing agreement with another operator, the following should be considered:

## 1. Regulatory requirements

The regulatory conditions for 3G licenses for Wideband Code Division Multiple Access (WCDMA) or Universal Mobile Telecommunications System (UMTS) are set on a national basis and vary from country to country. In many countries infrastructure sharing is not mentioned specifically. The recent EC announcement helps guide operators and regulators.

The German regulator RegTP was among the first to clarify its regulations regarding network infrastructure sharing: Site Sharing, for example, is allowed. The shared radio network solution is a separate solution with individual frequencies; thereby operators can build 25% population coverage in 2003 and 50% population coverage in 2005, as required by the license.

For additional population coverage, the Geographical Split Network, or roaming agreements, can be utilized as well. The Common Shared Network is ruled out in Germany because core network elements are not allowed to be shared by licensed operators. However, the Common Shared Network solution can be used for sharing with an MVNO, sharing the costs of building the network or obtaining additional income from the network.

## 2. Strategic partner and cooperation

Network infrastructure sharing can be referred to as “co-optition” (operators’ cooperation in building infrastructure, while having full competition on their

branding, marketing, sales and the introduction of new services). Infrastructure sharing should be a win-win situation for operators and should give them a competitive advantage over other operators in the market. Proper sharing partners therefore rely on their specific market situation, matching their rollout strategies and achieving mutual benefits.

A clear win-win situation and openness in cooperation have been shown to be the critical success factors for “co-optition” and sharing. In addition, an exit strategy should be defined in case the market situation changes, or if traffic increases, making it more beneficial to deploy an independent network. A clear exit agreement allows operators a smooth migration to individual networks.

## 3. Sharing solution

The sharing solution used should match regulatory requirements and operators’ strategic intentions with respect to the area covered, traffic expectations and operator control. Various solutions for infrastructure sharing can be utilized, each with their own characteristics, which are a balance between individual operator control and potential savings. More cooperation and increased dependency provide more savings.

In particular, considerable savings can be achieved in network operations. A proper organizational set-up should match the sharing solution. In some sharing arrangements a joint organization or independent third party could be part of the solution to achieve efficient network operation.

## 4. Business case

Business modeling tools are utilized to help operators identify the best infrastructure-sharing solutions. Sharing-solution benefits, such as initial CAPEX savings and long-term OPEX savings, need to be evaluated against potential restrictions. The savings of a Shared Network are mostly in the short and medium term of network deployment, when the network is built to expand coverage. In the capacity phase, infrastructure sharing offers no investment benefits when expanding the network with additional capacity.

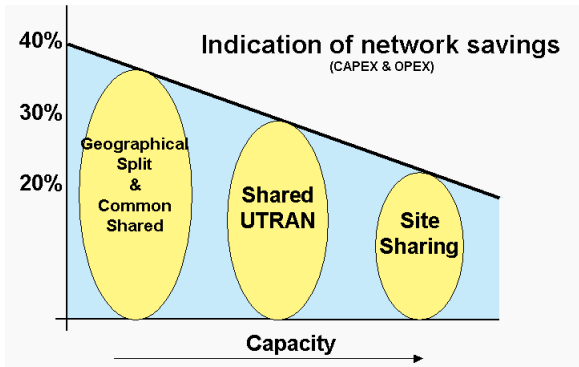


Figure 2. The potential savings to be gained from using a Shared Network compared with an individual network in the initial phase of network deployment. Site Sharing allows the sharing of all elements except for the base station itself. Shared UTRAN allows the sharing of the cabinet for the base station, transmission and RNC. The Geographical Split and Common Shared Networks allow the radio network to be shared. Please note that these savings are indicative as the actual savings depend on many factors, including the costs for sites, labor, transmission, the amount of traffic and the organization of network planning and management

## 3 Solutions for shared networks

Several solutions exist for infrastructure sharing among operators. They range from well-known Site Sharing, via radio network sharing, to sharing part of the network (network sharing). The shared elements can be owned by one of the operators, can be jointly owned, or owned by an independent third party, such as a tower company or an independent network-operating company. Different business models can be applied to the solutions provided in this section.

### Solution 1 – Site Sharing

Site Sharing typically involves sharing the site and mast for antenna placement. In addition to this, the power equipment, transmission equipment and antennas can be shared among operators. Site Sharing provides cost savings for site acquisition, civil works, annual site rent, transmission and operational costs for running the site. Site acquisition and site preparation represent a large part of the network rollout costs, about 20% of expenses.

Site Sharing can be handled on a site-by-site basis or can be combined with a coordinated rollout plan,

allowing additional savings on network planning, civil works and operation. A Site Sharing arrangement can be handled directly between operators or may include a tower company or other partner. Site Sharing is suitable for densely populated areas with limited availability and expensive sites, and rural areas with high costs for transmission and power.

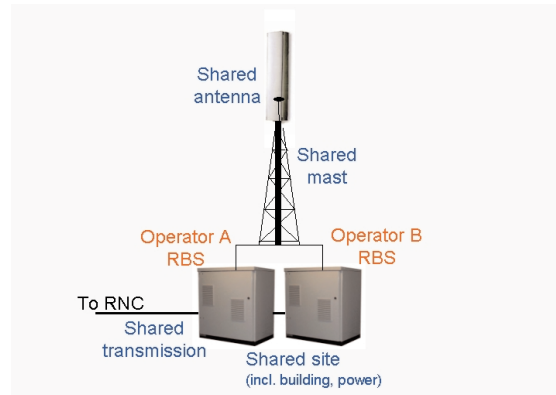


Figure 3. Illustration of Site Sharing. A site can be shared by two GSM operators, two WCDMA operators, or a combination of GSM and WCDMA operators.

License regulators usually promote Site Sharing in order to reduce the environmental impact antennas have on views and to allow new operators to build their networks by re-using existing sites.

### Solution 2 – Radio network sharing by Shared UTRAN

In the Shared UTRAN solution (UMTS Terrestrial Radio Access Network) the radio network is shared. One radio base station (RBS) is deployed per site, with individual frequencies for each operator. The radio network consists of RBS, Radio Network Controller (RNC) and transmission. The nodes are physically shared.

Within the shared radio network, each operator deploys its individual licensed frequency and deploys its individual cells, including individual control and network management. The sharing operators deploy its individual core network. Shared UTRAN can be seen as a Site Sharing solution with shared RBSs and a coordinated rollout.

Shared UTRAN requires a coordinated rollout between operators as the same sites in the shared area are used. This allows for additional savings on

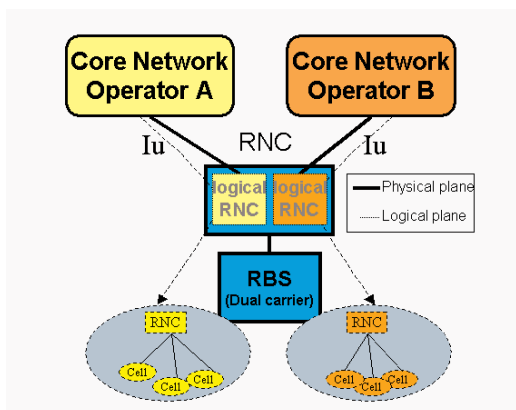


Figure 4. Overview of the Shared UTRAN solution based on the Virtual RNC function. One physical UTRAN (Radio base station, transmission and RNC) is split into two or more logical UTRANs.

infrastructure, network planning and operational expenses for running the radio network on top of the savings achieved by Site Sharing: site acquisition, civil works, annual site rent, transmission and transmission management.

Shared UTRAN is introduced in the RNC software, expanding the RBS with additional frequencies and expanding the radio network with the additional capacity required for sharing operators. Mobility and handover are identical to an individual network. Standard hardware and software is used, and the solution is 3GPP '99 compliant. The Core Network Standard hardware allows smooth migration to an individual network because invested infrastructure can be re-used.

Typical applications for the Shared UTRAN solution are in dense areas to fulfill the coverage conditions of the license, or for joint coverage of areas outside license requirements. Each operator can also connect RBSs or RNCs for individual coverage.

### Solution 3 – Network sharing with the Common Shared Network

In the Common Shared Network solution the operators jointly build and operate one common 3G network, consisting of the radio network and part of the core network. The operators share the RBS, RNC, Mobile Services Switching Center/Visiting Location Register (MSC/VLR) and Serving GPRS Support Node (SGSN).

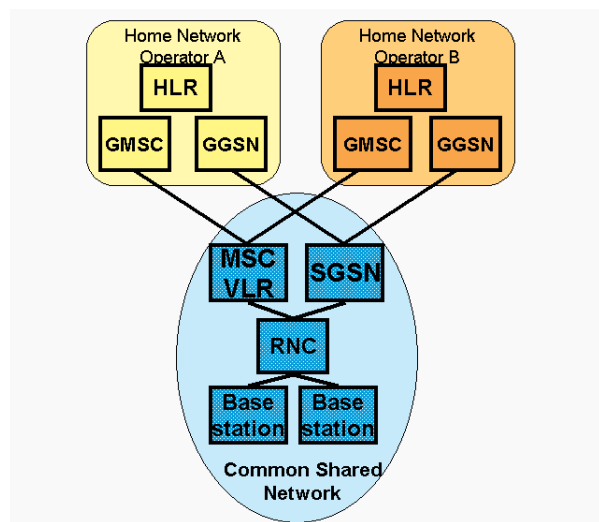


Figure 5. Overview of the Common Shared Network connected to each operator's individual Home Network. It contains all subscriber-related data, services and interconnections. Besides the Common Shared Network, each operator can have additional coverage from its individual (radio) network.

This solution also leads to better spectral efficiency. Each operator has its individual home network that contains the independent subscriber databases, services, subscriber billing and connection with external networks. The operators have individual HLR, GGSN, GMSC and service platforms. The subscribers of each operator can roam into the Common Shared Network, which provides coverage and services to sharing operators. One frequency for all sharing operators can be deployed to provide initial coverage, which makes this solution cost-effective for larger areas with limited traffic expectations: it is actually one radio network that is used by two or more sharing operators.

One of the operators' licenses is used in this sharing solution. Therefore, the solution is also applicable for joint coverage with an MVNO, an operator that does not have a 3G license to build its own network. This solution means joint coverage of more rural areas than can be covered cost-effectively by individual networks.

The Common Shared Network is actually one network with additional capacity for the sharing operators' traffic demands. This results in considerable savings for the radio network, but adds complexity to the planning and core network deployment because two or more operators have to be handled. Specific functions are available to handle the mobility for sharing operators.

The Common Shared Network is 3GPP compliant. Because the Common Shared Network is one network, it should be handled by one party – either a joint organization or an independent network organization.

## Solution 4 – Geographical Split Networks

For the Geographical Split Network solution each operator has its individual 3G network. The operators cover different areas and, by allowing national roaming, the coverage area for 3G services is expanded. In densely populated areas, operators can build their individual networks, restricting the access of other operators' subscribers. The traffic in the shared area is pooled on individual operators' frequencies, which makes this an efficient solution.

Up to five operators can deploy Geographical Split solutions, according to the 3GPP '99 specification. When roaming in another network, subscribers retain their operator's services; their operator's name is shown on the handset display.

Geographical Split Networks can be deployed as a long-term solution for enhancing coverage in more rural areas, while each operator keeps its own network. It can be a mutual roaming agreement or a one-sided roaming agreement, in which an operator with a large network provides additional coverage for an operator with limited coverage.

### Network management

Network management is essential for shared solutions with multiple operators. Site Sharing provides most control because each operator has individual network management of the radio base stations and over the rest of the network. Shared UTRAN provides individual network management control for the operator's individual cell settings (logical control) and a common network management interface for the physically shared nodes, being RBS, RNC and transmission. The Common Shared Network is one network that should also therefore be managed by one party, either a joint organization or an independent third party. For the Geographical Split Solution, the network is managed by the operator that owns the network.

### Sharing developments

Within the 3GPP standardization for WCDMA/UMTS, new items are being discussed to improve the support for network sharing. Ericsson is supporting and driving these developments.

### Five potential savings

Saving costs is the primary reason for infrastructure sharing. The actual savings, both in CAPEX and OPEX, will depend on many items; a business model can help estimate how much. The following items are of considerable influence:

- *Type of solution*

Site Sharing provides the basic savings on site and site-related costs. Savings are typically about 20% for both CAPEX and OPEX. Shared UTRAN can provide additional savings of about 10% because RBS and RNC nodes are shared. Additional savings can be made on OPEX due to combined network management of hardware. The Common Shared Network and Geographical Split Networks can provide savings of up to 10% because it is actually one network with extra capacity for sharing operators. All resources are pooled, which provides savings, particularly in the case of limited traffic.

- *Covered area*

All sharing solutions require coordination and organizational administration, which results in fixed costs. For the Common Shared Network and Geographical Split Networks, the additional network complexity caused by mobility and services means extra costs. Fixed costs make sharing more beneficial in larger areas.

- *Traffic expectations*

Radio network sharing and especially network sharing (Common Shared Network and Geographical Split Networks) provide the highest savings with limited traffic expectations due to pooling effects. The OPEX savings remain consistent, even in higher-traffic situations. Operators will have the opportunity to evolve into individually owned networks by fully re-using invested infrastructure.

## 4 Conclusions

Network sharing can play an important role in bringing 3G services to the mass market sooner by reducing initial investments and operational costs by 20–40% in the coverage phase. This may lead to a faster take-off of consumer services and traffic, thereby shortening the time for capacity expansion.

Ericsson supports various solutions, depending on the market situation, traffic expectations and license conditions. Long-term infrastructure volumes are not affected by sharing because they are determined by capacity requirements. The number of agreements will depend on market dynamics because network sharing provides the opportunity to maximize the return on investment and improve position in a competitive market. Network sharing offers opportunities for green-fielders and incumbent operators.

## 5 Appendix and acronyms

3GPP	Third Generation Partnership Project	PLMN	Public Land Mobile Network
BTS	Base Transceiver Station	RNC	Radio Network Controller
GGSN	Gateway GPRS Support Node	RBS	Radio Base Station
GPRS	General Packet Radio Service	SGSN	Supporting GPRS Support Node
GSM	Global System Mobile	SP	Service Provider
HLR	Home Location Register	UMTS	Universal Mobile Telecommunications System
IMSI	International Mobile Subscriber Identity	UTRAN	UMTS Terrestrial Radio Access Network
MNC	Mobile Network Code	VLR	Visiting Location Register
MSC	Mobile Switching Center	WCDMA	Wideband Code Division Multiple Access
MVNO	Mobile Virtual Network Operator		

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