

Shared Networks

An operator alternative to reduce initial investments, increase coverage and reduce Time To Market for WCDMA by sharing infrastructure

Abstract:

Sharing of network infrastructure among operators offers an alternative solution to reduce the investment in the coverage phase of WCDMA. Another advantage of the deployment of Shared Networks is the increased coverage, since operators can co-operate on coverage and sites and as it is a more cost-effective way to cover a larger area. All together this will result in reduced Time To Market and earlier user acceptance for WCDMA and its related services.

Business cases have shown an initial CAPEX reduction of up to 40% for two sharing operators. This document provides an overview of the three Ericsson solutions on Shared Networks:

- *Common Shared Network*
- *Geographical Split Network*
- *Shared UTRAN*

This document describes the technical solutions and its organizational implications, the evolution to individually owned networks in parallel with network capacity expansion and it helps to identify the best solution for the operator's specific situation.

Shared Networks allows a jump-start for WCDMA with early and large coverage, thereby accelerating the acceptance of WCDMA by the users. This will increase the operator's profit, which in turn will create good financial conditions for the operators when gradually expanding their network for extended capacity and coverage.

1 Introduction

Ericsson has the position as supplier of telecom equipment to the majority of Europe's most competitive operators. With shared networks we expect the operators to strengthen their positions even more in the future and this will result in the traffic and revenue increase that is needed to be able to migrate into wholly owned networks. Since more operators then will start the migration from an Ericsson network, we are in an advantageous position for further deliveries.

1.1 Ericsson Shared Networks strength

Ericsson offers three flexible Shared Networks solutions that can meet varying regulatory conditions as well as specific market and customer requirements in almost all situations. Each solution can be combined with each operator's individual WCDMA network. The Shared Networks solutions can also be combined to achieve the most cost-effective solution for a specific situation.

Each solution supports radio infrastructure sharing from two up to six operators and even more for specific situations. All solutions can also be migrated to individually owned networks in parallel with network capacity expansion and all invested infrastructure can be fully re-used. This implies, Ericsson can offer a full solution that starts with a Shared Network for initial investment reduction, reduced Time to Market and increased coverage that later migrates to individual networks in order to handle the growing traffic demands.

Shared Networks solutions are available from the start of WCDMA deployment. This allows the operator to take full benefit of the Shared Network such as reduced initial investment, reduced Time To Market and increased coverage.

All Ericsson's solutions are compliant with the 3GPP specifications and are therefore open for multi-vendor environments. In addition to the 3GPP specifications, Ericsson supports special functionality that enhances the capabilities of Shared Networks and provides the required flexibility for the future. Examples of this are Virtual RNC that enables flexible network handling and migration, Selective Handover for efficient network handover and Selective Routing for flexible routing of calls and data sessions in the Shared Network.

1.2 Ericsson Value Proposition

Flexible Shared Networks solutions - Ericsson offers three flexible solutions including migration to individually owned networks.

Knowledge of WCDMA – Ericsson is the largest contributor to the WCDMA standard and this ensures that the solutions will work, will be open to other suppliers and that it will be future proof. This ability of Ericsson to fully comprehend and to drive developments of the standard will be crucial in ensuring the operators the confidence needed to choose our solutions.

Experience - Ericsson has long experience with Shared Networks. We implemented the World's first Shared Network in 1995 for the operator Japan Telecom based on the PDC standard. From 2G Ericsson has gained the largest experience of integration in mobile networks and has taken a clear leading position in Mobile Internet.

Resources – Ericsson has the largest amount of competence and knowledge resources available on a global scale to put Shared Network into operation.

A good relation builds on trust – Entering a tri (or more) party relation between Ericsson and the operators puts increased demands on Ericsson's competence and integrity. This will be a major competitive advantage since Ericsson enjoys a long-standing positive relation with most operators in the world.

2 Basis for a successful commercial agreement

2.1 Who can benefit from the Shared Networks

Shared Networks offer benefits for all parties involved in WCDMA and is a win-win situation for operators, license regulators, suppliers and consumers.

WCDMA operators can benefit from Shared Networks as it can save up to 40% of its network infrastructure investments in the coverage phase. Moreover, the coverage can be increased as it is easier to find sites and is more cost-effective way in order to cover a larger area. All this can contribute to the Time To Market, market share and increased traffic. In addition to the CAPEX saving, the operational expenditure (OPEX) can be decreased as well, depending very much on the solution and organization of the Shared Network.

The regulator can benefit from Shared Networks as it enables all operators to survive and compete. As the sites are effectively shared, Shared Networks reduces the environmental effects. And, it will force operators to compete on new and innovative services to serve its customers.

Suppliers can benefit from Shared Networks as it allows a jump-start for WCDMA with early and large coverage, thereby accelerating the acceptance of WCDMA by the users. This will increase the operator's profit and result in increased infrastructure investments in order to deliver the demanded capacity. The initially reduced investments to fulfil the regulatory requirements will be compensated by the increasing success of WCDMA, resulting in a large demand for capacity and coverage.

Consumers will benefit from Shared Networks, as they will experience increased coverage and earlier service deployment.

2.2 Indication of savings

What savings can be expected from Shared Networks? The savings from Shared Networks depends on many factors, like the number of sharing operators, the size of the network, the co-operation between the operators, the number of subscribers, the amount of traffic, costs for sites, construction, transmission etc. Therefore the actual savings can best be determined by a specific business case for each situation. However, there is a general trend that is depicted in the figures below.

The potential saving of deploying Shared Networks can best be illustrated by splitting the costs for the network in the following parts:

- *Core*, that refers to the Core Network including MSC, GSN, HLR, transmission and backbone network etc.
- *Active RAN*, that refers to active elements like Radio Base Stations, Radio Network Controllers, transmission in the radio network etc.
- *Passive RAN*, that refers to passive elements like the site, the antenna tower, antenna, feeder cable etc.

Figures 1 and 2 show in a simplified way the potential savings in the coverage- and capacity phase for deploying Shared Networks. As can be seen, *most savings can be gained in the coverage phase*. In the capacity phase, the savings are in the Passive RAN mainly, which reflects Site Sharing savings.

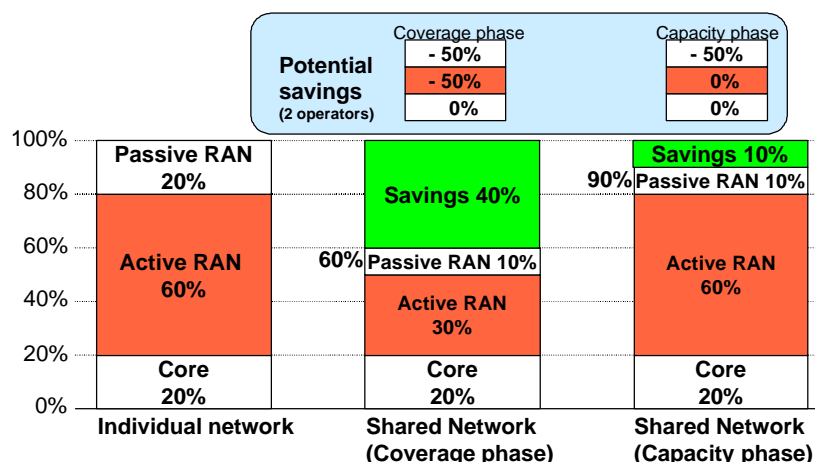


Figure 1. Illustration of potential savings by deploying a Shared Network based on roaming in the coverage phase and the capacity phase (Common Shared and Geographical Split Network).

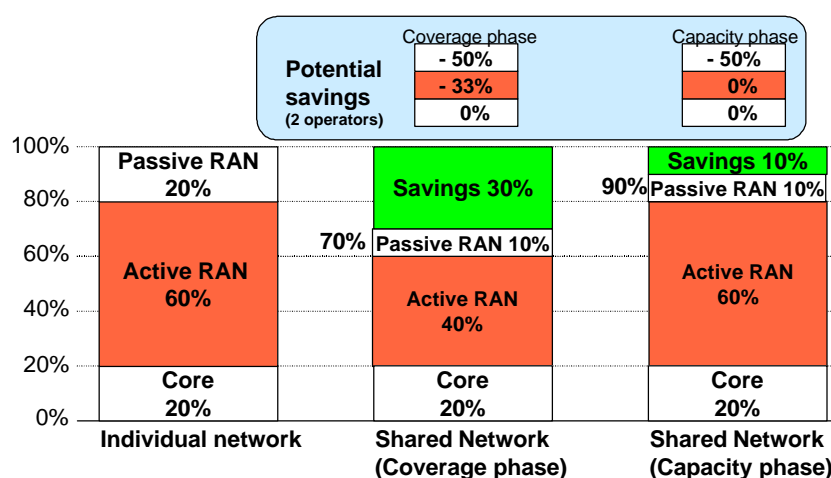


Figure 2. Illustration of potential savings by deploying a Shared Network based on the Virtual RNC functionality in the coverage phase and the capacity phase (Shared UTRAN).

2.3 Pre-requisites for Shared Networks

Before deploying a Shared Network, some important general issues have to be considered by the operators.

The national regulatory conditions of the WCDMA license may set limitations on the allowed level of network infrastructure sharing. In case the national regulator limits network infrastructure sharing, it may be possible to deploy Shared Networks for additional coverage or to deploy Shared Networks initially and migrate to individual networks later.

For example, in case the license conditions require 50% population coverage by 2005 by own functional controlled equipment, it may be possible to start with a Common Shared Network that is migrated to either an individual network or a Shared UTRAN solution before 2005. Moreover, any Shared Network solution can be deployed for additional coverage over the required 50% population coverage (and this is usually the biggest part of the country).

Other issues to be considered are:

- Co-operation between operators
- Deployment strategy (long term or introduction)
- Business case evaluation

3 Overview of solutions for Shared Networks

As described in the introduction, the three basic solutions to share radio infrastructure or coverage between operators are:

- Common Shared Network
- Geographical Split Network
- Shared UTRAN

3.1 Common Shared Network

In the Common Shared Network solution, two or more operators deploy a completely shared radio network and a partly shared Core Network. The shared radio network consists of Radio Base Stations, Radio Network Controllers, transmission, site etc. The part of the core network that is shared consists of the MSC/VLR and SGSN.

Each operator owns its individual Home Network that contains all functions related to subscriber data, services, billing and interconnections with other networks. The individual Home Network allows for independent services and interconnection-rates.

Every operator can add individual coverage to the Common Shared Network coverage by its individual WCDMA radio network. Handover and cell-reselection between the Common Shared Network and the operators individually owned WCDMA or GSM network is supported by the recently approved 3GPP'99 Change Requests on 'Equivalent PLMN's in March 2001.

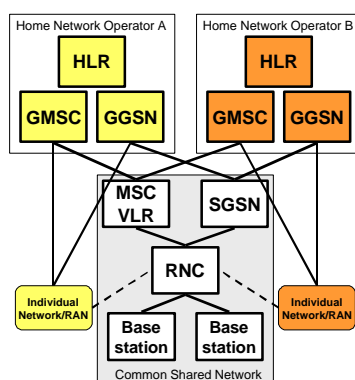


Figure 3. Overview of the Common Shared Network that is connected to each operator's individual Home Network, containing all subscriber-related data, services and interconnections. Besides the Common Shared Network, each operator can have additional coverage by its individual (radio) network.

Typically, a separate Mobile Network Code (MNC) is assigned for the Common Shared Network. This allows the Common Shared Network to be distinguished from the operator's individual WCDMA or GSM networks on an equal basis.

A typical deployment scenario for the Common Shared Network is at the initial stage of WCDMA deployment to achieve large and fast coverage for multiple operators. Another typical deployment scenario is to cover more rural areas that cannot be covered cost-effectively by each operator individually, enabling for cost-effective coverage of a larger area compared with individual networks.

3.2 Geographical Split Networks

In the Geographical Split Network solution each operator has its individual WCDMA network. The WCDMA coverage of each operator is enhanced through national roaming in the other operator's networks. By covering different parts of the country, the Geographical Split Network is an efficient way to provide large coverage while each operator keeps its individual Network Provider organization.

Handover and cell-reselection between the operator's networks are supported by the recently approved 3GPP'99 Change Requests on 'Equivalent PLMN's in March 2001. For WCDMA, the individual operator's RNC's must be

interconnected by the Iur interface to support soft handover. For areas covered by both operators, the own network is the preferred network. An overview of this solution is shown in figure 4.

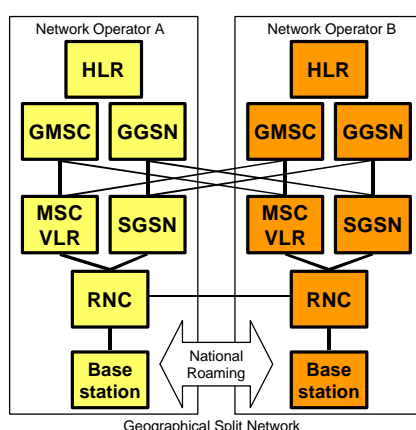


Figure 4. Overview of Geographical Split Network solution. Each operator has its individual network and coverage is enhanced through national roaming into the other operator's network.

The Geographical Split Network solution is 3GPP'99 compliant. The traffic of operators is pooled on the individual operator's frequency. This allows for the deployment of single carrier base stations, of course depending on the traffic expectations.

3.3 Shared UTRAN

In the Shared UTRAN solution, the WCDMA radio network is physically shared but logically each operator has its individual radio network. Each operator has its individual Core Network and individual cells with individual carrier, frequency and Mobile Network Code. This implies the UTRAN is physically shared and logically separated.

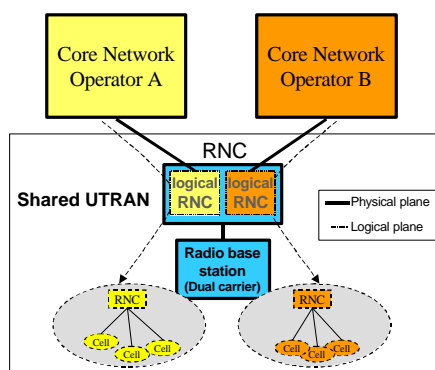


Figure 5. Overview of the Shared UTRAN solution based on the Virtual RNC feature. One physical UTRAN (Radio Base station and RNC) is split into two or more logical UTRAN's.

The Shared UTRAN solution is based on the Virtual RNC feature. The Virtual RNC functionality allows different Core Networks to be connected to the same physical RNC over the standard 3GPP Iu interface.

The Shared UTRAN solution can be deployed in case the regulator does not allow the Common Shared Network or the Geographical Split Network. Each operator requires its individual carrier or frequency in the Radio Base station. This implies that, for example, a dual carrier base station is required for two sharing operators.

Shared UTRAN coverage can be combined with each operator's individual coverage. This can be achieved by connecting each operators individual Radio Base station to the Shared RNC, where both individual Radio Base Stations and shared Radio Base Stations can be connected in a mix to the same RNC.

Migration to individually owned networks is simple. By installation of an additional Radio Base station at the same site (site sharing) and connect it to one operator's individual RNC and dedicate the former shared Radio Base station to the other operator's individual Radio Network Controller, the Shared UTRAN is split into

individual networks. Migration to individually owned networks could be done in parallel with network capacity expansion.

3.4 Site Sharing

Site sharing solution allows sharing of the construction and site premises equipment, the transmission to the RNC's, the power/cooling system for indoor use and the antenna sharing, including tower and feeder cables.

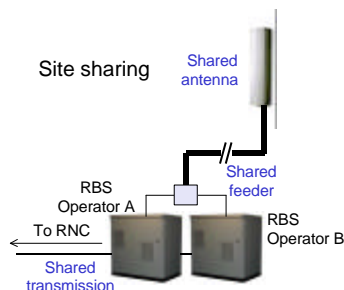


Figure 6. Illustration of Site Sharing

Site sharing offers advantages in case the building permit (or regulator) limits the number of antennas or when limited space is available for separate antenna installations. The license regulator usually doesn't set limitations for site sharing. Site sharing is not further explored in this document.

4 Migration to individual networks

For various reasons, operators might want to migrate its shared network into individual networks, for example, due to regulations or to increased traffic that reduce the cost-efficiency. Therefore it is important that an initial Shared Network can be migrated into an individual network with full re-use of invested infrastructure.

The Virtual RNC feature, with its ability to connect different Core Networks and a mix of shared and individual Radio Base Stations, offers a flexible way to migrate to individual networks in parallel with the network capacity expansion. Figure 7 shows a migration from an initial Common Shared Network, into a Shared UTRAN solution, followed by individually owned networks with full re-use of invested infrastructure.

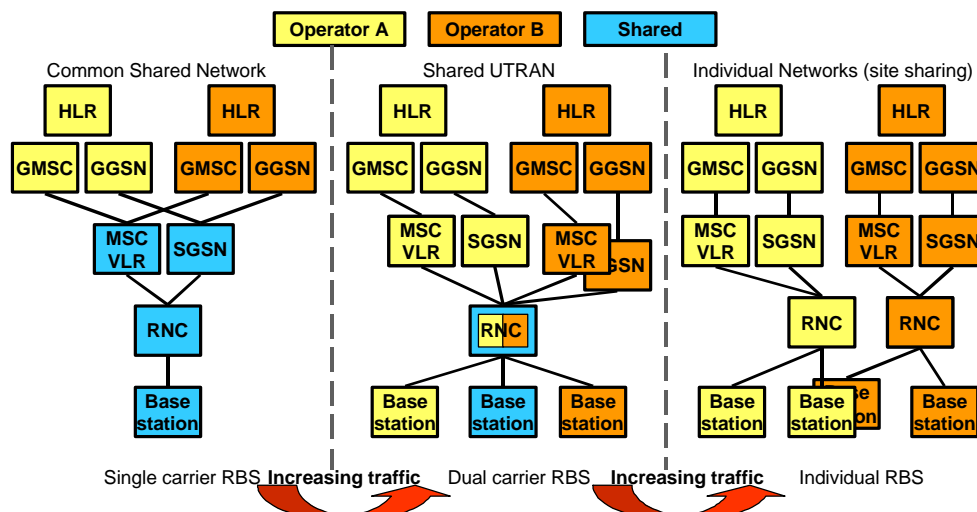


Figure 7. Example of migration from an initial Common Shared Network, into a Shared UTRAN solution, followed by individually owned networks with full re-use of invested infrastructure (see 'explanation')

Explanation of migration to individual networks

The WCDMA coverage is started with a Common Shared Network model (Fig 7, architecture on the left). When the traffic demand is increasing (or when the regulations require), the Radio Base Stations are equipped with additional carriers. When the RNC's are upgraded with the Virtual RNC software feature, the individual

Core Network of each operator can be connected directly to the Virtual RNC, allowing that each operator has its individual frequency. Also, each operator can connect its individual Radio Base Stations to expand its individual coverage (Fig 7, architecture in the middle).

When traffic demand is increasing even more, the shared Radio Base Stations can be divided among the sharing operators. At each location, an additional Radio Base station is installed that is connected to an operator's individual RNC. The former shared Radio Base station is connected to the other operator's individual RNC, and the network is split into individually owned networks, including the benefits of site sharing (Fig 7, architecture on the right).

5 Summary of Shared Networks solutions

The three solutions for sharing WCDMA radio infrastructure or coverage, outlined in this document, are:

1. Common Shared Network
2. Geographical Split Networks
3. Shared UTRAN

The Common Shared Network and the Geographical Split Networks are based on national roaming and can pool the traffic on a single carrier/frequency, making these solutions very cost-effective in case of low traffic demands.

The Shared UTRAN solution is based on the Virtual RNC feature and allow each operator to have its individual cells with individual carrier/frequency and Mobile Network Code. This allows for example to deploy the Shared UTRAN solution in case roaming based solutions is not allowed.

Table 1 gives a summary of the individual Shared Networks solutions.

	Common Shared Network	Geographical Split Network	Shared UTRAN
Cost savings for low traffic	Very significant for coverage phase and deployment of single carrier base stations possible	Very significant for coverage phase and deployment of single carrier base stations possible	Significant in coverage phase, each operator requires its individual carrier
Typical application	Initial coverage and cost effective coverage of more rural areas	Expansion of coverage through other operator's network	In case of license limitations of roaming based solutions or more high dense areas
Individual frequency per operator	No, traffic is pooled on one or more common carriers	Yes, in own area. No, in other operator's area	Yes
Number of operators	2 up to 6 (or more)	2 up to 6 (or more)	2 up to 6 (or more)
Shared antenna	Yes	Yes	Yes
Organizational impact	Preferably a Shared Network Provider	Individual organizations	Preferably a Shared Network Provider
Standard solution	3GPP compliant, with recent CR's supports handover and cell re-selection	3GPP compliant, with recent CR's supporting handover and cell re-selection	3GPP compliant (no impact on handover and cell re-selection)
Migration to individual networks	Yes, flexibility by using the Virtual RNC functionality	Yes, by expansion of individual network	Yes, part of the Virtual RNC functionality

Table 1 Summary of characteristics for the three Shared Networks solutions

6 Acronyms

3GPP	Third Generation Partnership Project
GGSN	Gateway GPRS Support Node
GSM	Global System Mobile
HLR	Home Location Register
MAP	Mobile Application Part
MSC	Mobile Switching Center
RNC	Radio Network Controller
RBS	Radio Base Station
SGSN	Supporting GPRS Support Node
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Terrestrial Radio Access Network
VLR	Visiting Location Register
WCDMA	Wideband Code Division Multiple Access