



Table of Contents

Executive Summary	3
1 Introduction	4
2 Benefits of UMTS/HSPA Deployment in the 900 MHz band	5
3 Status of Standards and Regulations	6
3.1 Technical Specifications and Standard Availability	6
3.2 Regulatory Status	6
4 Strategy of UMTS/HSPA Deployment in the 900 MHz band	7
4.1 Deployment in rural areas	7
4.2 Deployment in urban areas	8
4.3 Customer Impact of UMTS/HSPA Deployments in the 900 MHz band	8
4.4 Reviewing the impact of spectrum liberalization to free up GSM900 Spectrum for UMTS Services	8
5 Technical Considerations for UMTS/HSPA in 900 MHz implementation	8
5.1 Site Engineering	9
5.2 Multiband and multisystem mobility management	11
5.3 Addressing the Migration Challenges	13
5.4 Product Availability	13
5.5 Operator Case Studies	14
5.5.1 Cosmote Group UMTS900 pilot network	14
5.5.2 Elisa Commercial UMTS 900 network	15
6 Conclusions	16
Abbreviations	17

Executive Summary

This white paper presents the current views of the UMTS Forum on UMTS/HSPA deployment strategies in the 900 MHz frequency band including technical considerations, traffic management, site engineering to stimulate the deployment of this technology with a minimum of impact on existing GSM operation.

In this context, the UMTS Forum has a clear position on the GSM directive for reducing regulatory uncertainties regarding mobile broadband roll-out in Europe at 900 MHz that will open up access to mobile broadband services provided by UMTS/HSPA. A growing number of mobile operators are already deploying UMTS/HSPA services alongside their existing GSM networks operating in the 900 MHz band.

So far, there are around 10 operators (in Australia, Estonia, Finland, Iceland, New Zealand, Thailand and Venezuela) - commercially running UMTS/HSPA operations in this band, while the device ecosystem is flourishing with a choice of over 100 mobile terminals. In addition, many other operators are well prepared for the deployment of UMTS/HSPA in this band.

The UMTS Forum believes that there is a significant opportunity for other countries to follow suit and remove any obstacles for the provision of cost-effective mobile broadband coverage for users.

UMTS Forum members have demonstrated that GSM and UMTS/HSPA networks can co-exist in the same frequency bands without technical problems such as interference. Deploying UMTS with HSPA in rural areas by reusing the existing GSM sites is a cost-effective solution for mobile operators to offer mobile broadband services, such as high data rate multimedia services.

The availability of Multistandard/Multicarrier solutions with proper interworking eventually eases the deployment of UMTS /HSPA at 900 MHz while preparing the future evolutions of GSM networks toward new technology developments. Moreover, such solutions associated with UMTS/HSPA deployments also provide a significant opportunity for many operators to upgrade their existing networks to a more modern radio access method, allowing them to offer an enhanced service quality.

1. Introduction

IMT-2000/UMTS services were launched in the IMT-2000 core band (1920-1980 MHz/2110-2170 MHz) during the year 2001. As of May 2009, there are over 370 million UMTS subscriptions, including more than 120 million UMTS/HSPA high speed mobile broadcast subscriptions. More than 280 UMTS/WCDMA networks are launched in more than 115 countries, and services are supported by a choice of over a thousand terminal devices. Hence it is clear that the launch of IMT-2000/UMTS has been even a more rapid success than the first years of GSM.



3. Status of standards and regulations

3.1. Technical specifications and standards availability

The standards organisations ‘Third Generation Partner Project’ (3GPP) has developed technical specifications for many frequency bands, one of which is UMTS900 (Band VIII, 3GPP Rel-7 Technical Specification TS25.104 and TS25.101). The technical specifications of UMTS900 have been completed in December 2005 and are available at <http://www.3gpp.org/>. The developed 3GPP technical specifications are subsequently forwarded to regional or national standard bodies for adoption, for example in Europe by ETSI.

Moreover, 3GPP also developed in the 900 MHz band, Technical Specification TS36.104 and TS36.105 for LTE deployment in the context of IMT-2000 in Europe.

3GPP has in addition launched the work on specifications of the Multistandard/Multicarrier solutions. These specifications will be available at the end of 2009, and the corresponding test specifications will be available in March 2010. This is expected to further simplify deployments of UMTS900 as well as the flexibility of migrating between 3GPP technologies in the future.

In Europe, UMTS900 has been included in the Release 3 of the European harmonised standards EN301908 by ETSI. European harmonised standards are published at ETSI web site <http://www.etsi.org/>.

3.2. Regulatory Status

In Europe, the paired 900 MHz band 880-915 MHz / 925-960 MHz was harmonised by CEPT for GSM900 and it is currently heavily in use. The CEPT-ECC (Electronic Communications Committee) decision (ECC/DEC/(06)13 designating the 900 MHz and 1800 MHz bands for the deployment of UMTS/HSPA was approved and published at the end of 2006.

Relating to UMTS/HSPA usage in these GSM frequency bands, ECC has prepared two sharing and compatibility study reports and one recommendation:

- i) Compatibility between UMTS/HSPA and GSM operating in 900 MHz and 1800 MHz bands (ECC Report 082);
- ii) Compatibility between UMTS900/1800 and adjacent band systems (ECC Report 096);
- iii) Border coordination when both GSM and UMTS/HSPA are deployed in the same frequency band (ECC Recommendation (08)02).

The ECC decision and related ECC compatibility study reports and recommendation are available at <http://www.ero.dk/>.

This UMTS900/1800 ECC decision will assist in the harmonised implementation of UMTS/HSPA in the existing GSM900/1800 frequency bands. Based on the national decisions, mobile operators can decide in what timeframe to deploy UMTS/HSPA in GSM 900 MHz band, in line with their business plans.

Concerning the Multistandard/multicarrier solutions, corresponding 3GPP specifications will be approved by ETSI in Europe, and then by CEPT before each individual country gives its authorization for the deployment of such solutions.

In Finland, the regulator has already made the decision in June 2006 to allow mobile operators to deploy UMTS/HSPA in the GSM900 band. Finnish operator Elisa was the first UMTS900 operator in the world to launch commercial services in Finland in November 2007 and then in Estonia in January 2008. Today, 8 commercial UMTS900 networks have been launched which includes Australia, New Zealand, Thailand and Iceland in 2008 and most recently Venezuela in March 2009. In 2007, France has also published national decisions allowing the deployment of UMTS/HSPA in GSM900 frequency band. It is expected that national regulators in Europe and other regions (including Africa and Asia) will follow, facilitating UMTS900 deployment in the near future.

4. Strategy of UMTS/HSPA Deployment in the 900 MHz

Due to its radio characteristics UMTS/HSPA at 2 GHz has some limitations in regards to in-building coverage compared with other technologies in lower frequency bands. Therefore UMTS900 will be a cost-effective solution to provide mobile broadband services in sparsely populated rural and remote areas. It can in addition, be used to efficiently improve coverage in specific urban areas such as cluttered out-door situations and for better in-building coverage.

The best approach on an operator's long term strategy is to deploy a uniform UMTS 900 MHz layer for coverage purposes and deploy a UMTS 2100 MHz layer for capacity enhancement on specific regions (mainly urban).

4.1. Deployment in rural areas

Deploying UMTS900 with HSPA in rural area by reusing the existing GSM sites allows mobile operators to offer UMTS/HSPA services to consumers, such as high data rate educational, health, commercial and Government related multimedia services. One way of doing this is to use UMTS900 for wide area coverage. Then where there are localised 'hot spots' requiring extra capacity (such as tourist locations and railway stations) higher frequency bands – such as 2 GHz (with a possible extension in the 1800 MHz or the 2.6 GHz bands – can be used for either UMTS/HSPA or LTE to carry increased traffic loads by offering additional capacity, as shown in Figure 1 below.

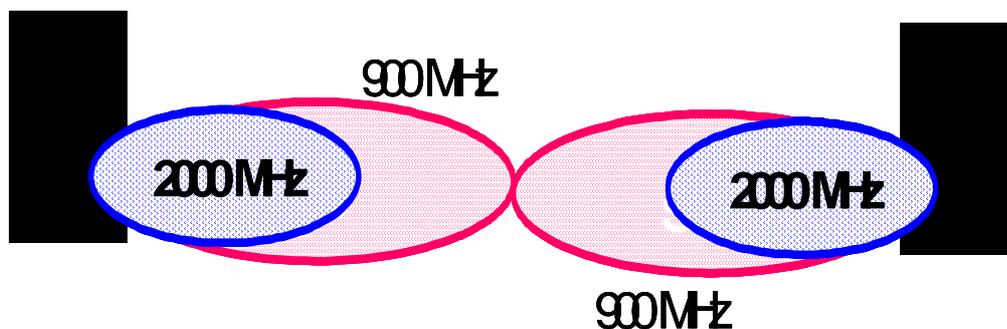


Figure 1: UMTS/HSPA in 900 MHz band enhances coverage provision and complement UMTS2000

4.2. Deployment in urban areas

In urban areas, where GSM is typically deployed in a multi-layer network structure (including macro cellular, micro cellular, and pico cellular layers in 900 MHz and/or 1800 MHz frequency bands), UMTS/HSPA can be used to improve coverage and indoor coverage of UMTS at 2 GHz.

4.3. Customer Impact of UMTS/HSPA Deployment in the 900 MHz band

When deploying UMTS/HSPA at 900 MHz, operators also have to consider the needs of their existing GSM subscriber base within the serving area/spectrum concerned. Capacity constrains may occur if the existing subscriber base cannot to be migrated to a multistandard technology, allowing to continue their mobile service on UMTS/HSPA in 900 MHz band and the remaining frequency bands. Beside migration from GSM900 subscribers to GSM1800 to overcome possible capacity constrains for GSM only terminals, the deployment of enhanced GSM features like AMR half rate codes will be an appropriate option. This will help to serve the GSM only terminals with their services. An additional option for the operator is the subsidization of GSM mobile terminals with terminals supporting UMTS 900 MHz technology.

4.4. Reviewing the impact of spectrum liberalization to free up GSM 900 MHz Spectrum for UMTS services

In order to deploy UMTS 900 MHz, an operator needs to free at least 4.2 MHz of spectrum in 900 MHz band. To achieve this liberalization extensive HW reconfiguration is needed in existing GSM network, in order to serve existing and near future GSM traffic without affecting GSM KPIs. This will lead to additional CAPEX investment from operators.

In addition, extensive radio planning and network re-planning is needed, in areas where UMTS 900 MHz will be deployed. Also adequate frequency planning is needed, in the areas where UMTS 900 MHz coverage is expected, in order to minimize interference problems between GSM and UMTS.

5. Technical considerations for UMTS/HSPA in 900 MHz implementation

Not all GSM operators will have the same strategies and time plans for migration from GSM to UMTS/HSPA. This migration needs a refarming of the existing frequency band to allow UMTS/HSPA technology within the existing GSM frequency plans. CEPT has studied the introduction of UMTS/HSPA at 900MHz, and has concluded that it is technically compatible to operate both GSM and UMTS/HSPA in 900MHz band. ECC Report 82 compiles all technical considerations needed in order to introduce UMTS/HSPA in 900MHz band while

results for the deployment of UMTS/HSPA operating in 900 MHz taking into account adjacent band systems. However, future systems operating in adjacent bands (below 880MHz and above 915MHz; below 925MHz and above 960MHz) need to take into account the impending introduction of UMTS/HSPA in 900MHz band, and hence protect IMT-2000 services. Trials and studies performed by operators, showed that using 4,2 MHz channel spacing at 900 MHz band, UMTS 900 MHz has very good performance without any significant degradation on existing GSM services.

5.1. Site engineering

For an existing GSM operator, it is known that the most cost-effective solution is to reuse existing GSM sites for UMTS/HSPA deployment. The existing antenna and feeders can be reused and the UMTS/HSPA in 900 MHz band base station can be added. Figure 2 (below) gives an example of GSM900 and UMTS/HSPA radio site design, with two 900 MHz vertical polarized antennae. Figure 3 illustrates multistandard/multicarrier solutions than can be directly connected to the antennas without introducing the loss of the duplexers. Figure 4 shows an example of GSM900/UMTS900/GSM1800/UMTS2000 radio site design using a tri-band polarization antenna.

9 0 0 M H z b a n d a n t e n n a

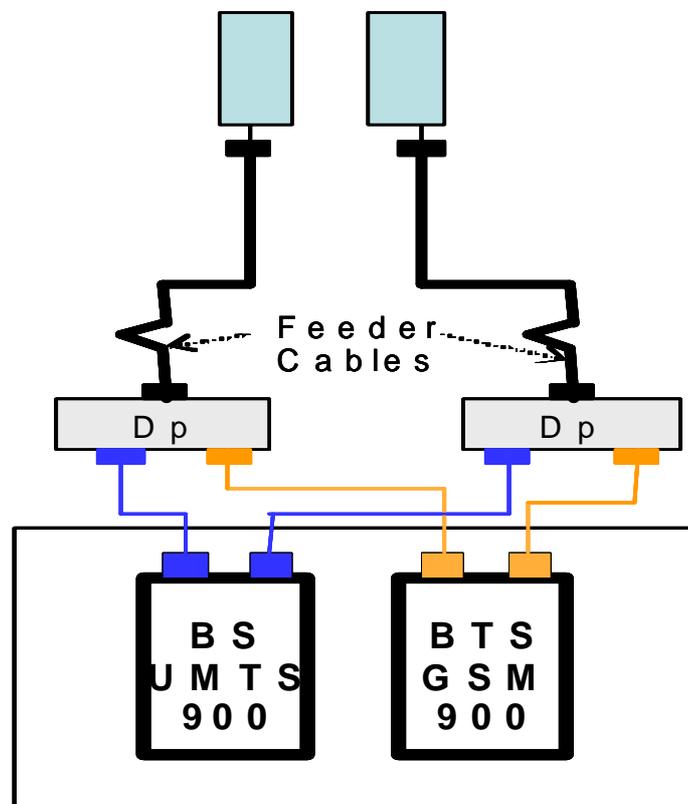


Figure 2 - Radio site design example for GSM900 and UMTS/HSPA in 900 MHz band with two vertical polarized antennae (Dp=Duplexer)

Figure 3 - Radio site design example for Multistandard/Multicarrier GSM900 and UMTS/HSPA in 900 MHz band with two vertical polarized antennae (Dp=Diplexer)

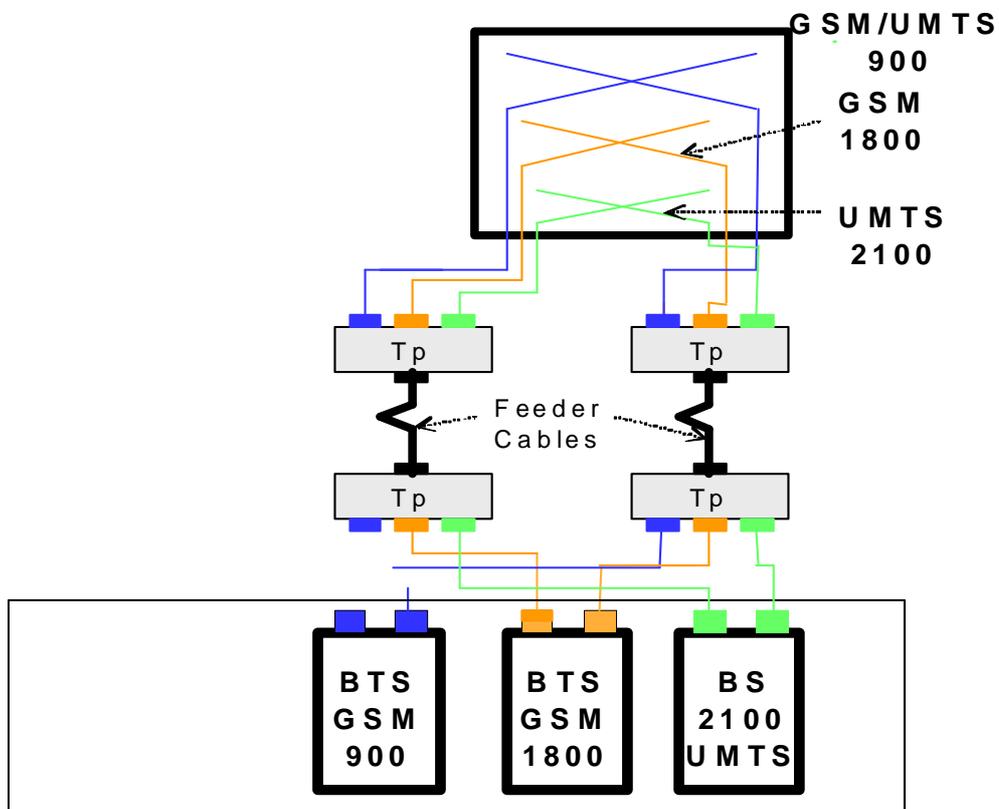


Figure 4 - Radio site design example for GSM-UMTS/HSPA in 900 MHz band/GSM1800/UMTS2000 with a tri-band polarization diversity antenna (Tp=Triplexer)

5.2. Multi-band and multi-system mobility management

• GSM load balancing between GSM900 and GSM1800

When an operator decides to refarm part of its GSM900 frequency band for implementing UMTS/HSPA in the 900 MHz band, the GSM900 network capacity will be reduced. However, the UMTS900 network will make up for this loss, provided that there is UMTS coverage and offer more capabilities for new services.

It is expected that traffic will move to UMTS900 network over time, as subscribers will request multi-media services offered with HSPA-enabled UMTS technology in the 900 MHz band.

In the first phase of refarming, several users may have GSM-only handsets. Therefore balancing the traffic between GSM900 and GSM1800 is key issue in order to avoid service congestion, as shown in Figure 5.

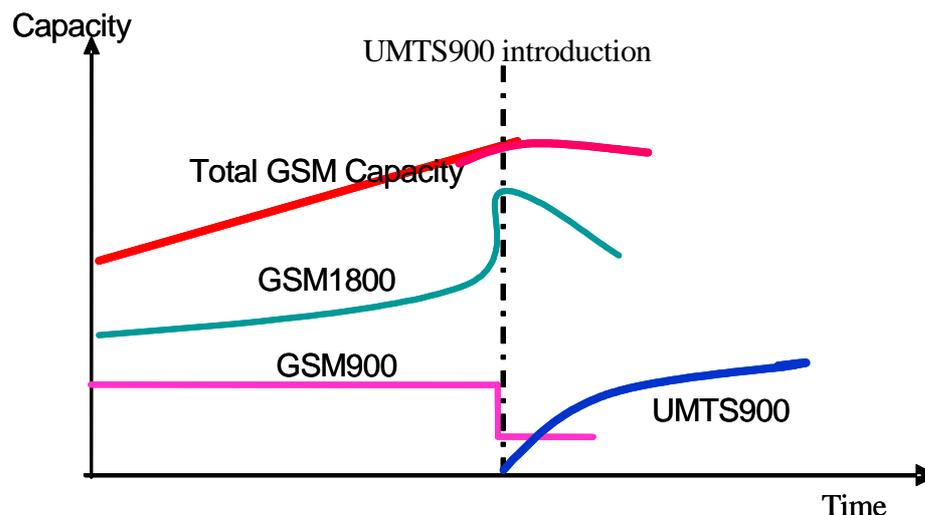


Figure 5 - Load balancing between GSM900 and GSM1800 in a dual band GSM network in order to refarm part of GSM900 spectrum for UMTS/HSPA in 900 MHz band deployment

However, this extreme situation is unlikely to occur due to two current trends in the terminal market:

- The number of GSM-only terminals will decrease over time;
- There will be both Multistandard/Multicarrier terminals enabled with UMTS/HSPA in 900 MHz band terminals on the market, even in countries where this technology is not deployed.

In any case prior to UMTS 900 MHz implementation, spectrum refarming activities should be completed. Also traffic should be pushed to GSM 1800 MHz layer (wherever this is possible) and special SW features like half rate, frequency hopping and AMR should be introduced.

- **Traffic management between GSM and UMTS/HSPA in 900 MHz band**

GSM and UMTS/HSPA were originally specified and designed to allow smooth hand-over between the technologies without customers experiencing disruptions.

It will be reasonable to transfer some of the less demanding data rate traffic from this UMTS technology to GSM/EDGE, while keeping the high bit rate data traffic at UMTS900 within the area covered by both GSM and UMTS/HSPA in 900 MHz band. This is illustrated in Figure 6.

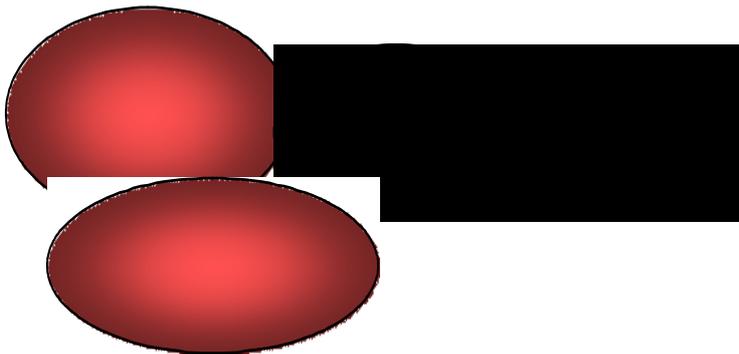


Figure 6 - Traffic management between GSM and UMTS

- **Traffic management between UMTS/HSPA in 900 MHz band and UMTS2000**

It is assumed that all (or at least most) of handsets for UMTS/HSPA in the 900 MHz band will support 900 and 2000 MHz dual-band operation. Taking into account that cell range for UMTS900 being larger than UMTS2000, in a dual-band 900/2000 network UMTS/HSPA traffic should be sent to UMTS2000 layer (a) whenever possible. This leaves the UMTS900 layer to handle traffic where there is no UMTS2000 coverage (b). This is illustrated in Figure 7.

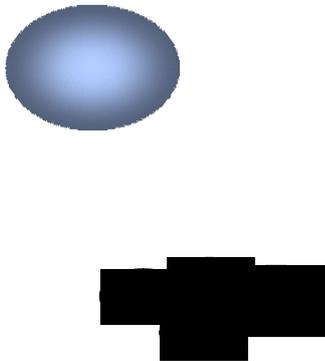


Figure 7 - Traffic management between UMTS/HSPA in 900 MHz band and UMTS2000

5.3. Addressing the migration challenges

A major concern for the operators is whether GSM 900 and UMTS 900 can work together.. By these terms the following issues should be addressed:

1. Degradation of call quality for GSM subscribers. One potential problem that it might be faced it could be GSM quality degradation due to the reuse part of the spectrum (especially when 4,2 MHz spacing is used for UMTS).
2. Potential decline of network KPIs on UMTS 900 MHz. Interference induced from existing GSM 900 MHz base stations and GSM mobiles, could possibly introduce quality degradation on UMTS 900 MHz KPIs.
3. Interoperability between networks. Finally an operator should address interoperability issues with existing UMTS 2100 MHz and GSM/GPRS/EDGE networks.

5.4 Product availability

UMTS/HSPA in the 900 MHz capable mobile handsets, other devices and network equipment are already available in the market.

As of March 2009, there are more than 100 UMTS900 terminals featuring UMTS/HSPA technology in the 900 MHz that have been announced by around 20 terminal vendors, while 8 commercial networks have been launched in some countries as mentioned previously.

5.5 Operator Case Studies

5.5.1. Cosmote Group UMTS 900 MHz pilot network

In 2007 Cosmote Group decided to evaluate the benefits of UMTS 900 MHz in real environment, by performing a UMTS900/1800/2100 trial network comparison. Trial took place in two different regions:

- The first trial area was a closed valley which provided the opportunity to easily deploy UMTS 900 MHz with minimum disturbance on the surrounding existing GSM 900 MHz network. In this area sites used were equipped with UMTS Node Bs supporting 900/1800/2100 MHz frequencies, along with GSM 900 MHz base stations in order to achieve a direct comparison. GSM 900 MHz refarming and frequency re-planning was performed in this area, in order to gain the required spectrum for UMTS 900 MHz deployment. It has to be mentioned that only half of the traditional UMTS 2100 MHz base stations were equipped with UMTS 900 MHz, based on network planning tool simulations in order to get the same coverage.
- The second area chosen was an area where one Node B was placed over a small hill in order to evaluate very long distance (extended range) coverage (target was more than 60 km).

In both trial areas extensive measurements were performed for UMTS and HSPA services. Also GSM Key Performance Indicators (KPIs) were recorded prior and after UMTS 900 MHz implementation.

Trial results showed that UMTS 900 MHz provides better coverage in urban environment, compared to traditional UMTS 2100 MHz networks, with coverage improvement varying from 12 – 20 dB (depending on the environment). With UMTS 900 MHz indoor environment users have regular mobile broadband services, while UMTS 2100 MHz users have no coverage and were transferred to GSM/GPRS/EDGE. Indoor coverage improvement recorded from UMTS 900 MHz was 20 % compared to the traditional UMTS 2100 MHz layer.

No GSM quality degradation faced due to the reuse part of the spectrum for UMTS (either using 4,2 MHz or 5,0 MHz channel spacing). No degradation on UMTS 900 MHz KPIs due to interference from GSM base station and GSM mobiles appeared.

For HSPA trial results showed that UMTS900 MHz performance was 31% improved compared to the performance of UMTS2100 MHz at identical measurement points. Also no significant difference was observed on HSDPA performance either using 4.2 MHz or 5 MHz channel spacing.

For extended cell performance trial results showed that UMTS900 MHz has extended coverage compared to the traditional UMTS2100 MHz. HSDPA, HSUPA and all kind of R99 services were established normally for UMTS900 MHz at a distance of 127 km far from the Node B, when the same services could not exceed 65 km on traditional UMTS2100 MHz.

Finally, all CS handovers and PS cell reselections between UMTS2100 MHz and UMTS900 MHz were tested successfully. Interoperability with GSM/GPRS/EDGE was tested successfully (but this is not a clear UTRAN functionality, because these handovers were driven by Core Network).

5.5.2. ELISA commercial UMTS 900 MHz network

Finnish operator Elisa launched commercial UMTS900 service on 8th November 2007 as the first commercial UMTS900 service in the world after the Government had approved the use of UMTS900 in Finland on 31 May 2006 and the decision was applied in the latest decision on the 900 megahertz frequency band by the Finnish Communications Regulatory Authority (FICORA) on 1 November 2007.

UMTS900 enables better implementation of the fast mobile Internet access that will cover the whole country. UMTS900, which uses a frequency of 900 MHz, makes it possible to build 3G networks profitably outside densely populated areas as the costs of building a UMTS900 network can be only one-third of the present costs of the UMTS2100 coverage. Actually, Elisa showed that 3G coverage with UMTS900 can save 50 to 70% of mobile network costs when compared to deployments in the 2100 MHz band, including both CAPEX and OPEX. Similar cost and coverage benefits also apply to UMTS system deployments in other lower frequency bands, such as 850 MHz.

In the first UMTS900 deployments the municipalities of Siuntio and Pertunmaa were covered by turning the existing GSM900 sites to be UMTS900 sites, as well. This way it was proven that in most cases GSM900 sites can be reused to achieve extra savings. It was also proven that UMTS900 coverage is comparable to GSM900 coverage and even better in many cases. I.e. voice coverage area for UMTS900 cell is typically some 20% larger compared to GSM900 and UMTS900 cell can easily cover 100% bigger area than UMTS2100 cell.

After the launch of UMTS900 the 3G coverage area has been expanded significantly and in the future it will cover all of Finland. Thanks to UMTS900, in the future all Finns will be able to use fast and affordable 3G mobile Internet access and other mobile services as confirmed by Elisa.

Up to now, most of the Finnish population in over 200 municipalities are covered by Elisa's 3G services. The connection speed of UMTS900 is similar to UMTS2100 and thus mobile data speed can be several Mega bits per second; moreover Elisa sells subscriptions up to 5 Mb/sec, which is comparable with good fixed broadband connections. And the trend is that data speeds are rising by deployment of HSPA+, also available for UMTS900.

UMTS900 is supported by a significant number of 3G terminals that were launched on the market after Elisa launched UMTS900 service, and UMTS900 is already almost a standard feature in all 3G terminals in Europe. Thus, there is now an availability of a wide portfolio of UMTS900 handsets and data terminals. Most of the new 3G terminals introduced in Europe will support UMTS900. All UMTS900 terminals in Europe also support present GSM and 3G networks, and the terminal selects automatically the best network available.

After commercial launch of UMTS900 by Elisa, its competitors applied UMTS900 in Finland, too; thus, within few years there will be countrywide 3G coverage provided by 3 different network operators in Finland. At the same time, the Finnish regulator set requirements to provide at least 1 Mbps connections almost everywhere in Finland and UMTS900 together with UMTS2100 is the way to meet these requirements in a cost efficient way.

6. Conclusions

The most significant benefit of deploying UMTS/HSPA in 900 MHz frequency band comes from the fact that compared to 2 GHz band; radio wave propagation properties and in-building penetration at 900 MHz are more favourable. These properties provide interest for implementation of UMTS/HSPA at 900 MHz in rural areas (extended cell coverage) and in some urban areas scenarios, respectively.

Considering an offering of the same service, same data rate and providing the same coverage, the required number of sites in 900 MHz band is reduced by 60% compared to that in 2 GHz band. This will bring economical benefits on UMTS/HSPA operator's cost situation and will make it possible to propagate these benefits to the end-users in terms of enlarged and improved urban area coverage with economical advantages.

UMTS900 (UMTS/HSPA in this band) will be deployed by reusing GSM sites within the existing service area. Deploying UMTS with HSPA at 900 MHz in rural areas by reusing the existing GSM sites is a cost-effective solution for mobile operators to offer mobile broadband services, such as high data rate multimedia services. The availability of multistandard/multicarrier solutions with proper interworking will ease the deployment of UMTS/HSPA while preparing the future evolutions of GSM networks toward new technology developments.

The deployment of this technology will also take care of existing subscriber base within the given spectrum concern. Furthermore, Multistandards/multicarrier solutions will also facilitate quality of service to customers. This is because a multistandard BS provides good opportunity for operators to upgrade the existing networks to a more modern radio access that will allow them to offer an enhanced service opportunity.

The timely availability of UMTS/HSPA regulations is needed to allow the deployment of UMTS/HSPA in GSM 900 MHz frequency band in line with operators' business plans. Network equipment and user devices are already available and have been deployed in many countries.

