UMTS900 – Benefits and issues

A summary report to GSMA

February 2007

Version – V1.0

Ovum Consulting, Cardinal Tower, 12 Farringdon Road, London EC1M 3HS

Telephone +44 (0) 20 7551 9000 Facsimile +44 (0) 20 7551 9090/1
www.ovumconsulting.com

GSMA is investigating the issues that can impact the use of the 900MHz frequency band for UMTS services. This paper presents the main findings from an Ovum report, commissioned by the GSMA and QUALCOMM, to assess the benefits and limitations of UMTS900 deployment.

Summary

There is a growing interest in deploying UMTS in the 900MHz frequency band. Compared with UMTS deployment in the 2100MHz band, UMTS900 will reduce the cost of coverage for mobile communications services, especially into rural areas. Ovum's modelling undertaken for the study indicates that UMTS900 can generate cost reductions of up to 40% in capex and 30% in overall costs when compared to a baseline case scenario of deployment using UMTS at 2100MHz. These lower costs are primarily due to the radio propagation characteristics in the lower band which provide greater reach of UMTS900 and improved in-building coverage. The cost reductions may allow an operator to economically roll out higher data rate services to a larger percentage of the rural population.

Ovum's analysis identified an number of benefits of UMTS900 deployment, when compared to UMTS2100, and also issues which may impede full advantage being obtained. These benefits and issues are discussed in this paper.

At a qualitative level, UMTS900 can bring economic benefits, especially to less developed countries. Capital investments would be stimulated and improved communications can stimulate productivity, job creation and business working practices. To illustrate this analysis the benefits for four specific countries were assessed with high-level modelling, This indicates that Finland could provide UMTS900 coverage for $700M less than it might cost to deploy UMTS2100; in Saudi Arabia it would be a $2.1bn reduction; South Africa $500M and Sri Lanka $24M.

There are several factors important for the successful introduction of UMTS900. Co-ordinated policy to refarm 900MHz spectrum, which is currently primarily used for GSM, is required to allow UMTS. Some NRAs have already initiated discussions and in Europe there are indications that the GSM900MHz and GSM1800MHz bands will be approved for UMTS900/1800 use in September/October 2007. The CEPT Electronic Communications Committee (ECC) has decided[1] that from January 2007 the 900MHz frequency bands are designated for terrestrial IMT-2000/UMTS systems, subject to market demand and national licensing schemes. The technology is already deployed in Finland and trialled in the Isle of Man and France, with trials being planned in a number of other countries.

The co-ordination will need to address the interest of GSM users, interference between bands and the potential for cross border interference. NRA spectrum policy on pricing and roaming has also to be considered. To maximise the benefits of UMTS900 – through lower equipment and device costs, and greater certainty of outcome –there needs to be international regulatory harmonisation of the 900MHz band, one of the most used bands in the world.

[1] ECC Decision of 1 December 2006 on the designation of the bands 880-915 MHz, 925-960 MHz, 1710-1785 MHz and 1805-1880 MHz for terrestrial IMT-2000/UMTS systems.

Key benefits of UMTS900

UTMS 900 provides increased coverage

Ovum's analysis indicates that UMTS900 provides between 44% (in urban areas) and 119% (rural areas) increased coverage per Node-B compared with UMTS2100. This is primarily due to the propagation characteristics of the lower frequency band and leads directly to lower capex and increased mobility benefits, providing a new option, with greater service capability, for operators who may wish to extend their 3G coverage or replace their GSM networks in future. The relative coverage area increase is shown in Figure 1. The results are based on the assumptions used in Ovum's modelling and, given the wide variations between national and international regions, the results should be considered to be indicative only.

Figure 1 Percentage increase in coverage area

Frequency	Percentage increase in coverage area per Node-B (km^2)			
	Dense Urban	Urban	Suburban	Rural
900MHz vs. 2100MHz	87%	44%	60%	119%

Source: Ovum model

The reason for the differences in coverage area per Node-B in dense urban and rural areas is due primarily to lower signal attenuation, which improves reach and in-building coverage. In more densely populated regions a combination of UMTS900 and UMTS2100 may be needed to provide capacity as well as coverage.

The difference in coverage areas for each Node-B will directly affect the number required to serve a given geographic area and consequently the capex costs.

UMTS900 improves mobility management

The improved Node-B coverage of UMTS900 technology reduces the number of cells in a region. This should decrease the potential number of gaps between cells, which will help overcome handover problems and thus improve the customer experience.

Demand analysis and network costs

Ovum's demand analysis model was developed to provide a high level view of service demand based on scenarios for each of four major world regions considered in the study (W. Europe, Asia Pacific, Sub-Saharan Africa, Middle East).

Figure 2 and Figure 3 show the 5 year cumulative network capex costs for UMTS900 only, and combined UMTS900 and UMTS2100 deployments respectively when compared to a network with only UMTS2100. In the UMTS900-only case, the Sub Saharan Africa case shows the highest cumulative capex reductions of 41% followed by Western Europe with 40%, Middle East with 36% and Asia Pacific with 32%. In the case of UMTS900 and UMTS2100, the Sub Saharan Africa case shows

the highest cumulative capex reductions of 37% followed by Middle East with 31%, Western Europe with 27% and Asia Pacific with 16%.

These results reflect a modelled scenario and there are many factors which will influence the actual capex reduction benefits in real-world networks. Although the case for UMTS900 seems to be the better of the two sets of results, it must be recognised that in many cases a combined UMTS900 and UMTS2100 network will be preferred, in order to meet market conditions for coverage and capacity.

In the regions examined it is to be expected that coverage and not capacity will be the main driver for network deployment. This is mainly due to the expectation that high-speed data service coverage and usage will be limited in most of the emerging markets due to cost of deployment. It is for this reason that the 'UMTS900 only' case shows higher capex savings compared to both the 'UMTS2100 only' case and the combined 'UMTS900 and UMTS2100' case. If analysis is performed on a country level with more detailed data on end-users' usage profiles and traffic split then it is expected, especially in W. European developed markets, that an overlay solution of UMTS900 for coverage issues combined with a deployment of UMTS2100 networks for capacity issues in hot-spots will be the optimal one.

Figure 2 Cumulative Capex costs for 'UMTS900 only' as a percentage of Cumulative Capex costs for 'UMTS2100 only'

Demand	Middle East	AsiaPac	W. Europe	Sub-Saharan Africa
Low	64%	69%	60%	59%
Medium	65%	69%	61%	59%
High	67%	70%	64%	59%

Source: Ovum

Figure 3 Cumulative Capex costs for 'UMTS900 and UMTS2100' as a percentage of Cumulative Capex costs for 'UMTS2100 only'

Demand	Middle East	AsiaPac	W. Europe	Sub-Saharan Africa
Low	69%	84%	74%	63%
Medium	71%	85%	75%	63%
High	73%	86%	78%	63%

Source: Ovum

Network capex efficiencies and enhanced capabilities

Whilst each case is operator and network specific, UMTS900 offers a new option for operators facing a GSM network equipment replacement cycle. As well as UMTS900 requiring lower up-front investments than UMTS2100 it also enhances network efficiencies and the network's capability to handle both voice and data traffic. Additionally, the increased coverage capabilities of UMTS900 allow high speed data

and more efficient voice traffic handling, with reduced Capex, when compared to UMTS2100.

Financial and economic analysis

Figure 4 presents an assessment broken down by geographic country area. In the case of UMTS900 only, the dense urban environment case shows the highest cumulative capex reduction in the range of 37%-46%, this is followed by rural environment (range of 33%-46%), suburban environment (range of 26%-34%) and finally urban environment (range of 20%-36%) for all of the regions examined. The Sub Saharan Africa case shows for all types of environments (except urban) the highest cumulative capex reduction.

Figure 4 Cumulative Capex costs per type of environment for 'UMTS900 only' as a percentage of Cumulative Capex costs for 'UMTS2100 only'

	W. Europe	AsiaPac	Middle East	Saharan Africa
Dense Urban	60%	63%	62%	54%
Urban	76%	71%	80%	79%
Suburban	74%	72%	74%	66%
Rural	66%	67%	63%	53%

Source: Ovum

Figure 5 and Figure 6 show the 5 year cumulative network capex and opex costs for UMTS900 only, and combined UMTS900 and UMTS2100 deployments respectively when compared to a network with only UMTS2100.

Figure 5 Total Capex and Opex costs for 'UMTS900 only' as a percentage of Total Capex and Opex costs for 'UMTS2100 only'

Demand	Middle East	AsiaPac	W. Europe	Sub-Saharan Africa
Low	67%	81%	87%	61%
Medium	68%	83%	90%	62%
High	70%	86%	92%	63%

Source: Ovum

Figure 6 Total Capex and Opex costs for 'UMTS900 and UMTS2100' as a percentage of Total Capex and Opex costs for 'UMTS2100 only'

Demand	Middle East	AsiaPac	W. Europe	Sub-Saharan Africa
Low	72%	90%	92%	66%
Medium	73%	92%	93%	67%
High	74%	94%	94%	68%

Source: Ovum

In the case of UMTS900 only, the Sub Saharan Africa case shows the highest total Capex and Opex costs reductions, when compared to UMTS2100 only, of 38%. The other regional total cost reductions are the Middle East with 32%, Asia Pacific with 17%, and Western Europe with 10%.

In the case of combined UMTS900 and UMTS2100,deployments, the Sub Saharan Africa case shows the highest total Capex and Opex costs reductions of 33% followed by Middle East with 27%, Asia Pacific with 8% and Western Europe with 7%.

NPV analysis

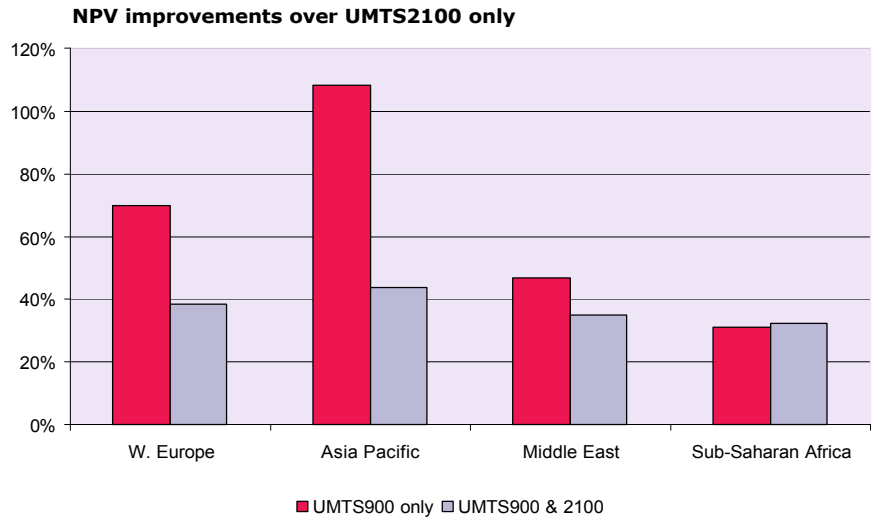
An operator deploying UMTS900 may be able to take advantage of the inherent cost reductions of deploying a UMTS900 network to fund further capital expenditure, which will allow the operator to attract more customers and hence increase the number of connections, or increase geographic coverage.

By modelling the number of WCDMA connections and WCDMA geographic coverage achieved with this capex, Ovum generated basic NPV calculations. The results are shown in Figure 7. These show NPV improvements of typically 30%-40%, but to over 100% in AsiaPac. The main reasons for greater NPV improvements in W Europe and Asia Pacific are that the absolute number of additional subscribers is higher in these two regions (due to higher potential addressable market) which contributes to higher expected revenues. Additionally, the capex spending per subscriber required to increase coverage/capacity requirements is lower due to landscape characteristics and existing WCDMA penetration – it is easier to provide additional capacity in existing areas than to greatly increase coverage in rural areas with no coverage.

There is potential for virtuous circles to develop:

- the lower the cost of deployment of mobile infrastructure, the greater the coverage - leading to more users and greater national benefit
- more users will drive a greater the volumes of handsets and devices, leading to a wider range of products becoming available and, when economies of scale cut in, leading to lower device costs.

Figure 7 NPV percentage improvements of UMTS 900 over 'UMTS2100 only'



Source: Ovum model

Economic analysis

The high level modelling for the study indicated that UMTS900 can effectively generate cost reductions of up to 40% in capex and 30% in overall costs when compared to deployment using UMTS at 2100MHz only. These lower costs are primarily due to the radio propagation characteristics in the lower band which provide greater reach of UMTS900 and improved in-building coverage.

When looking at regions at a macro level, the study did not assess interaction of capital costs, the price of services and the demand for services, however, some general economic principles were assessed:

- In the long term we might expect an accelerated replacement of GSM by UMTS900. When this happens, prices will tend to change reflecting the lower long run costs of UMTS
- The main impact of UMTS900 on the demand for services is expected to come from developing countries and regions as it becomes more economically viable to deploy UMTS services in suburban or rural areas where this was not possible previously.
- If lower costs are passed on in the form of lower prices, then this will expand the usage of services. If flat rate tariffs are introduced for data services, then this can be a major stimulator of demand.
- UMTS900 can bring economic benefits to a country through economic growth:
  - through the stimulation of capital investments
  - by stimulating job creation, by virtue of improved communications
  - by improving productivity

  - by stimulating change in business working practices.
- One direct consequence of the introduction of UMTS900 will be to speed up the penetration of 3G services in the different regions. It also impact Internet access.

All in all, UMTS900 can be instrumental in reducing the digital divide between developed and developing countries and urban and rural environments.

Handset and chipset issues

All major chipset and handset manufacturers think that UMTS900 will happen. They are all either currently developing or planning to develop UMTS900 chipsets and handsets.

The success of UMTS900 introduction will however require economies of scale to help drive down handset and device prices. Chipset and handset vendors will not push product into immature markets, the markets will have to be stimulated by operator/market pull to seed the market. This seeding is needed to ensure device availability before the network is enabled, without which customer take-up is bound to be limited. The ability for operators to stimulate the market with a wider selection of handsets and devices will be greater if it is possible to introduce services in multiple markets in parallel, which in turn will benefit if NRAs allow the introduction of UMTS900 in many markets at around the same time.

The availability of handsets, priced at market-attractive rates, is crucial to the success of UMTS900. High volumes will be needed to generate economies of scale and the variety of devices that really stimulate market take-up. These volumes will be more easily achieved if there is widescale regulatory acceptance for the 900MHz band to be used for UMTS services.

The need for regulatory co-ordination

Harmonisation of the 900MHz band

The 900MHz band is one of the most used bands in the world. GSM operators all over Europe, Africa and Asia use this band extensively, which makes it one of the most "harmonised" bands in the world. All operators using the 900MHz have started with GSM services and most of them have already acquired 3G licenses at 2.1 GHz. This business evolution makes UMTS900 a most attractive option for operators and a likely follow-up technology in the 900MHz band.

In order for operators to be able to utilise UMTS technology in the 900MHz band two prerequisites are required regarding spectrum availability:

- the NRA must allow the deployment of UMTS in the 900MHz band
- re-farming of 900MHz spectrum band is needed in order for the operators to be able to deploy 5MHz (WCDMA) carriers. For those operators having largely

deployed GSM in the 900 MHz band 2 x 10MHz is an indicative amount of spectrum required to roll out GSM and UMTS in parallel. In some countries where 900 MHz is still available, operators may start UMTS900 with 2x5 MHz of clean spectrum.

If these prerequisites are met and if both GSM and UMTS technologies can be deployed in the 900MHz band then this harmonisation of spectrum will improve the flexibility of mobile operators to use spectrum efficiently (through network and frequency planning process) to meet coverage and capacity requirements.

There are a number of key regulatory issues to be addressed:

- Spectrum availability: Some NRAs, especially in developed countries, have already initiated discussions about new 2G spectrum management policies, the re-farming of GSM bands and the processes to be followed for the migration of GSM services to UMTS services. It is essential to ensure that both GSM and UMTS services can continue to operate in a parallel and well-balanced manner as GSM networks will continue to be the core business for the majority of mobile operators for many years.
- Sharing of 900MHz spectrum: NRAs will have to assess the impact of allowing the GSM and UMTS services to co-exist. Interference effects among the services operating within the same band need to be minimised, and co-ordination with adjacent countries will also be necessary. In Europe, this is being addressed in CEPT/ECC reports 82 and 96.
- GSM licence renewal: In the majority of the cases second generation licences are technology specific allowing only GSM services to be used in the designated bands. Although the re-farming of the GSM bands allows the co-existence of second and third generation mobile services, such arrangements may raise concerns and competition issues among the mobile industry.
- Impact of UMTS900 on existing GSM and UMTS operations: The full use of 900MHz spectrum for the provision of 3G services in the future may be a barrier for new entrants.
- Spectrum pricing or national roaming: NRAs may have to develop new pricing formulas for spectrum fees.
- The impact of EU directives and national developments: The regulatory framework of the EU directives is a significant factor which could speed-up or delay the deployment of UMTS900 networks. Most of the NRAs are reluctant to move towards the UMTS900 adaptation due to these directives.

Case studies

The initial analysis was undertaken at major regional level. To help make the implications of UMTS900 introduction understandable, we provide a brief analysis of the UMTS900 benefits at a country level for one country in each of the four regions examined in the study. These figures are illustrative of the relative costs / savings of deploying UMTS900 and have been developed using high-level

modelling. The figures should be considered indicative of relative costs within the country per country, rather than absolute. More detailed demographic, demand and geographic analysis would be needed in each case to improve the reliability of these figures.

There are some common conclusions for all countries examined:

a) **When the same population and geographic requirements are met in both scenarios - 'UMTS2100 only' and 'UMTS900 only':** there are direct financial savings for operators in the UMTS900 case due to reduced capex spending, which is in the range of 25% to 40%. However, apart from the direct capex reduction benefits for the operators there are some also indirect benefits due to the reduced number of cell sites needed to be deployed; time and effort savings and reduced environmental and health impact.

b) **When the same cumulative capex spending (over 5-years) is assumed for both scenarios - 'UMTS2100 only' and 'UMTS900 only':** there is an increase in population and geographical coverage when deploying 'UMTS900 only' as opposed to the 'UMTS2100 only'. The increase varies with each country. However, in the 'UMTS900 only' case, countries can enjoy significant socioeconomic benefits as the 3G addressable market enlarges and more people have access to wireless broadband services.

In cases presented below only a high level analysis has been performed. To derive more accurate results a more detailed approach which assesses the country's market and geospatial characteristics would be needed. However, the analysis sets the overall picture and provides some useful insights of the benefits that are expected with the deployment of UMTS900 networks.

Sri Lanka

Sri Lanka is a developing market with the first WCDMA subscribers expected by the second half of 2007. The same assumptions about deployment analysis are made as previously discussed and comparative outcomes between use of UMTS900 and UMTS2100 technology are derived. There is the opportunity for countries like Sri Lanka, which do not have existing UMTS2100, to start with UMTS900 if the regulatory path for its deployment is clear, and a there is reasonable handset and device availability.

When deploying UMTS2100 technology (assuming 8% population coverage and 15% geographic coverage by 2011) a total cumulative capex (over 5 years) of around $126m is required to deploy approximately 1,100 sites to meet coverage and capacity requirements.

In the case of UMTS900 technology, and with the same requirements, a cumulative capex spending of $94m is required to deploy approximately 750 sites.

In the second case there is a 25% reduction in capex spending required, mainly driven by the reduced number of cell sites and other core and transport cost savings.

In the case where we assume that the operator will spend the same amount as in the case of UMTS2100 (i.e. $126m), over 5 years, but by deploying UMTS900 networks instead, then both population and geographic coverage can be significantly increased. By following a linear cost-oriented approach (capex/subscriber driver), it is estimated that by 2011 population coverage could increase by 50% from 8% to 12% and geographic coverage increases to 20% as compared to 15% previously.

Finland

In Finland, 3G penetration at the start of 2007 is almost 15% and is forecast by Ovum to rise to approximately 78% by 2011. The same assumptions about deployment analysis are made as previously discussed and comparative outcomes between use of UMTS900 and UMTS2100 technology are derived.

When deploying UMTS2100 technology (assuming 78% population coverage and 75% geographic coverage by 2011) a total cumulative capex (over 5 years) of around $1.86bn is required to deploy approximately 11,000 sites to meet coverage and capacity requirements.

In the case of UMTS900 technology, and with the same requirements, a cumulative capex spending of $1.1bn is required to deploy approximately 7,000 sites.

In the second case there is a 40% reduction in capex spending required, mainly driven by the reduced number of cell sites and other core and transport cost savings.

In the case where we assume that the operator will spend the same amount as in the case of UMTS2100 (i.e. $1.8bn), over 5 years, but by deploying UMTS900 networks instead, then both population and geographic coverage can be significantly increased. By following a linear cost-oriented approach (capex/subscriber driver), it is estimated that by 2011 population coverage could increase by 30% to reach almost 100% and geographic coverage increases to 95% as compared to 75% previously.

Saudi Arabia

In Saudi Arabia, the first WCDMA (3G) networks are expected to be launched in 2007. Ovum forecasts that population penetration will rise to reach 45% by 2011. The same assumptions about deployment analysis are made as previously discussed and comparative outcomes between use of UMTS900 and UMTS2100 technology are derived.

When deploying UMTS2100 technology (assuming 45% population coverage and 35% geographic coverage by 2011) a total cumulative capex (over 5 years) of around $6.3bn is required to deploy approximately 30,000 sites to meet coverage and capacity requirements.

In the case of UMTS900 technology, and with the same requirements, a cumulative capex spending of $4.2bn is required to deploy approximately 21,000 sites.

In the second case there is a 37% reduction in capex spending required, mainly driven by the reduced number of cell sites and other core and transport cost savings.

In the case where we assume that the operator will spend the same amount as in the case of UMTS2100 (i.e. $6.3bn), over 5 years, but by deploying UMTS900 networks instead, then both population and geographic coverage can be significantly increased. By following a linear cost-oriented approach (capex/subscriber driver), it is estimated that by 2011 population coverage could increase by 50% to reach almost 65% and geographic coverage increases to 50% as compared to 35% previously.

South Africa

In South Africa, 3G penetration is gradually increasing and is forecast by Ovum to rise from around 2% to approximately 25% by 2011. The same assumptions about deployment analysis are made as previously discussed and comparative outcomes between use of UMTS900 and UMTS2100 technology are derived.

When deploying UMTS2100 technology (assuming 25% population coverage and 20% geographic coverage by 2011) a total cumulative capex (over 5 years) of around $1.4bn is required to deploy approximately 19,000 sites to meet coverage and capacity requirements.

In the case of UMTS900 technology, and with the same requirements, a cumulative capex spending of $0.9bn is required to deploy approximately 12,000 sites.

In the second case there is a 35% reduction in capex spending required, mainly driven by the reduced number of cell sites and other core and transport cost savings.

In the case where we assume that the operator will spend the same amount as in the case of UMTS2100 (i.e. $1.4bn), over 5 years, but by deploying UMTS900 networks instead, then both population and geographic coverage can be significantly increased. By following a linear cost-oriented approach (capex/subscriber driver), it is estimated that by 2011 population coverage could increase by 40% to reach almost 35% and geographic coverage increases to 30% as compared to 20% previously.