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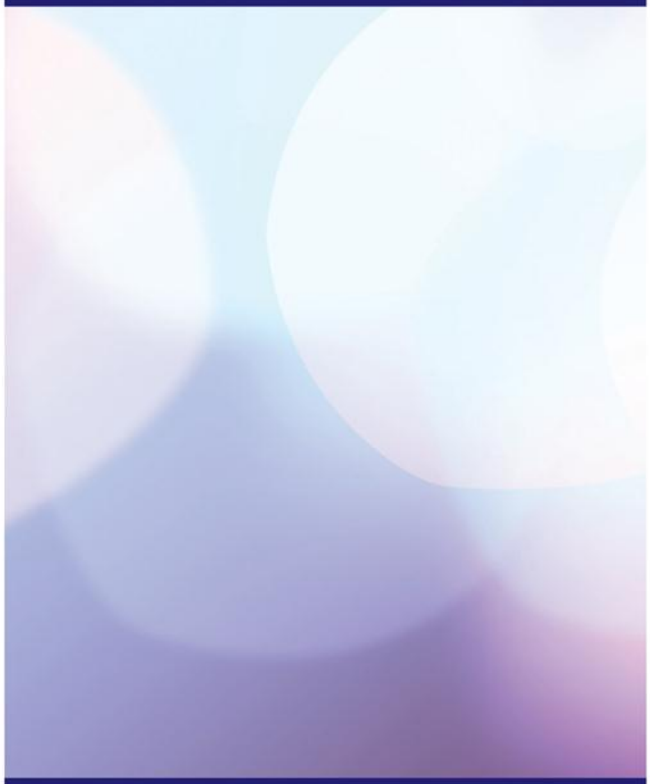

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Final report for the GSMA

The socio-economic benefit of allocating harmonised mobile broadband spectrum in the Kingdom of Saudi Arabia

30 April 2012

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Contents

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1 Executive summary

The Kingdom of Saudi Arabia (KSA) would receive considerable socio-economic benefits from the release of harmonised spectrum in the 700/800 and 2.6GHz bands for use by mobile operators to deliver next-generation mobile broadband services. In particular, the Kingdom would see:

- a total[1] GDP gain of SAR358 billion in net present value (NPV) over the period 2013 to 2025
- jobs for 424 000 people by 2020
- mobile coverage to KSA's large rural areas, providing education and information benefits to the poorer areas of the Kingdom.

Any delay in the release of this harmonised spectrum would have a significant impact on these benefits. A five-year delay in the release of harmonised spectrum would reduce the total GDP gain over 2013–2025 to just SAR96 billion, and reduce the number of jobs created to 75 000.

The current spectrum allocation for LTE in KSA involves a totally non-harmonised arrangement in the 2.3GHz (STC) and 2.5GHz (Mobily) bands. Because this fragmented allocation is unpaired it can only be used in TDD mode. As a consequence, the current allocation would not generate the socio-economic benefits of a harmonised FDD allocation in the 2.6GHz and 800MHz bands for LTE.

In order to achieve the benefits described above, KSA must release the internationally harmonised spectrum band plans of 140MHz of spectrum at 2.6GHz and at least 60MHz of digital dividend spectrum at 800MHz. The combination of those two bands offers excellent coverage for rural areas and good in-building penetration combined with high capacity for KSA's cities. This international harmonisation is critical to ensure that the new devices which are being developed around the world (such as tablets, smartphones and ultrabooks) will be able to work in KSA. Failure to harmonise this spectrum with the international community will result in KSA being forced to use higher-cost (typically a 500% increase in cost in 2013 falling over time to "just" 60% by 2020) and poorly-performing devices. This means that KSA consumers and businesses will not be able to use the latest/best devices for LTE (including iPad 3). Instead, they will be forced to use generic, less convenient devices at higher cost per device.

In addition, people from neighbouring GCC countries will not be able to roam with their devices in KSA. In the worst case, KSA's failure to harmonise would have a negative impact on the services available to foreign mobile operators with borders onto the Kingdom, limiting the economic growth of those operators.

Many GCC countries expect KSA, as a role model for the region, to take a lead in driving social and economic improvements. Timely release of this highly valuable spectrum would ensure that the Kingdom maintains this role model status and would help to drive the whole of the GCC though the next decade of economic growth and social improvements.

[1] In terms of net present value (NPV) using a discount rate of 5%.

2 Introduction

Analysys Mason Limited ('Analysys Mason') has been commissioned by the GSMA to investigate the socio-economic benefit of allocating harmonised mobile broadband spectrum in the Kingdom of Saudi Arabia (KSA).

The objective is to provide a complete view of the benefits associated with the development of mobile broadband in KSA, and to explore how spectrum management policy could affect those benefits. In particular, we discuss practical concerns associated with the current spectrum situation.

The remainder of this document is laid out as follows:

- Section 3 presents our findings on the socio-economic benefits of allocating harmonised mobile broadband spectrum in KSA
- Section 4 describes practical concerns associated with spectrum management issues.

The report also includes a number of annexes containing supplementary material:

- Annex A provides an overview of Analysys Mason and the authors of the report
- Annex B includes an overview of the GSMA and its Spectrum for Mobile Broadband campaign
- Annex C provides details of our calculations of the socio-economic benefits of mobile broadband
- Annex D presents a macroeconomic overview of KSA and includes an analysis of the pricing of residential broadband services
- Annex E contains the list of public sources used for the benchmark of global trends in regulating, licensing and operating mobile broadband wireless access systems.

3 Socio-economic benefits of allocating harmonised mobile broadband spectrum in KSA

3.1 Introduction

Analysys Mason has developed a macroeconomic model to estimate the socio-economic benefits of releasing 140MHz of harmonised spectrum at 2.6GHz and 60MHz of digital dividend spectrum at 800MHz and allocating them for mobile broadband in KSA.

The model follows the three steps outlined below to calculate the socio-economic benefits of allocating harmonised mobile broadband spectrum:

1) It assesses the impact of harmonised allocation of 800MHz and 2.6GHz spectrum on mobile broadband penetration
2) It assesses the impact of mobile broadband penetration on GDP
3) It assesses the impact of GDP growth on employment.

This three-step analysis is undertaken for the following three scenarios:[2]

- no harmonised 2.6GHz or 800MHz spectrum is released (counterfactual case)
- harmonised 2.6GHz and 800MHz spectrum is released in 2013 (base case)
- harmonised 2.6GHz and 800MHz spectrum is released in 2018 (five-year delay case).

The three scenarios used in the macroeconomic model do not specifically include the current non-harmonised allocation of spectrum in the 2.3GHz and 2.6GHz bands; this impact is addressed in detail in Section 4.2.

By comparing the counterfactual case and the base case, it is possible to estimate the socio-economic benefits from releasing the 800MHz and 2.6GHz spectrum in 2013. Similarly, by comparing the base case and the five-year delay case, it is possible to estimate the 'cost' of the delay in terms of lost socio-economic benefits.

Annex C describes how the macroeconomic model calculates the socio-economic benefits in the base case. The rest of this section describes the differences between the three scenarios to estimate the benefits from harmonised spectrum allocation and the 'cost' of a five-year delay.

3.2 Step 1: Impact of spectrum allocation on mobile broadband penetration

The first step in the macroeconomic model is to assess the impact on mobile broadband penetration of allocating of harmonised 800MHz and 2.6GHz spectrum.

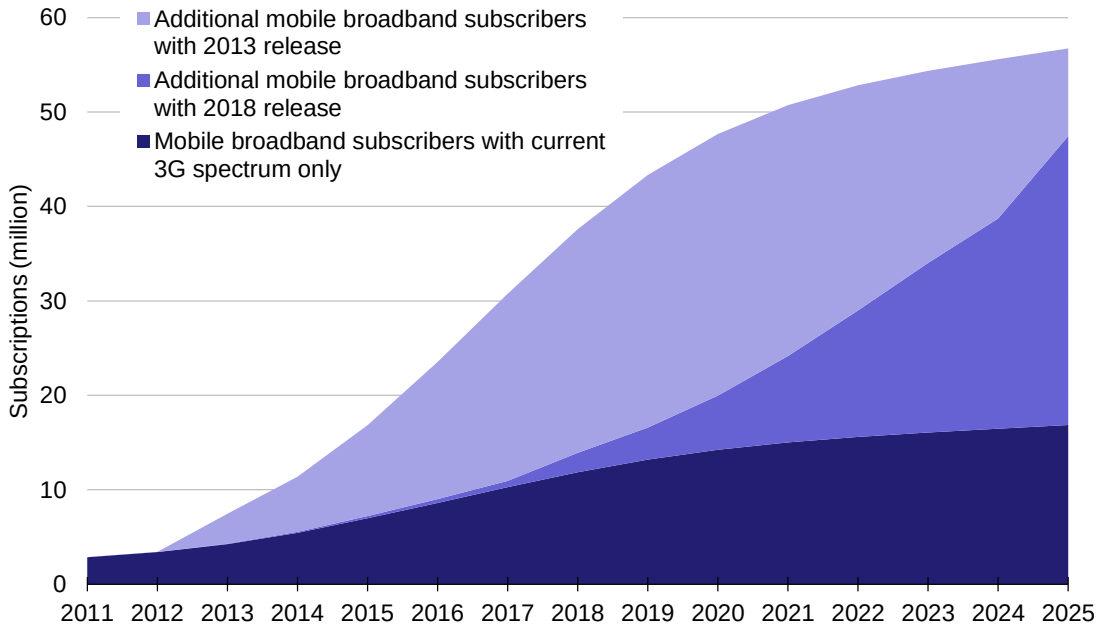
[2] None of the three scenarios includes any unharmonised 2.6GHz, 2.3GHz or 1.8GHz spectrum.

The release of both 800MHz and 2.6GHz provides additional capacity and means that the expected increase in the total number of mobile broadband subscriptions (both handset mobile broadband subscriptions[3] and dedicated mobile broadband subscriptions[4]) is not limited by spectrum capacity issues or limited to only 3G services, as would be the case without this spectrum release.

In addition, the release of 800MHz provides greater coverage than 2.6GHz and means that household mobile broadband penetration (typically provided over dedicated mobile broadband subscriptions[4]) is not limited to urban areas.

Figure 3.1 below summarises how we expect mobile broadband subscriptions to evolve, depending on whether and when harmonised 2.6GHz and 800MHz spectrum is released.

Figure 3.1: The impact of spectrum release on mobile broadband subscriptions in KSA [Source: Analysys Mason, 2012]



The assignment for mobile broadband of 140MHz of spectrum at 2.6GHz and 60MHz of digital dividend spectrum at 800MHz by 2013 is forecast to allow the total number of mobile broadband subscriptions to rise to 48 million by 2020 and to 57 million by 2025. This would mean a penetration of handset mobile broadband subscriptions3 of 136% of the population in 2020 and 149% in 2025, while penetration of dedicated mobile broadband subscriptions4 would grow to 63% of households in 2020 and 67% in 2025. By way of comparison, it is estimated that the penetration of handset mobile broadband subscriptions stood at 4% of the population in 2011, while the penetration of dedicated mobile broadband subscriptions stood at 33% of households.

[3] That is, "subscriptions to voice SIMs with use of data communications at broadband speeds" as measured by CITC [Source: *ICT Indicators in K.S.A. (End of H1 2011)*].

[4] That is, "subscriptions to dedicated data SIMs" as measured by CITC [Source: *ICT Indicators in K.S.A. (End of H1 2011)*].

A delay in spectrum assignment of five years would reduce the expected number of mobile broadband subscribers to 20 million by 2020 and to 47.5 million by 2025. This would mean penetration of handset mobile broadband subscriptions of 51% of the population in 2020 and 122% in 2025, while penetration of dedicated mobile broadband subscriptions would grow to 58% of households in 2020 and 67% in 2025.

3.3 Step 2: Impact of mobile broadband penetration on GDP

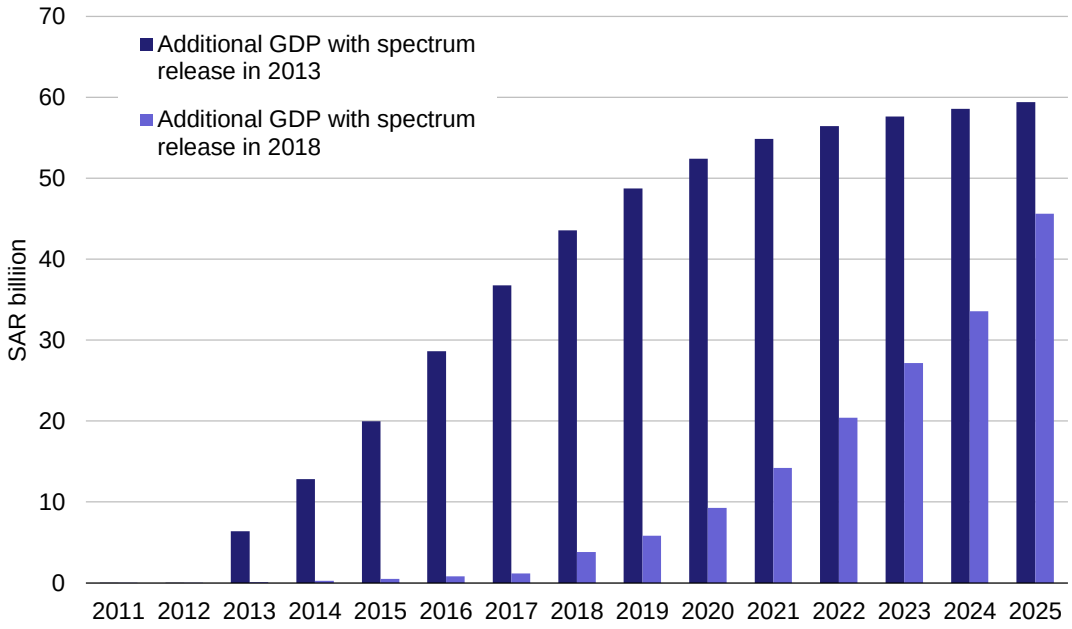
The second step in the macroeconomic model is to assess the impact of mobile broadband penetration on GDP.

This analysis takes into account three different types of macroeconomic impact:

- the **direct** impact of greater penetration of broadband services
- the impact of mobile broadband services on related economic sectors within the **ecosystem**
- the **second-order** impact of mobile broadband services in terms of productivity gain.

Annex C describes how the macroeconomic model calculates the socio-economic benefits in the base case. Figure 3.2 below presents the additional GDP resulting from spectrum being released in 2013 or in 2018.

Figure 3.2: The impact of spectrum release on GDP in KSA [Source: Analysys Mason, 2012]



In 2020, the additional GDP resulting from enhanced growth in mobile broadband subscriptions would amount to SAR52.4 billion, if spectrum is released by 2013. A five-year delay in assigning the spectrum would reduce this gain to SAR9.3 billion.

Looking at the entire period from 2013 to 2025, a spectrum release in 2013 would result in a net present value (NPV)[5] gain in GDP of SAR358 billion, while a five-year delay in assigning spectrum would reduce this NPV gain to SAR96 billion.

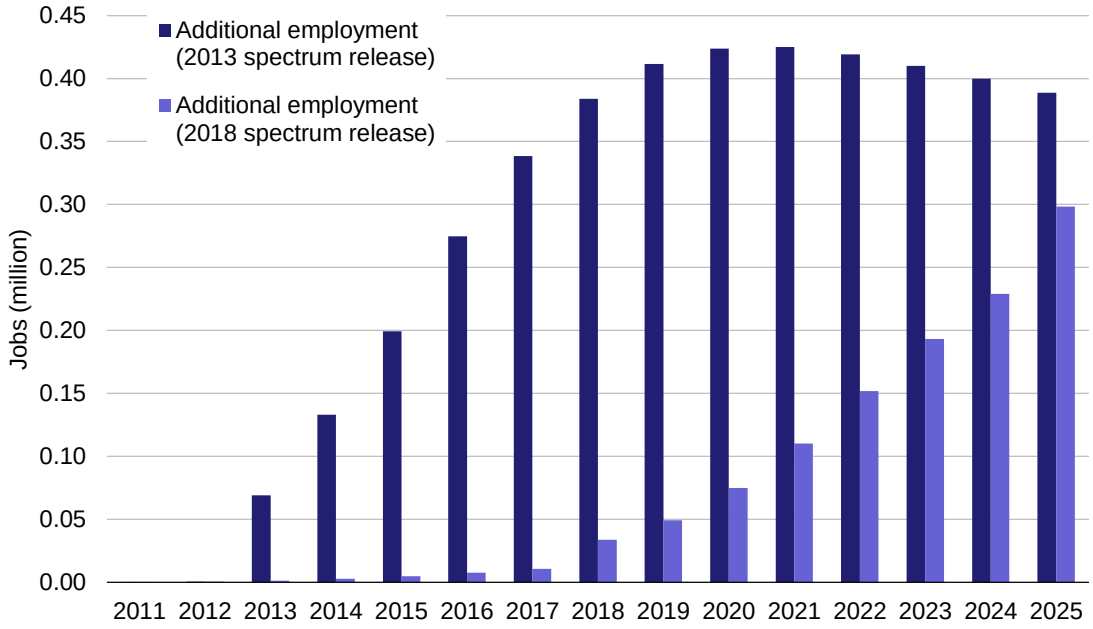
3.4 Step 3: Impact of GDP growth on employment

The final step in the macroeconomic model is to assess the impact of GDP growth on employment.

This analysis follows from the second step by converting the GDP gains into additional jobs using the GDP-to-employment ratio implied by third-party GDP and employment forecasts.[6]

Figure 3.3 below the additional jobs resulting from spectrum being released in 2013 or in 2018.

Figure 3.3: The impact of spectrum release on employment in KSA [Source: Analysys Mason, 2012]



In 2020, the additional employment resulting from enhanced growth in mobile broadband subscriptions would amount to 424 000 jobs, if spectrum is released by 2013. A delay in spectrum assign of five years would reduce this gain to 75 000.

5 Calculated using a discount rate of 5%.

6 GDP data sourced from the Central Department of Statistics and Information, *KSA Econ in figures 2010* (for actuals), and the EIU (for future growth); employment data sourced from Euromonitor until 2020 and an extrapolation of those numbers after 2020.

4 Practical concerns raised by spectrum management issues

The demand for, and use of, spectrum, both in KSA and internationally, is increasing dramatically with the rapid development of mobile broadband. A particular challenge arising from this growth in demand for spectrum is that, while mobile technologies benefit from large economies of scale when harmonised spectrum is used across countries and regions, legacy spectrum plans typically do not have the same usage for a given band. For instance, the 800MHz band may be used for analogue TV in one country and by the military in another. Spectrum management decisions therefore need to take into account both national and international aspects. In the following sections we look at both the constraints on and motivations for spectrum management decisions in KSA.

4.1 Spectrum management issues in KSA

4.1.1 Possible spectrum bands for mobile broadband

Spectrum is increasingly being seen as one of the most valuable assets of a mobile operator and one of the most important components in the mobile industry. It is both a sought-after resource that requires management by national governments and/or regulators and a public good. Spectrum which has the capacity to produce commercial services such as GSM and mobile broadband is valued highly by the industry. Moreover, it provides significant social and economic benefits to society and consumers.

The motivation behind spectrum management decisions is to make a choice that will yield benefit for the national economy, consumers and citizens; that is, to find an allocation that will be used by those who value it the most for purposes that offer the highest value. The propagation features of various spectrum bands have significant implications for the allocation choice of regulators, with lower-frequency bands offering excellent long-distance propagation, and thus requiring fewer base stations for a given level of coverage, and higher bands offering high data rates and large bandwidths, suitable for high-capacity services. As a result of this, the bands between 400MHz and 5GHz are potentially suitable for mobile broadband services.

Figure 4.1 below compares the advantages and disadvantages of different spectrum bands between 400MHz and 5GHz that have been used or considered for mobile broadband provision.

Figure 4.1: Advantages and disadvantages of various spectrum bands [Source: Analysys Mason, 2011]

Spectrum band	Advantages	Disadvantages
450MHz	• Good propagation • Signals travel further • Fewer base stations needed for wide area coverage	• Limited bandwidth available in the band (only 2×10MHz, thus space for only one or two operators) • Limited LTE device availability, although wider availability of devices based on technology such as narrowband CDMA and OFDM
700MHz (digital dividend 2)	• Good propagation	• Proposed but not yet harmonised
800MHz (digital dividend)	• Good propagation • Sufficient bandwidth for three operators to provide LTE • European/global harmonisation, good infrastructure and device availability	• In some countries the 800MHz band is used for military systems which would also need to be migrated to free up the band for LTE
900MHz (GSM bands)	• Good propagation	• Used for GSM and UMTS/HSPA • Use for LTE possible but not harmonised in the short term
1800MHz (GSM bands)	• Good for additional LTE capacity • Use for LTE possible and becoming harmonised	• Used for GSM; would require re-farming or unused spectrum to be made available
2.1GHz	• Good for providing capacity	• Used for UMTS/HSPA; would require re-farming or unused spectrum to be made available • Use for LTE possible but not harmonised in the short term
2.3GHz	• Good for providing additional LTE capacity	• Limited spectrum available in some countries, typically 40MHz unpaired • Signal capacity worse than in bands below 1GHz • Unpaired, so not useful for FD-LTE, which is more commonly used by mobile operators to date and so there is limited device availability
2.6GHz	• Lots of bandwidth available (2×70MHz paired and 50MHz unpaired) and thus sufficient for operators to gain 2×20MHz • Can deliver higher-speed LTE services using a contiguous 20MHz channel • European/global harmonisation, good infrastructure and devices availability	• High cost of deployment for wide area coverage as more base stations are needed to compensate for propagation loss
3.6GHz	• Good for additional LTE capacity • Likely to be a good option for future use but of limited utility at present without the availability of more devices	• No harmonised European plan for this band at the moment so there are no LTE devices on the market that use this band • High propagation losses, so significantly more base stations are needed

Furthermore, although the 5GHz band is internationally harmonised for WLAN and can be used to offload mobile data traffic, it is not suitable for wide-area cellular coverage.

The ideal combination of spectrum for mobile broadband is the association of lower-frequency bands offering excellent long-distance propagation (typically the bands below 1GHz) and higher bands offering high data rates and large bandwidths (typically close to or over 2GHz).

Recent developments in worldwide markets have led to identification of the 700/800MHz and 2.6GHz bands as the most favourable choice with the potential to be used extensively for mobile broadband services. The 1800MHz band is also being seen as a good candidate for providing additional LTE capacity, in addition to or as a replacement for the 2.6GHz band. However, the 1800MHz band is used for GSM today and it may be complex to re-farm it, depending on the situation in each country. With regard to the sub-1GHz bands, there appears to be no realistic replacement for the 700/800MHz band, as the 450MHz band is very narrow and the 900MHz band is already being re-farmed for UMTS/HSPA.

4.1.2 Global trends in regulating, licensing and operating mobile broadband wireless access systems

In order to analyse global trends in spectrum assignment and allocation we conducted an international benchmark of 15 countries. This benchmark primarily focuses on Region 1, from which it includes:

- four countries in the GCC region of the Middle East (Bahrain, Oman, Qatar and the UAE)
- seven European nations (Austria, Belgium, Denmark, France, Norway, Sweden and the UK)
- one African country (South Africa).

To provide a global perspective on spectrum assignment, the sample also includes:

- one country from the Americas (Brazil) and
- two from the Asia–Pacific region (Australia and New Zealand).

The principal trends identified as a result of the benchmark are:

- that countries around the world are making a significant amount of spectrum available for mobile broadband wireless access systems
- that countries around the world are making spectrum available in a harmonised way
- that it is particularly important to make the 700/800MHz and 2.6GHz frequency bands available.

In the following sections we look at these trends in greater detail.

Countries around the world are making a significant amount of spectrum available for mobile broadband wireless access systems

The benchmark countries have all allocated a significant amount of spectrum to mobile services, as shown in Figure 4.2.

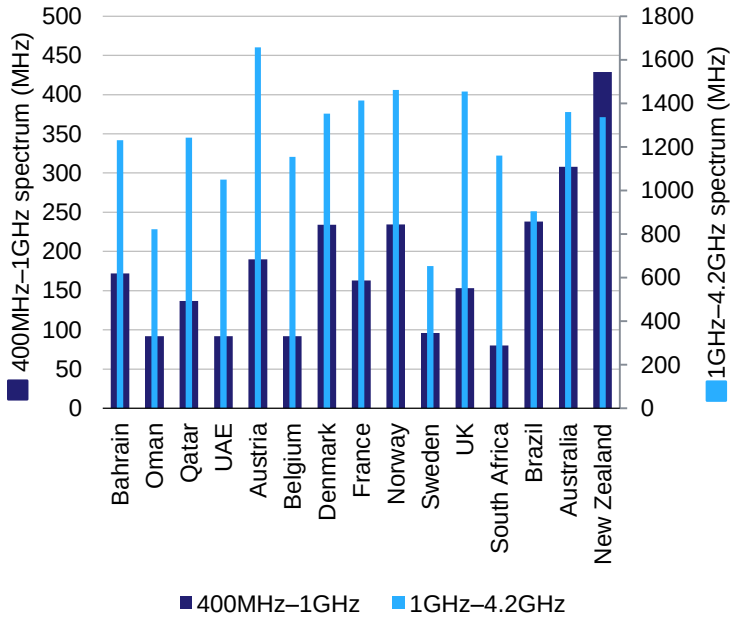


Figure 4.2: Spectrum allocated to mobile services between 0GHz and 4.2GHz[7] [Source: national frequency allocation plans, 2012]

While some of the spectrum allocated to mobile remains un-assigned, many of the countries have plans in place or are engaged in consultations on future plans to license the entire remaining spectrum in the near future.

Another indicator of global demand for mobile spectrum is the rise in the number of mobile spectrum auctions in recent years, as shown in Figure 4.3 on the next page.

In both 2010 and 2011 there were 33 mobile spectrum auctions internationally, significantly higher than in the years immediately preceding this and even higher than the number of auctions around 2001, when 3G spectrum was initially awarded.

A number of studies have been carried out to analyse whether the existing spectrum holdings of mobile network operators (MNOs) are likely to be sufficient in the medium to long term.

For example, Analysys Mason recently conducted a study[8] to examine the demand for wireless broadband spectrum[9] in Denmark. The study estimated that, by 2025, total demand in Denmark could be between 550MHz (for mobile only) and 1700MHz of spectrum (assuming that 50% of users who are unable to obtain a fixed 100Mbit/s service use a mobile service, and that they consume 25% as much data as an average fixed broadband user).

7 No data for Qatar is available for spectrum below 900MHz and above 3GHz.

8 Source: *The future need for broadband frequencies in Denmark*, Analysys Mason, 2011.

9 Spectrum assigned to 3G, LTE, Wi-Fi, etc.

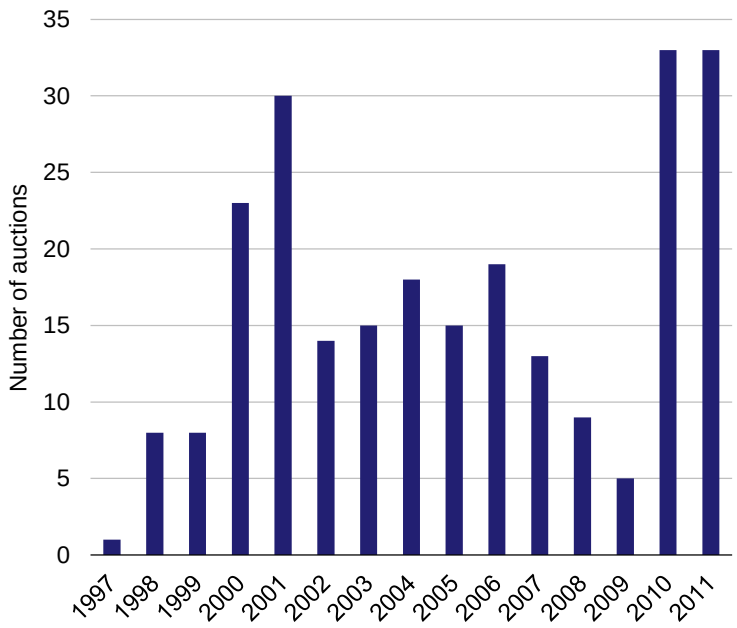


Figure 4.3: Number of mobile spectrum auctions [Source: Analysys Mason Research, 2012]

As another example, Qatar's recent *Public Consultation on Radio Spectrum Policy for the State of Qatar* highlighted the growing demand for mobile spectrum over the next decade, driven by the need to support mobile broadband services. As a result of this Qatar is looking to reassign the spectrum in the 800MHz and 2.6GHz bands, and the country's MNOs have expressed an interest in obtaining such licences.

Other recent studies carried out elsewhere have identified similar – or in some cases higher – spectrum needs. For example, the ITU-R Report M.2078 estimates a requirement of:

- 1280MHz for low market demand (rural areas)
- 1720MHz for high market demand (urban areas).

As a result of similar studies, Australia, Sweden, the UK and the USA are targeting 500MHz of additional spectrum release for mobile broadband services (in addition to the existing allocation of approximately 600MHz for wireless services in general).

This suggests that, internationally, there is a need to assign and license more of the allocated spectrum for mobile broadband in order to meet the high demand. KSA's mobile industry would be at a significant disadvantage if it was unable to gain access to similar amounts of spectrum.

Countries around the world are making spectrum available in a harmonised way

Both within the benchmark countries and globally, countries are moving towards allocating and licensing the same spectrum frequency bands. This is clearly demonstrated by the way the 450MHz, 800MHz, 2.3GHz, 2.6GHz, 3.4GHz and 3.6GHz bands have been defined across the benchmark countries, as shown in Figure 4.4.

Figure 4.4: Primary mobile spectrum allocations across the benchmark countries[10] *[Source: national frequency allocation tables; NRAs;*[11] *EFIS,*[12] *2012]*

	450MHz	800MHz	2.3GHz	2.6GHz	3.4GHz	3.6GHz	5GHz
Austria	451–466	790–862		2500–2690	3400–3600	3600–3800	5150–5725
Belgium	450–470	790–862	2300–2450	2500–2690	3410–3600		
Denmark	450–470	790–862	2300–2500	2500–2690	3400–3600	3600–3800	
France	453–470	790–862	2300–2483.5	2500–2900	3400–3600	3600–3800	5090–5340
Norway	450–470	790–890	2200–2400	2500–2690			
Sweden	450–479	790–862	2300–2450	2500–2690	3400–3600	3600–4200	5150–5350
UK	450–470	790–862	2200–2450	2500–2690	3400–3500	3500–3700	
Bahrain	406–470	862–890	2300–2450	2500–2690		3600–3700	
Oman	440–470	790–876	2300–2450	2500–2690	3400–3600		5150–5350
Qatar				2500–2690			
UAE	450–470	862–890	2300–2450	2520–2690	3400–3600	3600–4200	5250–5350
Australia	440–470	820–890	2300–2450	2500–2690	3300–3400	3600–4200	4800–5250
New Zealand	440–470	610–890	2300–2450	2500–2690	3400–3500	3600–3700	5150–5350
Brazil	450–470	806–902	2300–2450	2520–2670			
South Africa	440–470	862–890		2500–2690			5150–5350

The regulators have been acting on this allocation and have begun assigning the spectrum bands to mobile operators, as shown in Figure 4.5:

10 It is noted that not all allocations are available for assignment to mobile technologies.

11 National regulatory authorities.

12 European Communications Office Frequency Information System.

Figure 4.5: Current and future spectrum assignments [Source: Analysys Mason Research; EFIS; CEPT; TeleGeography, 2012]

	450MHz	800MHz	2.3GHz	2.6GHz	3.4GHz	3.6GHz	5GHz
Austria	Mobile broadband: two operators (T-Mobile, Green Network AB)	LTE: auction planned for 2012		LTE: four operators (Orange, T-Mobile, A1 Telekom, Hutchison 3G)	BWA:[13] four operators (4G Mobile, Salzburg AG, B.net Burgenland Telekom, EVN Netz)		
Belgium				LTE: four operators (Mobistar, Telenet, KPN, Belgacom)			
Denmark		LTE: auction planned for 2012		LTE: four operators (Telenor, Telia, Hi3G, TDC)			
France		LTE: three operators (Bouygues Telecom, SFR, Orange)		LTE: four operators (Orange, SFR, Bouygues Telecom, Free/Iliad)			
Norway	CDMA2000: one operator (Ice.net)	Auction planned for 2012		LTE: two operators (NetCom, Telenor) WiMAX: one operator (Craig Wireless)	IMT: eight operators (Hardanger, UPC, Telenor, Catch, NextGenTel, Bane Tele AS, Netpower, Nera)		
Sweden	CDMA2000: one operator (Net 1)	LTE: three operators (Tele 2, Telenor, TeliaSonera)		LTE: four operators (Hi3G, Tele 2, Telenor, TeliaSonera)			
UK		LTE auction planned for 2012		LTE auction planned for 2012			

13 Broadband wireless access.

	450MHz	800MHz	2.3GHz	2.6GHz	3.4GHz	3.6GHz	5GHz
Bahrain	Licensee unknown		W-CDMA: one operator (Batelco)	Technology to be confirmed: two operators (Zain, Mena Telecom)			
Oman	Licensee unknown		Licensee unknown	Licensee unknown			
Qatar							
UAE				LTE: two operators (Etisalat, du)			
Australia		CDMA2000: three operators (Hutchison, Telstra, AAPT)	Unknown technology: three operators (NBN, Telstra, BKAL)	Auction planned for 2012	Technology to be confirmed: six operators (Freecor, Amcom, HaleNET, ActewAGL, AKAL, Walker Wireless)		
New Zealand		CDMA2000: one operator (Telecom Mobile)		LTE: two operators (Telecom Mobile, Vodafone New Zealand)			
Brazil	Auction planned	CDMA2000: five operators (Algar Telecom, Sercomtel Celular, Telecom America, TIM Participacoes, Vivo Participacoes)		Auction planned			
South Africa		Auction planned for 2012		LTE auction planned for 2012			

While the majority of the benchmark countries have allocated and assigned the same spectrum bands to mobile services, indicating a desire for harmonisation by the government and regulatory bodies, there is also evidence that operators are taking advantage of this common approach to assignment by adopting similar technology, based upon LTE. While the spectrum is often allocated in a technology- and service-neutral manner, operators have, in the main, introduced the same technologies within particular spectrum bands. For example, LTE-FD technology dominates the 800MHz and 2.6GHz spectrum bands, CDMA services are common in the 450MHz band, and LTE-TD technology is becoming more widely available in the 2.3GHz bands. The 5GHz spectrum is often left unlicensed for WLAN services.

This shift towards harmonised band plans is being driven by two factors: governments and national regulatory authorities seeking to take advantage of the benefits of operating services in harmonised spectrum bands, and encouragement from international bodies such as the EC[14] and the ITU[15].

The ITU has stated that the "Harmonisation of spectrum is key to innovation and efficient use of spectrum". In order to achieve such beneficial spectrum harmonisation, it is sometimes necessary to develop regional band plans for spectrum that is allocated internationally, to reflect regional variations in availability. These regional spectrum plans represent an international consensus reflecting the demands for spectrum for different services within the ITU Member States, taking account of existing assignments for legacy services. For example, there are various band plans in place across the three regions for the 700MHz and 800MHz bands, as a result of legacy technologies using the spectrum to deliver 2G mobile services that were already in place when the new 4G plans were developed.

Meanwhile, the EU has set out its own policy on spectrum, the "Radio Spectrum Decision" (676/2002/EC)[16], which acts as the regulatory framework for radio spectrum policy within the EU. This includes the Radio Spectrum Policy Programme, a regulatory instrument with the express purpose of "further enhancing the cooperation and coordination between Member States regarding EU spectrum policy".

It appears that both international bodies and national regulators are recognising the benefits of harmonised spectrum. The KSA mobile industry would be at a significant disadvantage if it had access to non-harmonised spectrum.

It is particularly important to make the 700/800MHz and 2.6GHz frequency bands available

Within the benchmark countries, both 700/800MHz and 2.6GHz spectrum has been predominantly allocated to mobile, and in the majority of these countries it has either been auctioned or plans are underway for this to happen. Most benchmark countries have either licensed[17] or are in the process

14 European Commission.
15 International Telecommunication Union.
16 Put in place in 2002, revised in 2009.
17 Austria, Belgium, Denmark, France, Sweden, Brazil, New Zealand and the UAE.

of licensing[18] at least one of these two bands. Furthermore, there is significant harmonisation in these two bands with respect to technology adoption, and the majority of the benchmark countries (including the UAE) have operators that are either trialling or implementing LTE in at least one of the bands.

Worldwide, a significant amount of the recent mobile spectrum licensing activity has also been in the 700/800MHz and 2.6GHz frequency bands. Spectrum has been auctioned in at least one of these bands in countries as diverse as Germany, Spain, Hong Kong and South Korea. However, there are a few countries in the world where the 2.6GHz band is used for multi-point wireless video systems (such as Greece, Ireland and the USA).

Globally, the 700/800MHz bands have been assigned using four different band plans:

- the CEPT plan: 790–862MHz
- the APT plan: 698–806MHz
- the US 700MHz plan: 698–806MHz
- the traditional Region 3 CDMA plan: 820–890MHz.

An illustration of the CEPT plan can be seen below:

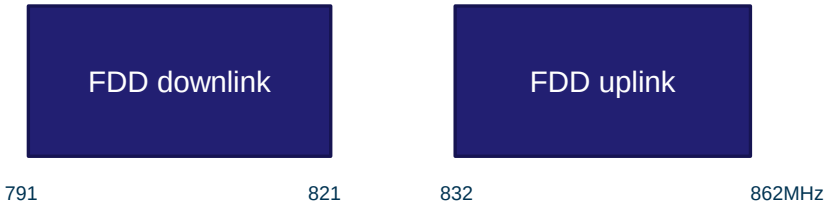
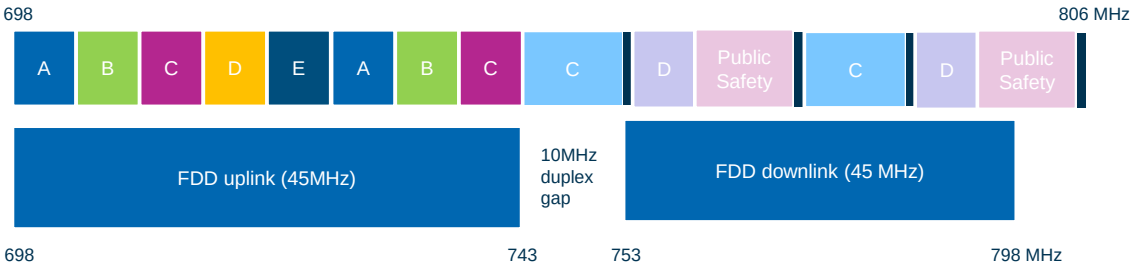


Figure 4.6: CEPT 800MHz band plan [Source: Analysys Mason, 2012]

A comparison of the APT 700MHz band plan with the US 700MHz plan is provided below.

Figure 4.7: Comparison of the APT 700MHz band plan and the US 700MHz band plan [Source: Analysys Mason, 2012]



18 Norway, the UK, South Africa and Australia.

While the APT plan is popular in the Americas, elsewhere the CEPT plan is gaining traction. Within Europe, the CEPT plan has been universally accepted and all countries are planning to have released the 800MHz spectrum in a harmonised fashion by 2014. Elsewhere in Region 1, such as in sub-Saharan Africa, both individual countries and the Southern African Development Community have indicated a preference for the CEPT plan as they consider that harmonisation with this plan would result in economies of scale and benefits to consumers (such as lower costs, interoperability and cross-border co-ordination).

For the 2.6GHz band, many European countries are planning to assign this spectrum by 2014, according to the ITU Option 1 plan[19] (which is illustrated in Figure 4.8 below).

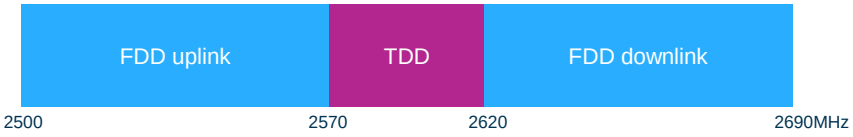


Figure 4.8: ITU Option 1 plan for the 2.6GHz band [Source: Analysys Mason, 2012]

In the Americas, countries such as Canada, Chile and Brazil are due to adopt the ITU Option 1 plan for the 2.6GHz band in order to benefit from the economies of scale offered by using the equipment and devices developed for this band and thereby reduce prices for consumers. However, South Africa has elected to adopt a non-standardised unpaired band plan, which has led to disadvantages with regard to roaming and a need to develop alternative technologies.

In the past year there have been a significant number of spectrum auctions in the two bands worldwide, as shown in Figure 4.9.

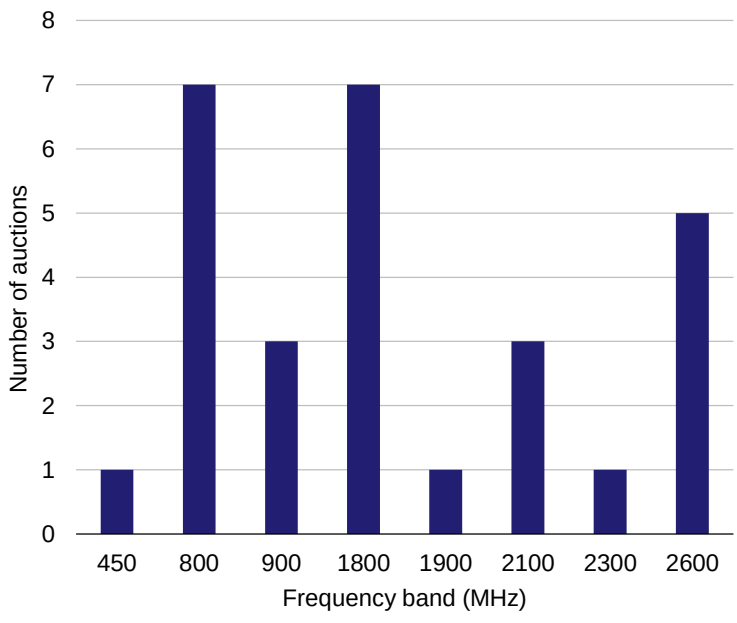


Figure 4.9: Number of spectrum auctions in 2011 [Source: Analysys Mason Research, 2012]

There has also been a large amount of activity in the 1800MHz band, although as this has been the traditional location of European 2G (GSM1800) mobile spectrum in many cases these auctions

[19] 2500–2570MHz FDD uplink; 2570–2620MHz TDD; 2620–2690MHz FDD downlink.

represent a re-farming of the spectrum from 2G to next-generation services rather than the release of new bandwidth to mobile services. However, as explained in Section 4.1.1, 1800MHz is increasingly seen as a substitute for 2.6GHz, as demonstrated by increased auction activity and the fact that LTE1800 equipment is becoming more readily available.

The high demand for harmonised spectrum in the 800MHz band in particular is further illustrated by analysis of the prices obtained at auction for spectrum in this frequency, as shown in Figure 4.10.

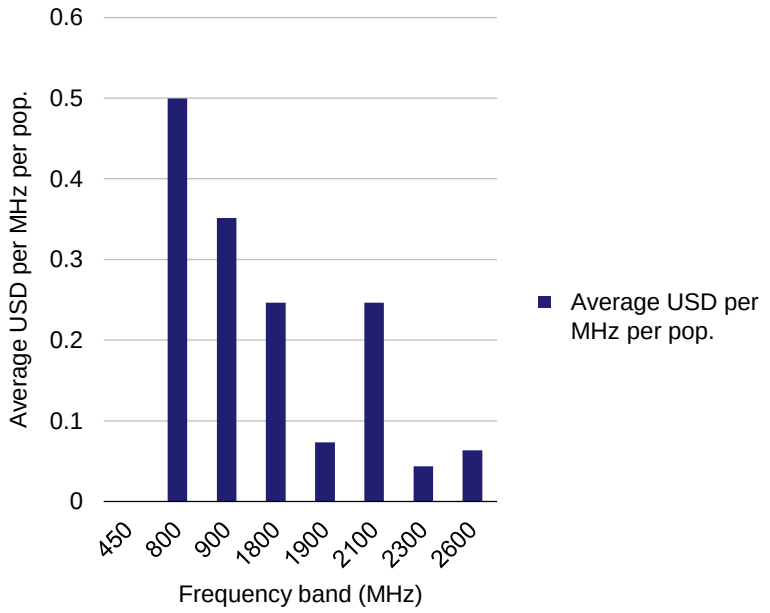


Figure 4.10: Average price for spectrum across the 2011 auctions [Source: Analysys Mason Research, 2012]

Within the benchmark countries, recent auctions (as shown in Figure 4.11) have exhibited similar trends, with the French 800MHz auction in December 2011 resulting in the highest prices. We also note the relatively high price that was achieved in Bahrain for the less attractive 3.4GHz band, which demonstrates the country's high level of demand for mobile spectrum.

Figure 4.11: Spectrum prices from auctions in benchmark countries [Source: Analysys Mason Research, 2012]

Country	Frequency band (MHz)	Spectrum value (USD per MHz per pop)
Austria	450	0.088
France	800	0.884
Sweden	800	0.569
Brazil	800	0.086
Australia	2300	0.063
New Zealand	2300	0.003
France	2600	0.257
Sweden	2600	0.217
Denmark	2600	0.168
Belgium	2600	0.062

Country	Frequency band (MHz)	Spectrum value (USD per MHz per pop)
Norway	2600	0.038
Austria	2600	0.033
Bahrain	3400	0.513
Australia	3400	0.020
Norway	3400	0.010
New Zealand	3400	0.003
Austria	3400	0.001

Operators' willingness to pay a high price for both the 800MHz and 2.6GHz bands reflects the high demand for these assets due to the harmonised nature of the spectrum, which has resulted in good availability of equipment and economies of scale. The price of 2.6GHz spectrum relative to that of 800MHz also needs to be considered within the context of the large amount of 2.6GHz spectrum that is available, relative to spectrum in other bands. This wide bandwidth (290MHz in most countries) is a significant advantage of the 2.6GHz spectrum to mobile operators and regulators, enabling it to be used to offer highly desirable mobile broadband capacity in urban areas that are growing rapidly, and making it an ideal complement to the valuable and limited-bandwidth 800MHz band.

Furthermore, 34 more auctions have been announced in these two bands. These are due to occur across all three ITU regions, with auctions planned for 2012 in countries such as Slovakia, Canada and Pakistan.

This activity within the 800MHz and 2.6GHz frequency bands is creating a global harmonised environment, with the benefits this entails for the next-generation networks that are being rolled out in those bands. It appears that the 800MHz and 2.6GHz bands are crucial in maximising the gains to be had from harmonised mobile spectrum for next-generation networks.

Mobile device manufacturers are taking advantage of the harmonisation of LTE services in the 800MHz and 2.6GHz spectrum bands, and focusing their development of LTE-ready devices in these bands. This means that countries which do not license these bands for mobile services will suffer from a lack of devices that are capable of supporting next-generation technology. Furthermore, if KSA was to allocate the 800MHz and 2.6GHz spectrum bands to a non-mobile service, it would encounter cross-border interference from neighbouring countries (which in the main have licensed, or are in the process of licensing, these bands to mobile operators).

4.1.3 The situation in KSA today

As discussed in the previous section, the 700/800MHz, 1800MHz and 2.6GHz spectrum bands are emerging as the preferred choice for developing mobile broadband. In KSA these bands are currently in use and will need re-farming if they are to be made available for mobile broadband development.

- The **700/800MHz** spectrum band is typically occupied by analogue TV services and is being re-farmed to mobile broadband in many countries across Europe, thanks to the digital switchover. However, in KSA the 809–862MHz band is not designed to be used exclusively for broadcasting, but rather for fixed, mobile and broadcasting technologies. This indicates that, in theory, it should be relatively easy to re-farm this band. However, a further hurdle arises as roughly half of this band is currently occupied by the military and thus may be unavailable for re-farming. It is noted, however, that military systems previously occupied part of the 800MHz band in some European countries (e.g. France and Belgium), but those systems have now been migrated to other bands to enable harmonised assignment of 800MHz frequencies for mobile broadband services.

- The **2.6GHz** spectrum band has been identified by the ITU as "the 3G Extension band", with the goal being to use this band globally to provide additional capacity for 3G services. However, at present some of this band is used by the military in KSA and so at least in the short term it is unavailable to the mobile operators. Mobily does hold some spectrum in the 2.5GHz band through Bayanat Al-Oula[20], which it is probably using for its recently launched TD-LTE (or TDD-LTE) services. STC is using unpaired 2.3GHz spectrum for its recent TD-LTE deployment.[21]

- The **1800MHz** band is already being allocated for the provision of mobile services, and in fact these licences are technology neutral, meaning they could easily be re-farmed by the individual service providers. Furthermore, there would appear to be some spare unlicensed capacity, perhaps up to 2×55MHz of spectrum,[22] and thus there is potential for mobile broadband to be developed in this band. Zain has started using 1800MHz spectrum for its recent LTE deployment.[21]

There is no visibility on use of the other spectrum bands in KSA, and the National Frequency Plan of the Communication and Information Technology Commission (CITC) lists them all as being used for commercial fixed mobile services, with the 2.1GHz band additionally used for space research, the 2.3GHz band for radio location and the 3.6GHz band for fixed-satellite mobile.

As can be seen from the above discussion, most of the current spectrum allocation for LTE in KSA follows a totally non-harmonised arrangement in the 2.3GHz (STC) and 2.5GHz (Mobily) bands. This fragmented allocation can only be used in TDD mode as it is unpaired. As a consequence, the current allocation would not generate the socio-economic benefits of a harmonised FDD allocation in the 2.6GHz and 800MHz bands for LTE that were described in Section 3.

The KSA mobile industry is therefore in danger of not being able to use the harmonised 800MHz and 2.6GHz spectrum bands for the expansion of mobile broadband. In the following sections we evaluate the impact of non-harmonised mobile broadband on KSA mobile operators and consumers.

20 Source: Saudi Arabia Country Report (Analysys Mason Research).

21 Source: Wireless Intelligence.

22 See Figure D.17 in Annex D.

4.2 Impact on cost of mobile broadband

Economies of scale

The use of internationally harmonised spectrum in KSA for the roll-out of new mobile broadband services based on LTE would bring the benefits of economies of scale and competition, thus improving efficiency in handset manufacture and distribution due to KSA joining the global market for infrastructure and device manufacturing.

Failure to use harmonised spectrum would thus stop KSA from deriving economies of scale and would require equipment to be specially designed for that market. Equipment vendors may be reluctant to develop such equipment, or may charge very high prices for it, as they would be unable to spread their fixed costs over a very large user base, and ultimately this would translate into higher prices for consumers. It is also possible that devices would have less functionality, and might perform less well, as a result of more-limited investment in research and development (R&D) for devices being developed for an individual country.

RTT's report *RF Cost Economics for Handsets* found that manufacturers will find it difficult to justify developing handsets for individual markets, particularly those that account for a small proportion of the global handset market. The report also found that the impact of non-standard band allocations on device costs could be substantial for small or medium-sized markets. This is because of additional costs such as R&D for new devices and equipment, as well as the development of production processes that could potentially be significantly different from those used to produce devices and equipment compatible with the harmonised spectrum bands.

Figure 4.12 on the next page shows the relationship between the additional cost per device using non-standard chipsets and the annual volume of device purchases in the corresponding market. The numbers should be compared to USD30, the reference cost for a device using harmonised bands and produced for the global market.

The macroeconomic model Analysys Mason has used to estimate the socio-economic benefits calculates revenues from equipment sales based on the number of subscribers and assuming an average equipment lifetime of two years. In the base case (where harmonised spectrum is released by 2013), the potential demand for LTE mobile broadband devices in KSA can be estimated at approximately 1.8 million per year in 2013, rising to 17.9 million by 2020. Based on the chart in Figure 4.12, this would indicate that the average increase in cost per device in KSA from non-standard chipsets that have to be 'custom made' for the country's operators would start at around USD162 (SAR605) in 2013 and then (if spectrum is released in 2013) fall to approximately USD17 (SAR65) per device by 2020.

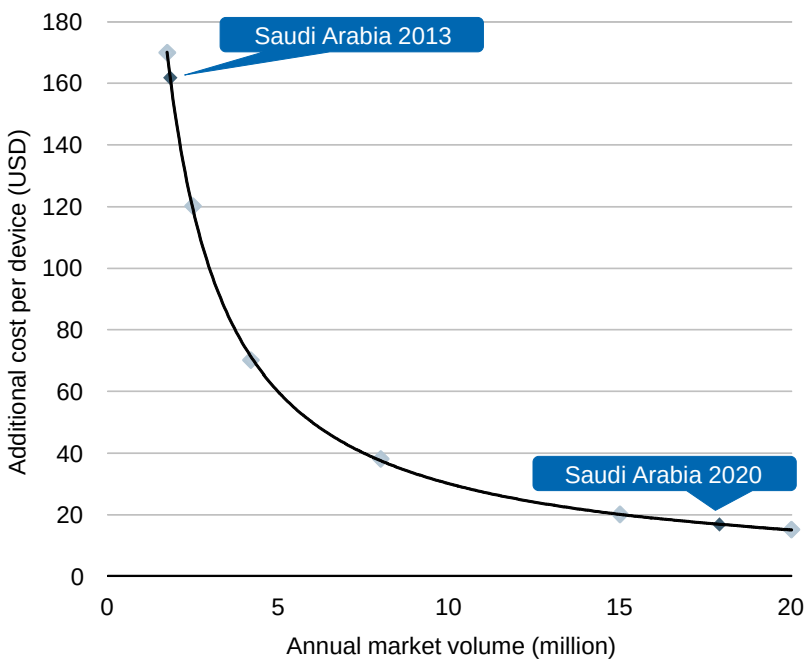


Figure 4.12: Relationship between additional cost per device using non-standard chipsets and the size of the market [Source: Analysys Mason based on RTT report on RF Cost Economics for Handsets]

This increase in cost per device would represent an average annual cost of SAR1.1 billion between 2013 and 2020 for the industry (and ultimately for consumers). This would obviously have a massive impact on the success of mobile broadband in KSA and would probably result in a much lower penetration than assumed in the scenario where harmonised 800MHz and 2.6GHz spectrum is released by 2013.

Cross-border interference

One of the major challenges for spectrum management is to tackle the problems of interference among different users of spectrum in neighbouring countries. As a general rule, operators use co-ordinated frequency assignments to mitigate interference that arises if the same spectrum is assigned to different network operators in neighbouring areas. However, if those geographical areas are in different countries, there is a reliance on commitment to the ITU and its Radio Regulations, whereby the signatories should manage their national spectrum in a manner that prevents cross-border interference.

The methods typically used to counteract any interference that arises are for the countries on both side of the border to agree to reduce the power of their transmissions or to tilt those antennae which are close to the border. Such mitigating activities involve significant costs as they typically result in a reduction in the radius of the cell sites close to the border and so there is a need for more sites to provide the same coverage. An alternative method of minimising cross-border interference is to add filters; however, this increases the operators' costs, and often leads to higher prices for consumers. Estimates of the cost of such filtering have suggested it may be up to USD60 million per "mode of transmission border" in a country of roughly 15 000 sites.[23] This is especially

[23] Source: GSMA.

pertinent, as the 800MHz spectrum that is often used for LTE is known for its strong propagation and could therefore result in significant interference effects. The need for mitigation techniques decreases when the same technology is used on both sides of the border. The most cost-effective manner in which countries can minimise problems with interference is therefore to ensure regional spectrum harmonisation, thus increasing technical efficiency.

4.3 Impact on consumers

A move towards allocating harmonised spectrum would deliver the highest benefits to KSA consumers. In particular, those benefits include a greater ability to meet end-user roaming requirements and an expansion in the choice of mobile devices available to consumers.

Roaming

Using harmonised spectrum bands for mobile broadband services leads to significant benefits with regard to ease of roaming. The existence of an international base of users for the spectrum band makes it easier for operators to make an international roaming service attractive to customers.

Although multi-band technologies are capable of overcoming the incompatibilities between different spectrum plans, they require multiple radio interfaces, which drives up the cost of development and manufacture. Such multi-band handsets do exist, but tend to be used to offer multiple harmonised rather than non-harmonised bands.

Device choice

Spectrum harmonisation leads to expansion in the market for equipment due to its capacity to globalise the market and thus bring lower prices on handsets to consumers. Fragmentation of the allocation of spectrum creates delays in the development of features and service inter-operability and reduces the diversity of devices available to consumers.

Harmonisation can drive down device prices as it leads to the capability to produce large volumes of handsets and other equipment, thus allowing the large upfront costs (such as those related to R&D and setting up factories) to be shared among a sufficiently large number of equipment manufacturers, who are willing to invest because of the large user base that exists across wide markets. A GSMA analysis of the value of harmonising spectrum found that markets for a handset would only be economically viable with more than 100 million sales of that handset per annum.[23] Furthermore, harmonisation reduces the time to market compared to that in countries which follow a non-internationally harmonised plan. The provision of extra band capabilities in a device can reduce the available range and data rates and increase the cost of service delivery.

Standardisation and spectrum harmonisation represent the most time- and cost-efficient path towards interoperability of networks.

KSA's population of approximately 27 million[24] is expected to grow to close to 35 million by 2015. Even assuming the most optimistic success for mobile broadband in KSA, the size of the market would be significantly smaller than the 100 million level discussed above. This means that KSA subscribers would face not only expensive handsets (as discussed in the previous sections), but also a significant reduction in the variety of devices available. In particular, many of the most desired smartphones that support LTE (available internationally) would simply not be available in the KSA market.

[24] Source: Euromonitor.

Annex A About Analysys Mason and the authors

A.1 Analysys Mason's consulting services

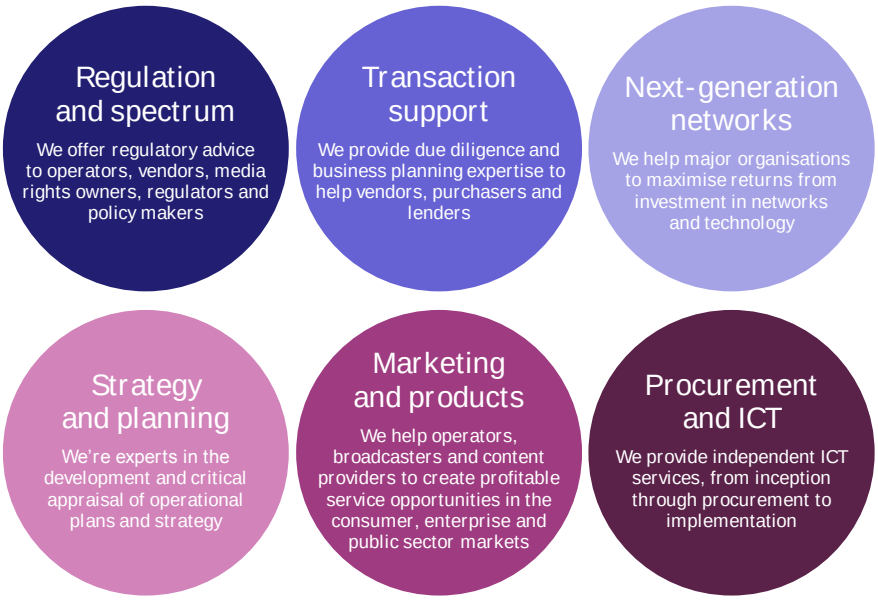
For more than 25 years, our consultants have been bringing the benefits of applied intelligence to enable clients around the world to make the most of their opportunities

Unlike some consultancies, our focus is exclusively on TMT. We advise clients on regulatory matters, support multi-billion dollar investments, advise on network performance and recommend commercial partnering options and new business strategies. Such projects result in a depth of knowledge and a range of expertise that sets us apart.

We look beyond the obvious to understand a situation from a client's perspective. Most importantly, we never forget that the point of consultancy is to provide appropriate and practical solutions. We help clients solve their most pressing problems, enabling them to go further, faster and achieve their commercial objectives.

We blend our range of skills each day, every day, to solve our clients' most-complex challenges

Our skill set is broad. It has to be. Our clients in the TMT sectors operate in dynamic markets where change is constant. We help shape their understanding of the future so they can thrive in these demanding conditions. To do that we have developed rigorous methodologies that deliver real-world results for clients around the world.

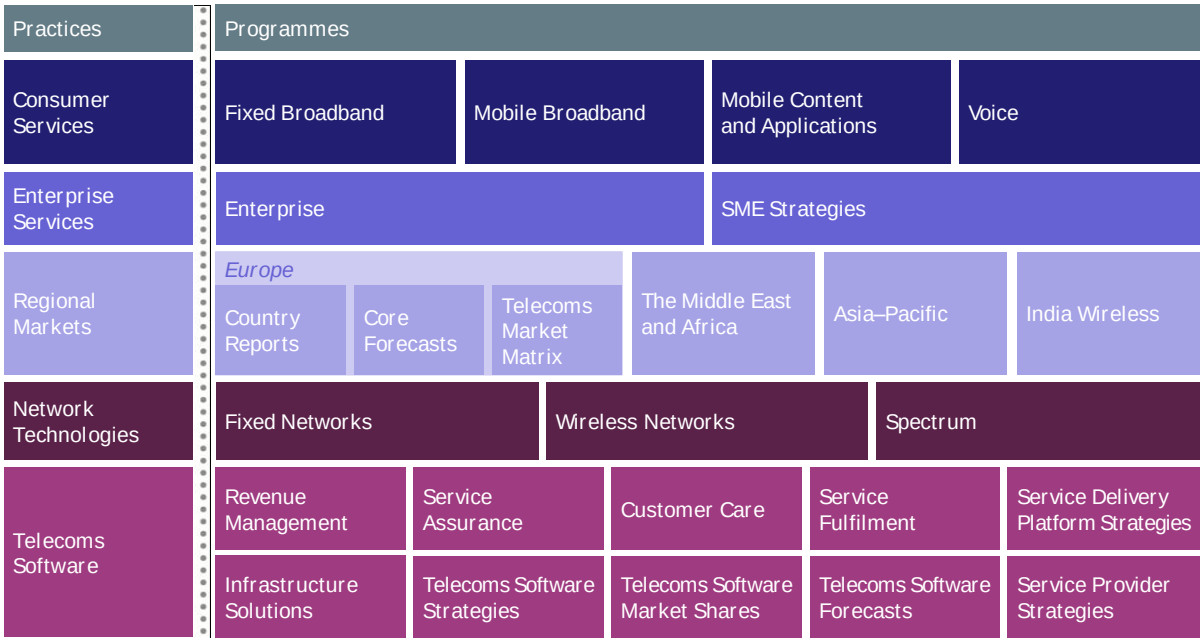


For more information about our consulting services, visit www.analysysmason.com/consulting.

A.2 Analysys Mason's Research Division

Our subscription research programmes address key industry dynamics in order to help clients interpret the changing market

The programmes focus on five key areas:



We analyse, track and forecast the different services accessed by consumers and enterprises, as well as the software, infrastructure and technology that underpin the delivery of those services. Subscribing to our research programmes gives you regular and timely intelligence. It also provides direct access to our team of analysts – that is, the opportunity to engage one-to-one with our subject experts for insight, opinion and practical advice relating to your most-critical business decisions.

Take advantage of this service and you'll be in good company. Many of the world's leading network operators, vendors, regulators and investors subscribe to our programmes and rely on our insight on a daily basis to inform their decision making.

Our customised research service offers in-depth, tailored analysis that addresses specific issues to meet your exact requirements

Our experienced custom research team can undertake market sizing and analysis, and competitor and partner profiling, supported by all the analysis and insight you require. In addition, we can carry out expert interviews and quantitative surveys to obtain fresh and genuine insights, and we can deliver reliable benchmark data together with first-class interpretation and advice on getting the best from such information.

For more information about our research services, visit www.analysysmason.com/research.

A.3 The project team

Janette Stewart (Senior Manager) specialises in wireless and spectrum consulting, with more than 20 years of experience in radio engineering and spectrum management. She managed our study to investigate the economic value of alternative uses of UHF Band IV/V spectrum in Russia for the GSMA and contributed to studies undertaken for the EC, NITA and Ofcom on the digital dividend and 2.5GHz spectrum bands.

Gilles Monniaux (Manager) is an experienced consultant with over 10 years' experience in the telecoms sector. He has worked on a range of spectrum-related projects and has also been very active in regulatory costing projects for European regulators. Gilles was also a member of our team working on the 'Total solution costs study in the embedded mobile (M2M) space' study for the GSMA last year.

Alex Reichl (Associate Consultant) has worked on a range of market analysis engagements during her time at Analysys Mason. Her recent experience includes work for European regulators and an investigation of the barriers to broadband video enablement in South America. Alex gained a BA in Economics from the University of Cambridge in 2011, with her dissertation in the field of Labour Economics.

Annex B The GSMA and its 'Spectrum for Mobile Broadband' campaign

B.1 The GSMA

The GSMA represents the interests of the worldwide mobile communications industry. Spanning 219 countries, the GSMA unites nearly 800 of the world's mobile operators, as well as more than 200 companies in the broader mobile ecosystem including handset makers, software companies, equipment providers, Internet companies, and media and entertainment organisations. The GSMA is focused on innovating, incubating and creating new opportunities for its membership, all with the end goal of driving the growth of the mobile communications industry.

B.2 The Spectrum for Mobile Broadband campaign

Mobile networks could make broadband universally available to people across developed and emerging markets, significantly contributing to the socio-economic wellbeing of societies around the world. Mobile broadband could have a particularly positive impact in less-developed countries which have limited fixed-line infrastructure. Numerous studies have found the widespread use of broadband stimulates economic activity, increases productivity and creates jobs.

The GSMA runs an ongoing global campaign to secure the spectrum required to meet the fast-growing demand for mobile broadband.

Data traffic on existing mobile broadband networks is growing exponentially as consumers and business users increasingly use smartphones, laptop dongles, tablets and other devices to access the Internet, email, business applications, social networks and many other online services.

Although there is scope for operators to repurpose, or re-farm, the spectrum bands allocated to second-generation mobile services to carry mobile broadband services, they will also need new spectrum to provide additional capacity.

Full mass-market usage of mobile broadband, particularly in densely-populated or heavily-visited areas, will depend on more spectrum becoming available. Mobile data traffic is growing far faster than experts anticipated. In 2005, the ITU forecast that worldwide mobile traffic would increase from around 610 PB per year in 2010 to around 1450 PB per year in 2020 – in reality, in 2010 mobile traffic was seven times the 610 PB forecast.[25]

The development of mobile broadband devices and services requires significant investment by the industry and, therefore, regulators need to ensure that they draw up transparent and stable long-

[25] Source: ITU, Analysys Mason.

term spectrum policies and ensure that each spectrum-related decision is consistent with these policies.

It is crucial that operators and manufacturers can develop new products and services in a clearly-defined and stable regulatory environment, confident in the security of spectrum allocations.

Annex C Macroeconomic model of the socio-economic benefits of allocating 800MHz and 2.6GHz spectrum for mobile broadband by 2013

C.1 Outline of macroeconomic model

Analysys Mason has developed a macroeconomic model to estimate the socio-economic benefits of releasing 140MHz of spectrum at 2.6GHz and 60MHz of digital dividend spectrum at 800MHz and allocating this for mobile broadband in KSA.

The model follows the three steps outlined below to calculate the socio-economic benefits of allocating harmonised mobile broadband spectrum:

1) It assesses the impact of harmonised allocation of 800MHz and 2.6GHz spectrum on mobile broadband penetration
2) It assesses the impact of mobile broadband penetration on GDP
3) It assesses the impact of GDP growth on employment.

This three-step analysis is undertaken for the following three scenarios:

- no harmonised 2.6GHz or 800MHz spectrum is released (counterfactual case)
- harmonised 2.6GHz and 800MHz spectrum is released in 2013 (base case)
- harmonised 2.6GHz and 800MHz spectrum is released in 2018 (five-year delay case).

This annex illustrates the estimation of socio-economic benefits under the base case, where harmonised 2.6GHz and 800MHz spectrum is released in 2013.

C.2 Step 1: Impact of spectrum allocation on mobile broadband penetration

The first step in the macroeconomic model is to assess the impact on mobile broadband penetration of allocating harmonised 800MHz and 2.6GHz spectrum.

The release of both 800MHz and 2.6GHz provides additional capacity and means that the expected increase in the total number of mobile broadband subscriptions (both handset mobile broadband subscriptions[26] and dedicated mobile broadband subscriptions[27]) is not limited by spectrum capacity issues or limited to only 3G services, as would be the case without this spectrum release.

[26] That is, "subscriptions to voice SIMs with use of data communications at broadband speeds" as measured by CITC [Source: *ICT Indicators in K.S.A. (End of H1 2011)*].

[27] That is, "subscriptions to dedicated data SIMs" as measured by CITC [Source: *ICT Indicators in K.S.A. (End of H1 2011)*].

In addition, the release of 800MHz provides greater coverage than 2.6GHz and means that household mobile broadband penetration (typically provided over dedicated mobile broadband subscriptions[27]) is not limited to urban areas.

Figure C.1 below summarises how we expect mobile broadband subscriptions to evolve if 2.6GHz and 800MHz spectrum is allocated to mobile broadband and released by 2013.

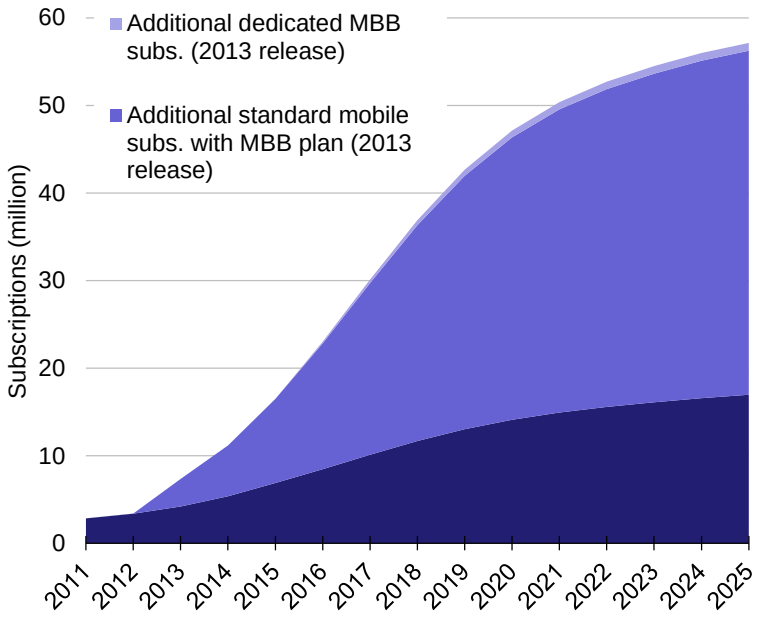


Figure C.1: Expected mobile broadband subscriptions assuming additional spectrum is released by 2013 [Source: Analysys Mason]

C.3 Step 2: Impact of mobile broadband penetration on GDP

The second step in the macroeconomic model is to assess the impact of mobile broadband penetration on GDP.

This analysis takes into account three different types of macroeconomic impact:

- the **direct** impact of greater penetration of broadband services
- the impact of mobile broadband services on related economic sectors within the **ecosystem**
- the **second-order** impact of mobile broadband services in terms of productivity gain.

Figure C.2 below shows the impact of mobile broadband on GDP by 2020 assuming that 140MHz of harmonised spectrum at 2.6GHz and 60MHz of digital dividend spectrum at 800MHz is released and allocated for mobile broadband in KSA by 2013.

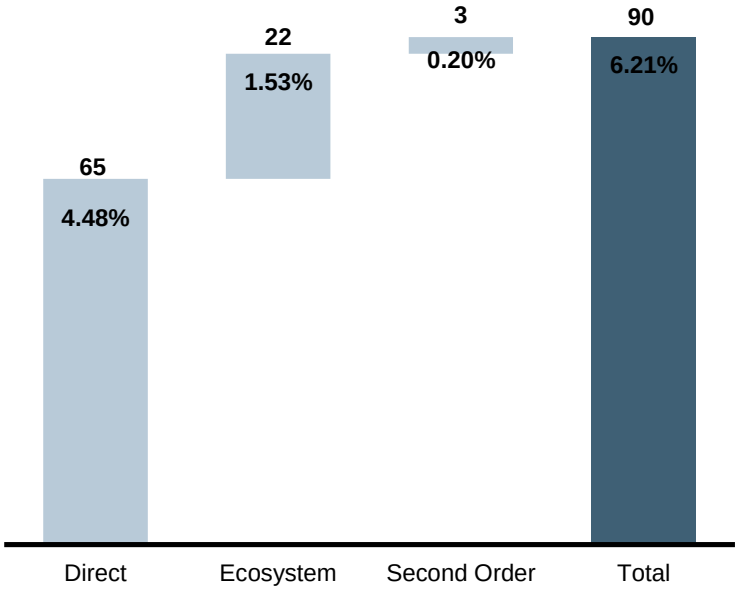


Figure C.2: Total impact of mobile broadband spectrum on GDP, 2020 (SAR billion) [Source: Analysys Mason]

C.3.1 Direct impact

The direct impact is due to revenue from the sale of additional wireless broadband services and devices. We estimate that mobile broadband will have a total direct revenue impact of SAR65 billion (4.48% of GDP) by 2020, and of SAR75 billion (4.05% of GDP) by 2025, as shown in Figure C.3 below.

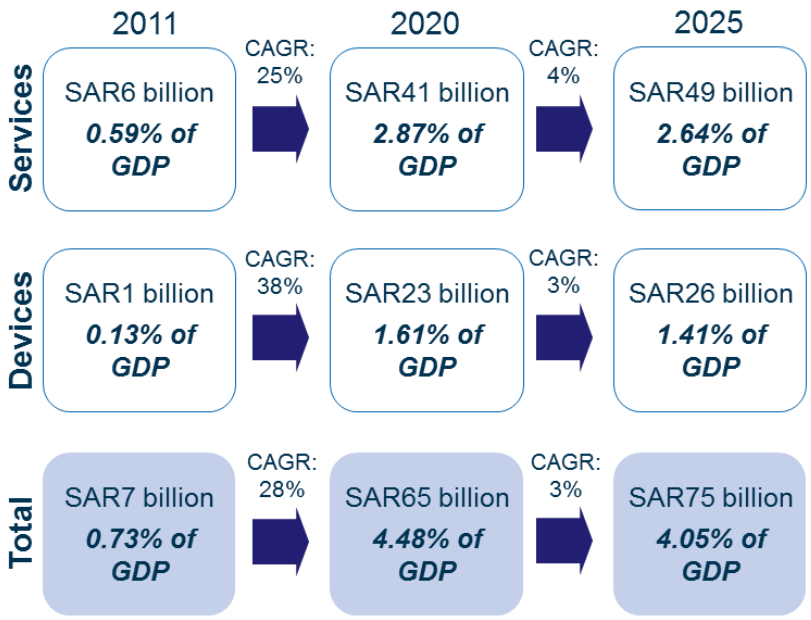


Figure C.3: Direct revenue impact from mobile broadband [Source: Analysys Mason, 2012]

The rest of this section describes separately the impact from the sale of additional wireless broadband services and the impact from the sale of additional devices.

Services

Consumers will drive service take-up, as more cybercafé users opt for personal broadband access. Revenue from enterprises is not expected to exceed that from consumers during the forecasting period (i.e. until 2025) due to the relatively small formal enterprise sector in KSA. By that same year, we expect total service revenue to be SAR49 billion (as shown in Figure C.4), with the enterprise segment contributing approximately 7% of the revenue.

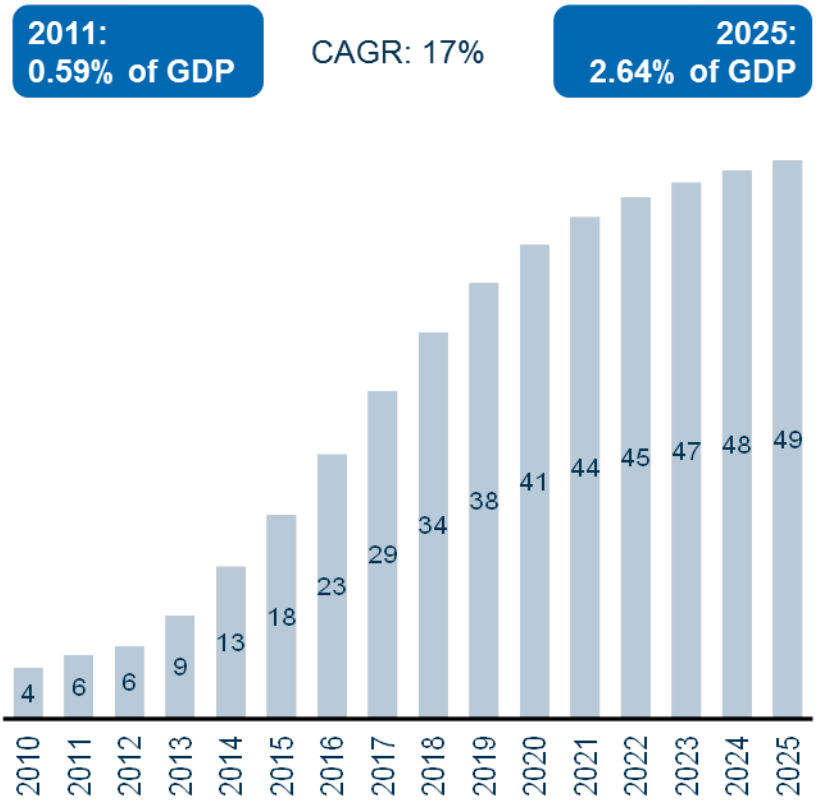


Figure C.4: Projections for spending on mobile broadband services (SAR billion) [Source: Analysys Mason, 2012]

Devices

We believe that consumer mobile broadband usage will be driven by a rise in increasingly affordable and feature-rich smartphones, followed by dedicated mobile devices such as dongles. We expect enterprises to use a similar mix of smartphones and dedicated mobile devices such as dongles. The total broadband device market size is expected to be SAR26 billion in 2025 (as shown in Figure C.5 below), with the enterprise segment contributing approximately 3% of the revenue.

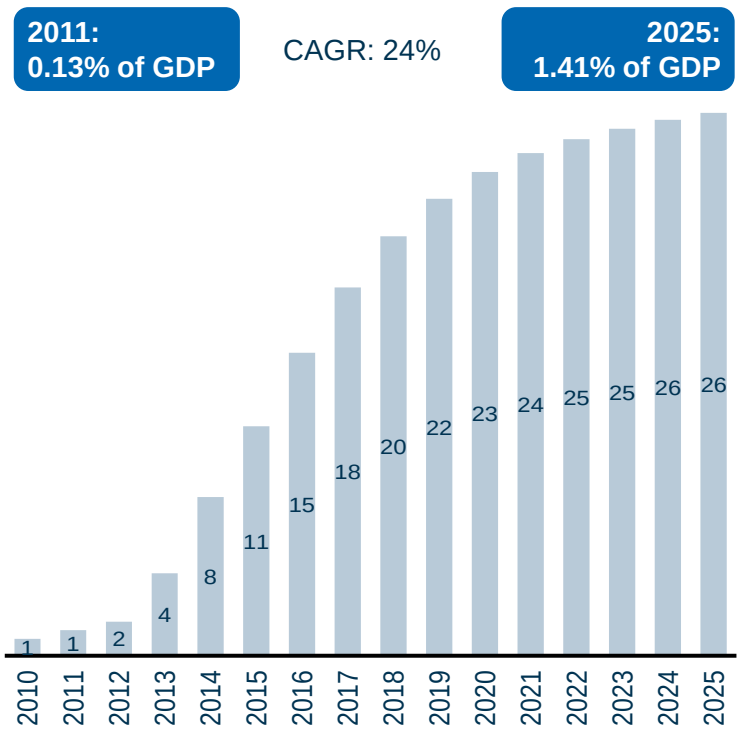


Figure C.5: Projections for spending on mobile broadband devices (SAR billion) [Source: Analysys Mason, 2011]

C.3.2 Impact on the ecosystem

The 'ecosystem' in this case refers to goods and services that rely particularly on Internet connectivity for their delivery. Ecosystem revenue accrues to a variety of players, including entrepreneurs, existing real-world businesses that develop an online presence, advertisers and international firms. The ecosystem impact reflects the fact that KSA's digital economy would benefit from government commitments to provide online services and access to data.

The analysis of the quantitative impact of mobile broadband on related economic sectors within the ecosystem was done using the analysis grid presented in Figure C.6. That same grid is used in Section D.2.2 of Annex D to presents the qualitative analysis of the effect of the mobile broadband value chain on the ICT ecosystem.

Figure C.6: High-level impact of mobile broadband on the entire ICT ecosystem [Source: Analysys Mason]

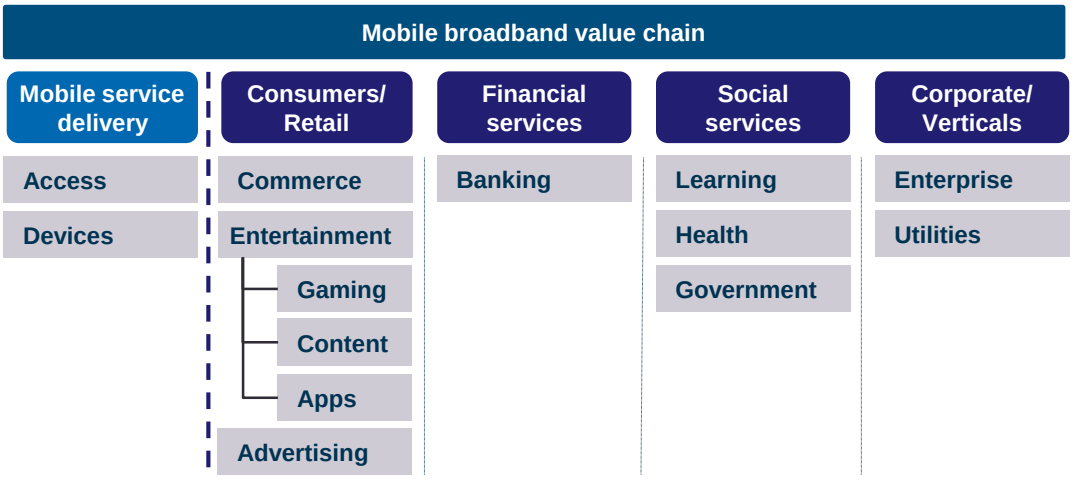


Figure C.7 below shows the evolution over time of ecosystem revenues from retail, financial services, social services and corporate services.

Figure C.7: Mobile broadband ecosystem revenues from retail, financial services, social services and corporate services (SAR billion) [Source: Analysys Mason, 2012]

Sector	2011	2015	2020	2025
Retail services	**1.7**	**4.7**	**10.7**	**14.0**
– Advertising	0.0	0.2	0.7	1.5
– Content	1.0	3.1	7.0	8.2
– Gaming	0.1	0.4	0.8	1.0
– Apps	0.0	0.2	0.5	0.6
– Commerce	0.5	0.8	1.6	2.7
Financial services	**2.9**	**4.0**	**6.1**	**8.2**
– Banking	2.9	4.0	6.1	8.2
Social services	**1.2**	**2.4**	**2.4**	**2.5**
– Learning	0.1	0.2	0.3	0.6
– Health	0.8	1.7	1.4	1.3
– Government	0.2	0.5	0.7	0.6
Corporate services	**0.4**	**1.2**	**2.9**	**3.4**
– Farming	0.0	0.0	0.0	0.0
– Enterprise	0.3	0.7	1.3	1.4
– Utilities	0.1	0.5	1.5	2.0
Total	**6.3**	**12.3**	**22.1**	**28.1**

Content is the fundamental driver for growth in retail consumption, followed by commerce[28] and gaming.[29]

We expect financial services to become a relatively important component of the KSA mobile broadband ecosystem, essentially due to the importance of overseas remittances. In addition, online and mobile banking are becoming popular in KSA, as discussed in Annex D (Section D.2.2).

M-health applications are likely to be the main driver of value-added services from social services, because of the additional applications and benefits they can provide.

28 As indicated in Section D.2.2 of Annex F, e-commerce is still at an early phase of development and implementation in Saudi Arabia, and represents an opportunity for further growth based on both wireless access to wired devices and mobile-specific applications.

29 As discussed in Section D.2.2 of Annex F, online gaming is very popular in Saudi Arabia.

C.3.3 Second-order impact (productivity and efficiency gains)

Industrial productivity in the wider economy rises as workers increasingly use email and electronic file exchange, have quicker access to business-critical information, and can access more-distant customers and suppliers. Improved broadband also increases the attractiveness of KSA to foreign investors. Analysys Mason expects that mobile broadband will create SAR29 billion of indirect value from 2011 to 2020, mostly outside the oil industry, as shown in Figure C.8.

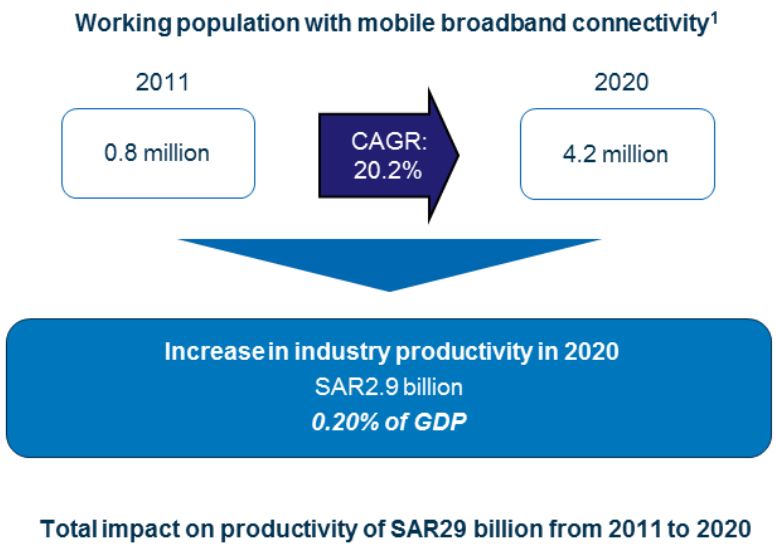


Figure C.8: Estimate of impact on productivity due to mobile broadband [Source: Analysys Mason, 2012][30]

The service industry will benefit the most from mobile broadband services, as shown in Figure C.9 below.

Industry vertical	Industry contribution to GDP in 2020	Share of increase in productivity in 2020
Manufacturing, mining and industry	11%	9.1%
Services	58%	88.8%
Agriculture	4%	2.1%
Other (e.g. oil sector)	27%	0%
Total	100% (SAR1 443 billion)	100% (SAR2.9 billion)

Figure C.9: Distribution among industries of productivity gains due to mobile broadband (2020) [Source: Analysys Mason, 2012]

Enhanced growth in the services and non-oil industrial sectors will support the diversification of the economy. We also expect that increased productivity in the agricultural sector can support rural economic development. Mobile broadband can therefore play a valuable role in these sectors by helping the KSA economy to diversify away from petroleum products.

30 Includes retail mobile broadband connections used for official/business purpose and corporate connections.

C.4 Step 3: Impact of GDP growth on employment

The final step in the macroeconomic model is to assess the impact of GDP growth on employment.

This analysis follows from the second step by converting the GDP gains into additional jobs using the GDP-to-employment ratio implied by third-party GDP and employment forecasts.[31]

Figure C.10 presents the additional jobs resulting from spectrum being released by 2013.

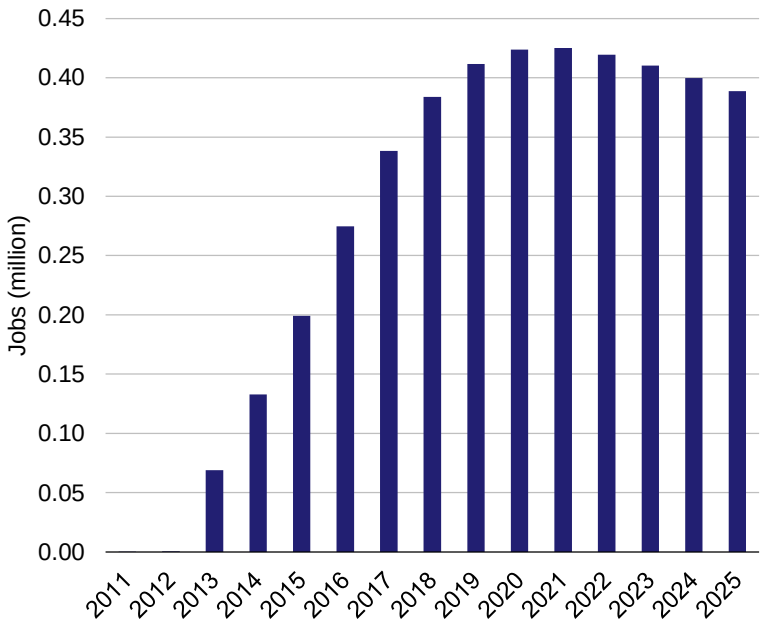


Figure C.10: Impact of spectrum release by 2013 on employment in KSA [Source: Analysys Mason, 2012]

31 GDP data sourced from Central Department of Statistics and Information, *KSA Econ in figures 2010* (for actuals), and the EIU (for future growth); employment data sourced from Euromonitor until 2020 and an extrapolation of those numbers after 2020.

Annex D Overview of broadband services and the ICT ecosystem in KSA

D.1 Overview of broadband services in KSA

D.1.1 Macroeconomic overview of KSA

Growth perspective and GDP breakdown

KSA's nominal GDP reached USD435 billion at the end of 2010[32] and continues to grow rapidly (expected GDP growth in 2011 stands at 6.7%).[33] Although nominal GDP declined in 2009 due to the financial crisis, 2010 saw a strong increase, with expected sustained future growth. KSA's GDP growth rate is forecast to be ahead of most benchmark Middle Eastern countries, as shown in Figure D.1.

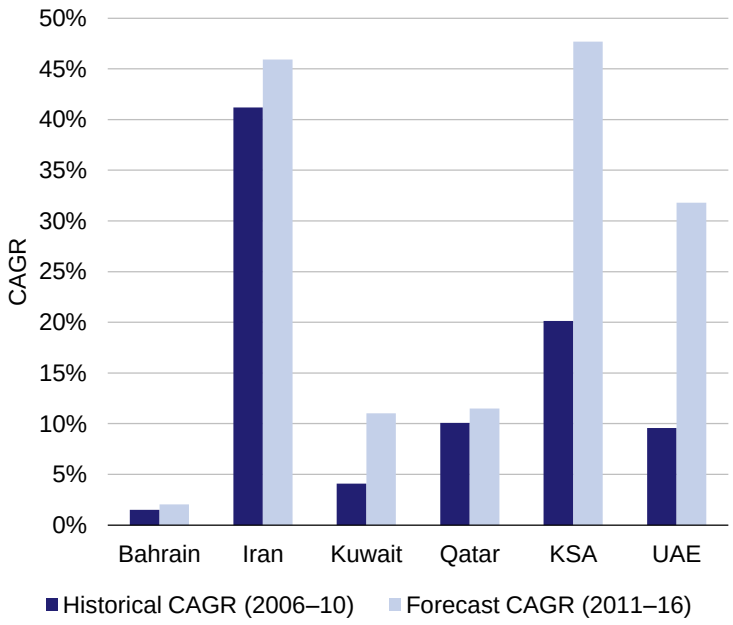


Figure D.1: GDP growth rate in KSA and benchmark countries [Source: EIU]

Historically, KSA's growth has been driven by the oil sector, with further strong performance from the service sector. There is a continuing shift away from agriculture and towards industry and services. While both the industry and service sectors are expanding, services have overtaken industry as the dominant source of GDP. Between 1980 and 2010, industry's contribution to GDP fell from 57% to 40%, while the proportion of GDP originating in services rose from 37% to 45%,[33] as shown in Figure D.2. Economic expansion in 2010 was driven in particular by a buoyant construction sector,

32 Source: World Bank.

33 Source: EIU.

with sector growth predicted to remain at 4% per annum until 2015.[34] To indicate the importance of construction to the KSA economy, it provided employment to 9% of the KSA labour force.[35]

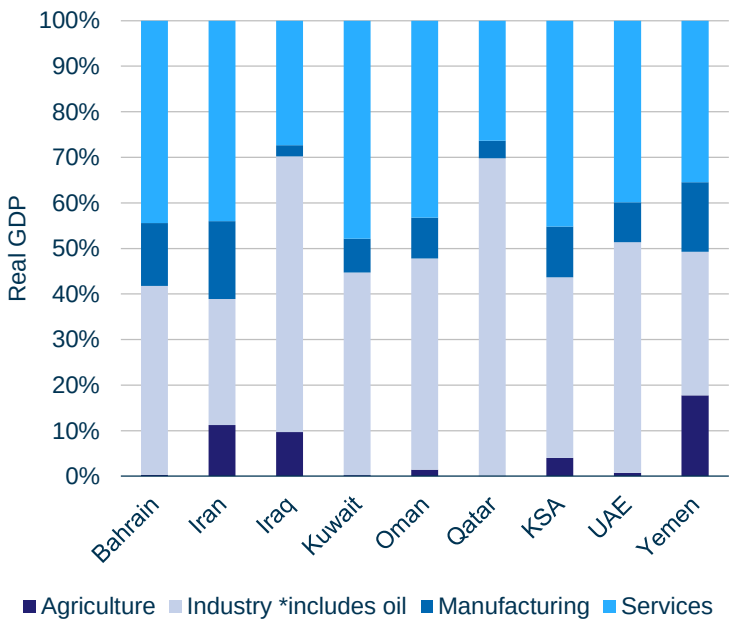


Figure D.2: GDP breakdown by sector in KSA and benchmarks (2010) [Source: EIU]

Focus on the oil sector and diversification

The KSA economy has historically been heavily reliant on the oil sector, with roughly 80% of budget revenues, 37% of GDP and 90% of export earnings originating from this sector. This economic contribution of oil reflects the fact that the country possesses about 20% of the world's known petroleum reserves.[36]

While the oil sector is the biggest contributor to GDP with SAR314 billion (USD84 billion) revenues in 2009 (as shown in Figure D.3), government services come in second, , contributing SAR151 billion (USD40 billion) in 2009. Crude oil and natural gas contribute SAR199 billion (USD53 billion) or 63% of total oil sector revenues, the rest being import duties and manufacturing.[37]

34 Source: Business Monitor International.
35 Source: Euromonitor.
36 Source: CIA World Factbook.
37 Source: CDSI.

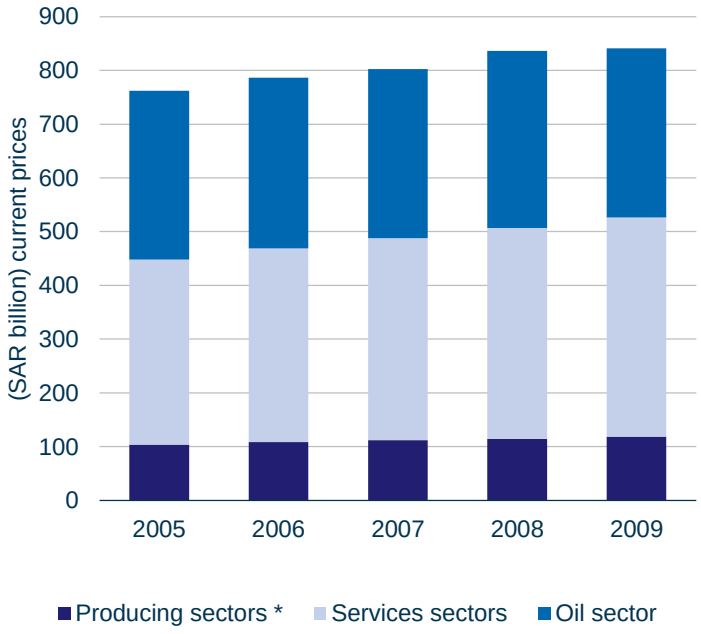


Figure D.3: GDP breakdown by sector [Source: CDSI][38]

KSA is looking to develop non-oil sectors to reduce its financial dependency on oil. Diversification is important for both GDP and employment growth as it has the capacity to create jobs and to maintain steady revenue flows to counteract the potentially wild fluctuations in oil prices.

The KSA government's pursuit of diversification has been particularly prevalent since KSA's accession to the World Trade Organisation in December 2005. The government has encouraged private sector growth and has promoted foreign investment, particularly in the power generation, telecoms, natural gas exploration and petrochemical sectors. Key initiatives in this process have included the establishment of six "economic cities",[39] which will offer benefits to businesses locating there, including access to state-of-the-art technology infrastructure and business-friendly regulatory environments.

There is already evidence of success from the government's diversification efforts; the share of GDP from oil (excluding manufacturing) fell from 33% in 2003 to 25% in 2009. The government announced plans to capitalise on this success by spending USD373 billion on social development and infrastructure projects between 2010 and 2014, to advance KSA's economic development.[36]

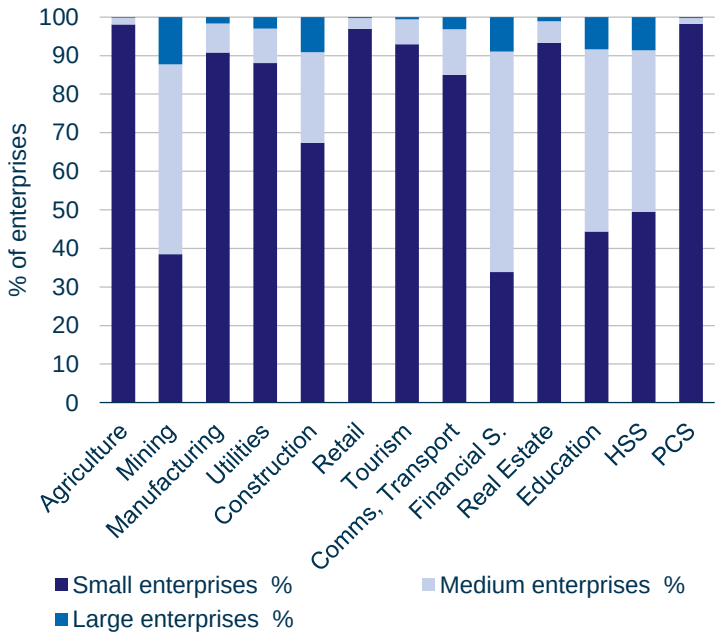
Business perspective

The KSA economy is dominated by small firms as can be seen in Figure D.4; in 2008, private-sector enterprises numbered 823 500, 94.2% of which were small enterprises. Wholesale and retail trade firms made up the largest part of those small enterprises, accounting for 48.3% of the total. Meanwhile, medium-sized enterprises account for a high proportion of the firms engaged in financial

38 Note: 'Producing sectors' include: agriculture, forestry & fishing; mining and quarrying; electricity, gas & water; building & construction. 'Services sectors' include: trade, hotels etc.; transport, storage & communications; finance, insurance & real estate etc.; community, social & personal services; government services. 'Oil sector' includes: crude oil & natural gas; import duties; manufacturing.

39 Note: Tabouk, Hail, Medinah, Rabigh, Jazan, Eastern Provinces.

services, education, health and social services, mining and construction. However, large-sized enterprises account for only a small percentage (1.0%) of the total.[40]



Note: Financial S. = financial services, HSS = health and social services, PCS = public and community services

Figure D.4: Distribution of private companies by size and industry [Source: 9th Development Plan]

KSA is emerging as a regional leader for business, and the *Doing Business* report issued by the IFC of the World Bank in 2009 ranked KSA 13th out of 183 countries for business environment (first out of Middle Eastern countries).[41] This high ranking is particularly attributable to KSA's strong performance in areas such as:

- the rapid rate of economic growth as a result of economic sector reform
- the high level of property protection (ranked first in the world).

Employment/education challenges

With a domestic labour force of 8.6 million[33] and unemployment reaching 462 100 in 2010,[35] KSA is experiencing relatively high unemployment among its own nationals for a country whose economy is growing as strongly as indicated previously.

Furthermore, there are nearly 6 million foreign workers in KSA, employed mainly in the oil and service sectors.[36] Figures from 2004 indicate that only 15% of foreign workers in KSA are engaged in skilled labour industries such as oil, healthcare, finance and trading, and that such positions are dominated by European and North American expatriates. The majority are employed in low-skilled

40 Source: 9th Development Plan.
41 Source: IFC.

industries (agriculture, cleaning and domestic service). These low-skilled workers are primarily from South and Southeast Asia.[42]

This apparent paradox that both unemployment and immigration co-exist can be explained by a skills deficit: a large proportion of youth unemployment (which stood at 28.24% in 2008[36]) is attributable to individuals both lacking the education and skills required to make them desirable for the highly skilled private-sector jobs and being overqualified for the low-skilled jobs available. This lack of professional opportunity represents a source of frustration for the KSA youth population.

The KSA job market is concentrated around public services, as seen in Figure D.5, with 37.1% of employment originating there. However, while the share from public services is falling marginally, trade and tourism, communications and financial services are increasing in importance, indicating growth in the private sector.

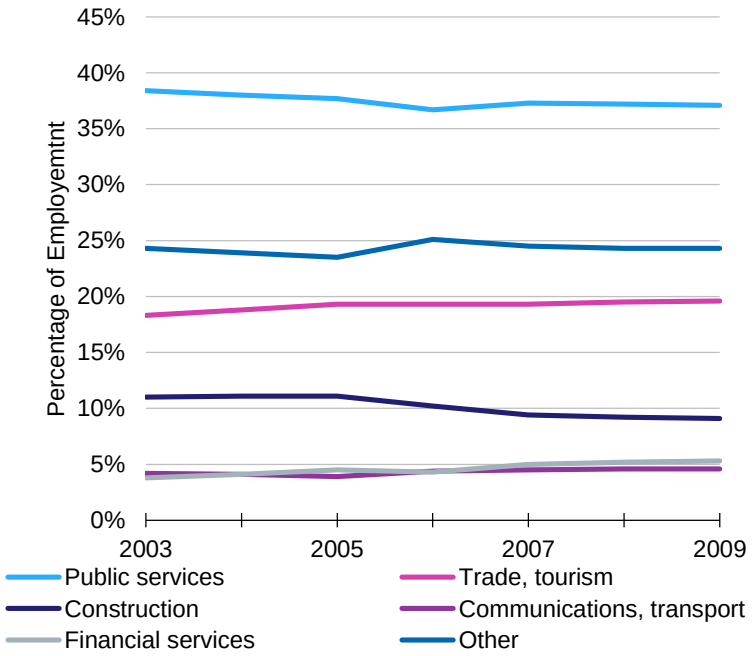


Figure D.5: Distribution of employment by industry [Source: Euromonitor]

The government has been proactive in introducing education reforms to improve the employment situation. Among various initiatives it is notable that there has been an increase in spending on education, with large projects such as the opening of KSA's first co-educational university (King Abdallah University of Science and Technology). Progress can be seen already:

- adult literacy in KSA currently stands at 87.3%, having grown steadily from 81.6% in 2003[35]
- the percentage enrolling in tertiary education rose from 18.9% of males and 26.2% of females in 2001 to 36.6% and 37.4% respectively in 2009[37]
- enrolment in technical and vocational training stood at 93 000 in 2009, up by 7.8% from the previous year[37]
- the unemployment rate in 2010 was 6.3%, down from its 2004 high of 7.7%.[35]

42 Source: migrationinformation.org

Demographic challenges

KSA has a young population, with about 32% of its population under 15 years of age at 1 January 2011, as shown in Figure D.6. Furthermore, the working age category (15–64 years) is the one with the highest growth projections.[35]

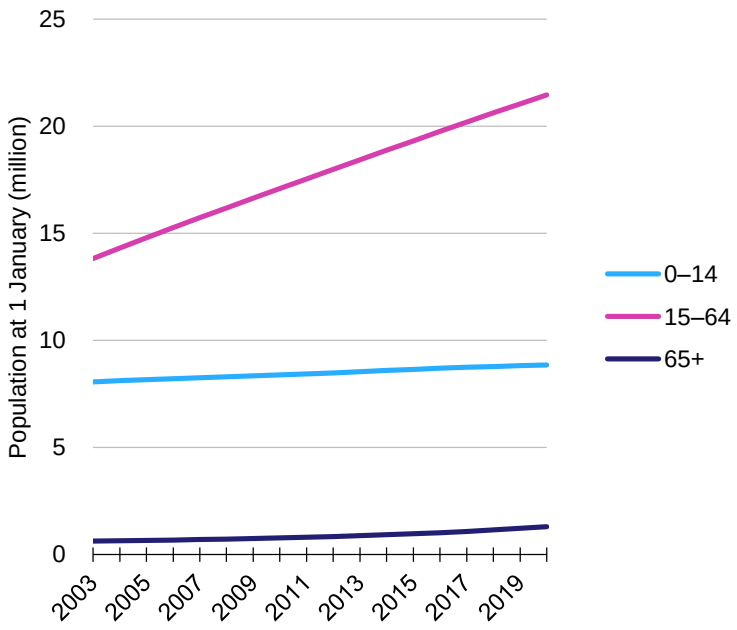


Figure D.6: Population distribution by age [Source: Euromonitor]

The ratio of urban to rural[43] population was 82:18 as of 2010; however, the urban population looks set to grow faster than the rural one, reaching 84% of the total population by 2020.[35] Average household size fell from 5.8 persons in 2003 to 5.4 in 2010, while households rose from 3.9 million to 4.9 million over the same period.[35] This sharp increase in households, combined with the urbanisation the country is experiencing, has led to problems due to a lack of housing, which represents another source of frustration for the KSA youth population.

There is a large spread of population density across the KSA regions, as shown in Figure D.7. Density can also vary dramatically within regions; for example, Riyadh city has the highest population density in the country, at 2525.5 per km^2 in 2008, while Riyadh region has an average density. The wide variations in density suggest that mobile broadband services in KSA need to have both sub-1GHz spectrum (which is best for coverage in rural areas) and spectrum over 1GHz (which is good for capacity in urban areas).

43 Towns or "localities" with a population of under 5000 are categorised as rural by CDSI.

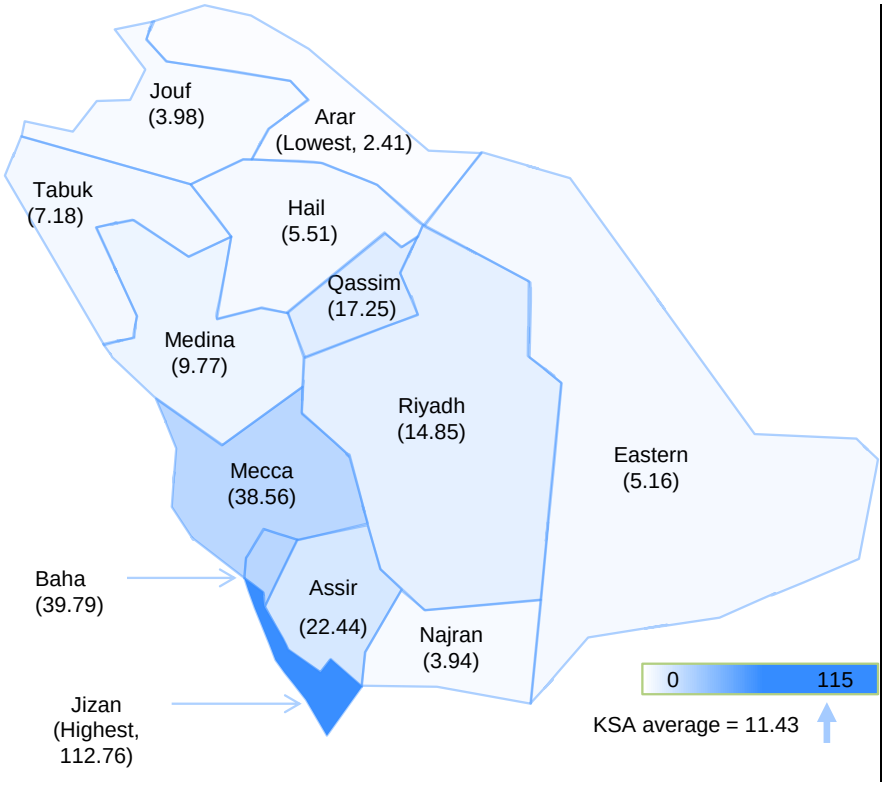


Figure D.7: Population density by region (population per km^2) [Source: CITC consultation on USF[44]]

D.1.2 The broadband sector in KSA

Broadband penetration

Figure D.8 shows the strong growth of both fixed and mobile broadband in KSA since 2004. This shift to broadband demonstrates that KSA's citizens understand the benefits of high-speed Internet. This is confirmed by survey evidence indicating that 70% of residential users in 2009 accessed the Internet daily, while a further 24% used it at least once a week.[45] Their motivations for this usage were predominantly browsing, communicating and searching for information.[46]

44 Universal Service Fund.

45 Source: *ICT Market Study (2009–2010)* from the CITC.

46 Source: CITC.

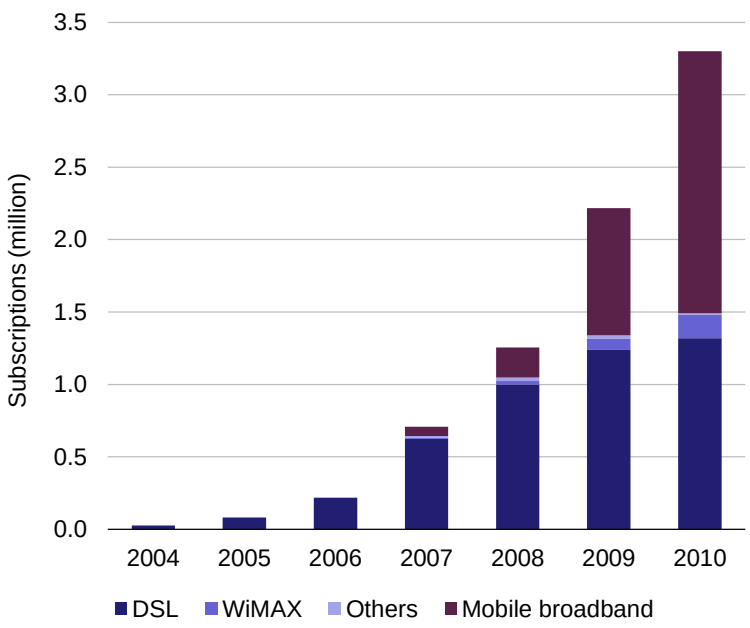


Figure D.8: Evolution of fixed and mobile broadband in KSA [Source: TeleGeography, CITC for mobile broadband[47]]

The introduction of competition to the KSA telecoms market has had a significant impact on residential prices and has most probably stimulated take-up of services; the average price per Mbit/s per month has fallen by a CAGR of 16.7% since 2007, to SAR159.84 per Mbit/s per month.[48] The range of services offered has also expanded significantly, especially services in the low-price category. Of the 22 fixed broadband services currently offered, 11 are priced at less than SAR200 (USD53) per month.[48]

Over the same time period, business Internet penetration rose continuously, from 52% in 2007 to 65% in 2009. Penetration is noticeably higher among large companies (85% of which had an Internet connection in 2009), while for small companies it trailed at 58% Internet penetration.[46] Finally Internet (specifically broadband) penetration is also increasing among health, education and government institutions in the country.

The growth of broadband in KSA is impressive. However, the examples of regional leaders in broadband development, such as Qatar, the UAE or Kuwait, as shown in Figure D.9, indicate that broadband in KSA may have the potential to go much further than the current 48% population penetration shown in Figure D.9.

47 Source: *CITC – ICT indicators H1 2011*, assuming the same proportion of dedicated mobile data subscriptions as in H1 2011.

48 Source: TeleGeography.

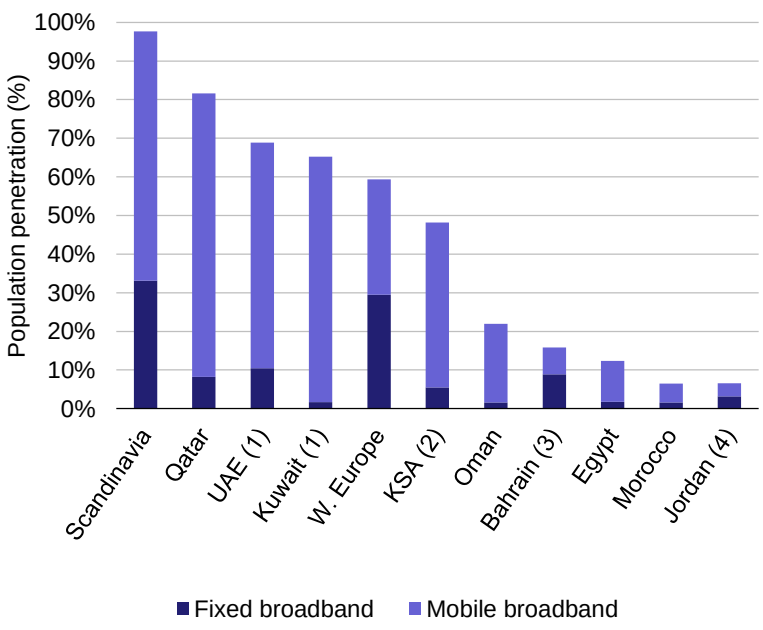


Figure D.9: Total broadband penetration in KSA and benchmarks,[49] 2010 [Source: ITU, TRC Jordan, Analysys Mason, TRA Bahrain]

(1) Estimated from ITU World Telecoms Indicators
(2) Estimated ITU and Analysys Mason Research
(3) Estimated based on a statement by TRA Bahrain that mobile broadband makes up 44% of the broadband customer base
(4) Estimated using 2011 data from TRC Jordan.

Analysis of the pricing of residential broadband services

Residential broadband can be divided into three downstream speed categories: low speed (<1Mbit/s), medium speed (1–8Mbit/s) and high speed (>8Mbit/s). The speed and price corresponding to the various fixed broadband offerings can be seen in Figure D.10.

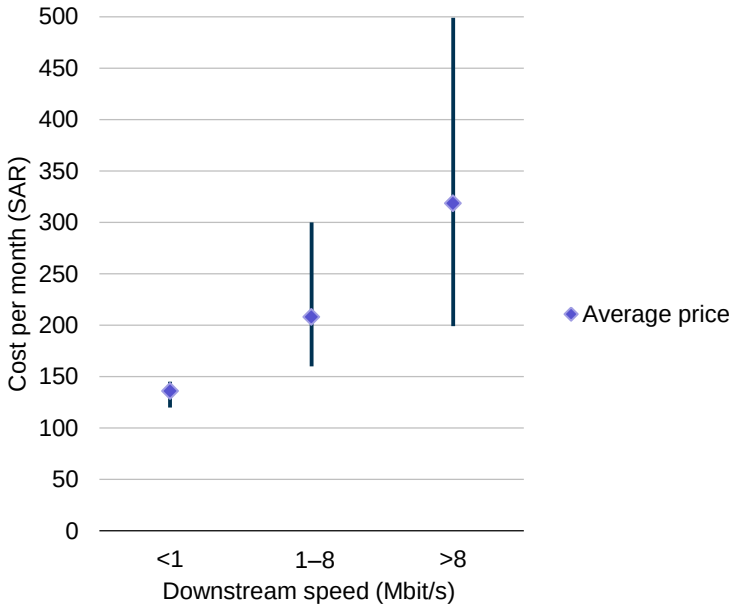


Figure D.10: Fixed broadband offerings by speed and price, October 2011 [Source: TeleGeography]

[49] Including "Mobile subscriptions with use of data communications at broadband speed".

Competition among fixed broadband providers (FBPs) in KSA starts from 256kbit/s access speed for residential uncapped services, and the lowest-price offer as of October 2011 was Mobily's "Mobily Broadband @ Home" package at SAR120 per month (USD31.95). Average household Internet speed in 2009 was in this basket; however, with annual growth of 82% this is unlikely to remain the case. This move away from low speed can be seen from the fact there are currently only four service offers in this basket.

Of the 11 medium-speed offers, the average price was SAR208 per month (USD55.38). However, as most of these offers are for fixed WiMAX connections, only STC's ADSL offering provides speeds higher than 2Mbit/s.

There are only four broadband services in the high-speed basket. However, with the revised Reference Offer for Data Access (RODA) announced by STC and the CITC in 2010, it is likely that more competition may enter this segment.

Fixed broadband

Fixed broadband has expanded rapidly in KSA and with four providers is now one of the most competitive markets in the Middle Eastern region, as seen in Figure D.11. Existing residential broadband service retail offers, as discussed in the previous section, reflect a mature market with well-established usage segments based on downstream speed categories.

Provider	Market position
STC	• Makes up 50% of the fixed broadband market • Provides DSL, WiMAX and FTTH services • STC is 70% owned by the government
Bayanat Al-Oula	• Founded in 2004 by local investors, bought out by Mobily in 2007 • Provides services via optical fibre, FTTx, Wi-Fi, nomadic and mobile WiMAX and WiBro
Etihad Atheeb Telecom	• Permitted to provide fixed and wireless services • Atheeb's network is based on mobile WiMAX and is compatible with next-generation technology
SITC	• Its national fibre-optic backbone Saudi National Fibre Network (SNFN) spans over 12 500km, covering 19 major cities, and offers an initial capacity amounting to 40Gbit/s

Figure D.11: Overview of fixed operators in KSA [Source: TeleGeography]

The KSA fixed broadband market has grown rapidly, with the fixed subscriber base increasing from 67 000 to 1.5 million between 2005 and 2010[48], as shown in Figure D.8. In fact, broadband subscriber numbers in KSA passed the 1 million mark based almost exclusively on fixed DSL services. However, that initial strong growth period appears to have stalled and new broadband subscribers now mainly use mobile broadband technologies.

Several factors can explain the stalling of fixed broadband growth in KSA:

- The current fixed xDSL services provided in KSA do not allow for capacity to be shared, and the bandwidth limitations are exacerbated by the distance sensitivity of this technology
- DSL coverage in KSA appears to be limited at 78.6% on average, with discrepancies between well-served regions and those with limited coverage, as seen in Figure D.12 below
- Further transition towards next-generation fixed access technologies (i.e. FTTC/VDSL or FTTH) would require an expensive new fibre access overlay network, and while fixed-line competition is limited, the large size of the country, the relatively low population density and the lower level of new-build housing as a proportion of total housing stock make nationwide roll-out of FTTx a less attractive commercial prospect than elsewhere in the region
- A prominent barrier to adoption of fixed broadband cited by KSA residents was computer affordability. Despite the fact that computer penetration among KSA residents has increased significantly (from 43% in 2007 to 51% in 2009), the availability of comparatively low-cost mobile broadband handsets in the KSA market will favour mobile broadband over fixed broadband.[46]

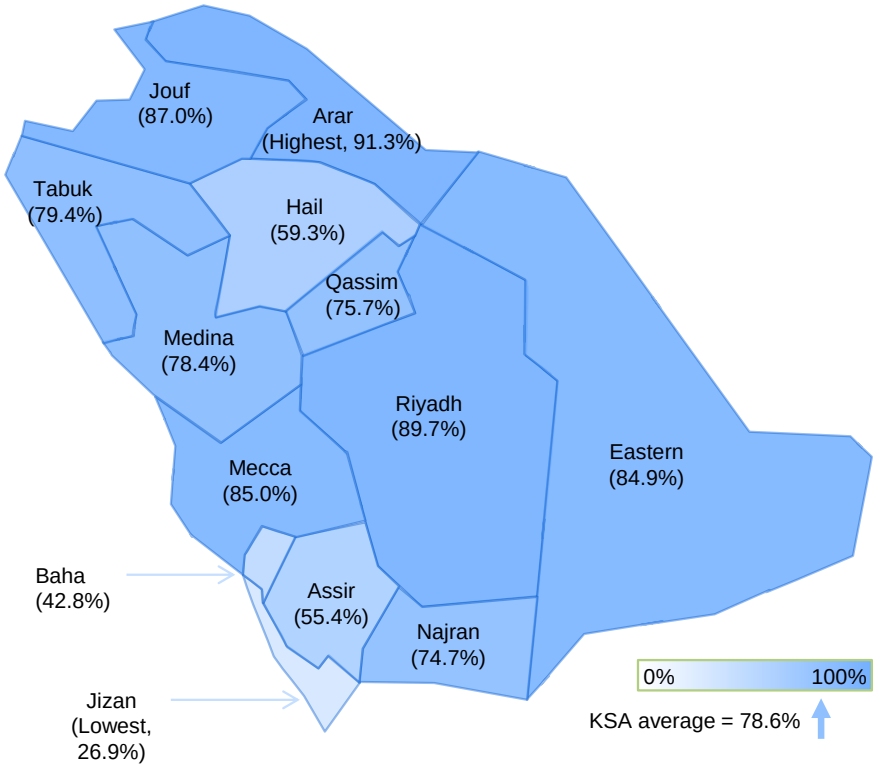


Figure D.12: DSL coverage by area [Source: CITC consultation on USF]

Overall, it appears that further significant growth in fixed broadband penetration is relatively unlikely, at least in the short to medium term, and that mobile broadband is required to enable the further development of the ICT ecosystem in KSA.

Mobile broadband

Since the launch of mobile broadband services in KSA in mid-2006, the adoption of this technology has been very successful. With three competitive players in the market, as seen in Figure D.13, opportunities for growth are significant. Meanwhile, smart devices in the form of smartphones – which currently make up 41% of all mobile handsets in KSA – are predicted to rise to 61.3% of all mobile handsets by 2014.[50]

Provider	Market position
Saudi Telecom Company	• Launched 3G services in January with coverage of most major cities in 2010 • Upgraded networks to HSPA+ 21.1 in 2009 and launched commercial service in January 2010 • Upgraded further to HSPA+ 42.2 in January 2011 • Launched LTE in un-harmonised 2.3GHz spectrum band in September 2011
Mobily	• Second largest provider of 3G services • Launched 3G services in June 2006 with 80% 3G population coverage in 2010 • launched HSPA+ in 2010 • Launched LTE in un-harmonised 2.5GHz spectrum band in September 2011
Zain	• Launched 3G services in 2008 and is planning an HSPA+ launch • Launched LTE in 1.8GHz spectrum band in September 2011

Figure D.13: Overview of mobile operators in KSA [Source: TeleGeography, Wireless Intelligence]

In 2009, residential Internet penetration reached 40%, up from 31% in 2007. There is significant evidence that mobile broadband is now driving broadband growth:

- HSPA-type mobile broadband accounts have taken off rapidly, with roughly 1.4 million in existence by Q3 2010[51]
- WiMAX broadband subscriptions rose from 24 200 at the end of 2008 to 160 000 at the end of 2010[48]
- The important role of mobile broadband is confirmed by a recent CITC survey which indicated that a significant number of Internet users (70% of online respondents to the survey) had accessed the Internet via a mobile device in the six months preceding the survey.[45]

One reason for the significant take-up of mobile broadband has been the aggressive move from mobile operators into the broadband market. Indeed, faced with increasing competition in the mobile voice market, data services have become increasingly important to mobile operators. This in turn has led to greater competition in mobile broadband, resulting in greater innovation and take-up.

50 Source: Analysys Mason Research, Viewpoint: "Smartphones forecast to grow to 26% of handsets by 2014" (published April 2010).

51 Source: Wireless Intelligence.

We expect mobile broadband to continue to appeal to two types of consumer. For some users, the mobile aspect is key – the service is a *complement* to fixed broadband service. For other users, mobile broadband is an *alternative* to fixed broadband, due to issues of availability or price.

With disposable incomes among the general population forecast to rise and economic prospects in the wider economy expected to improve, adoption of mobile broadband as a complement looks likely to expand.

With regard to substitutability, the relative youth of the Saudi population (half of the citizens are under 25, as seen in Figure D.6) and the high number of students in the country offer good prospects for mobile broadband take-up given their reduced purchasing power and potential difficulties getting their own housing, as discussed in Section D.1.1. Moreover, we would expect the mobile broadband market to become even more competitive, with promotions and deals encouraging sign-ups, which should further reduce the barriers to entry.

As a result, growth is expected to continue, with four in ten individuals likely to have a 3G handset by 2014[48]. This increased proliferation of 3G handsets will open up new revenue opportunities from applications.[48]

Mobile broadband technologies

Figure D.14 compares the main mobile broadband access technologies in terms of user base and device availability.

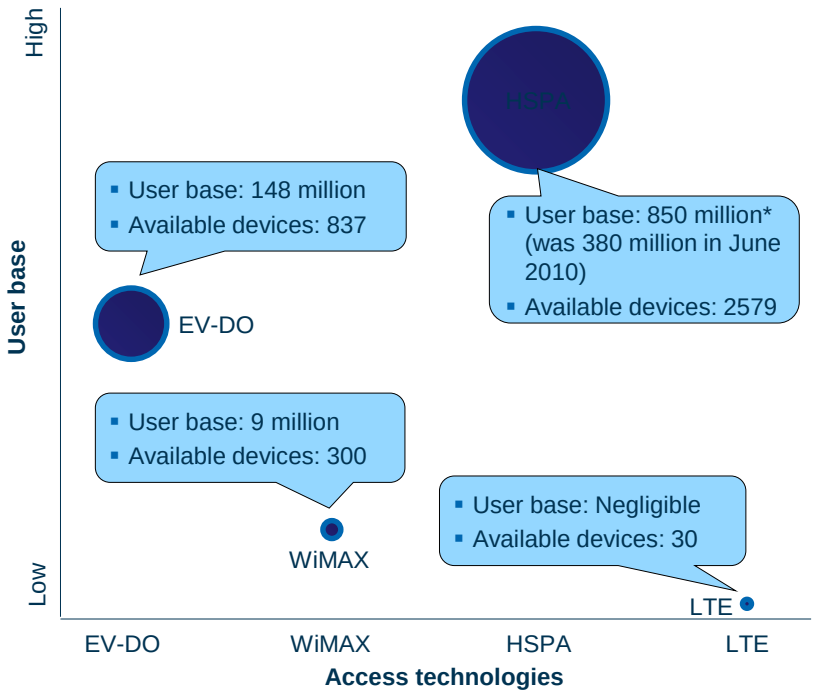


Figure D.14: Global status of access technologies (June 2010) [Source: GSA; Wireless Intelligence; AMR][52]

** Data as of Q1 2012*

52 Note: the size of the bubbles represents the number of devices available for the access technology.

HSPA has a much stronger device ecosystem maturity, and as such we expect the technology to continue to drive scale benefits for the end user in terms of better device options, availability and pricing. Support for voice and better mobility are dominant factors that give HSPA greater mass-market appeal than WiMAX, which we expect to remain a niche broadband technology.

Looking ahead slightly, based on the growing global subscriber base of LTE and on the first LTE launches in KSA in 2011, we expect LTE to achieve greater support and a more robust ecosystem than WiMAX. Compatibility of LTE devices with existing technologies also means there is likely to be a smooth transition to the production/take-up of LTE devices.

D.1.3 Regulation and policy initiatives

Under the auspices of the CITC, KSA has made significant progress with regard to regulation in recent years. Of particular note are initiatives relating to universal service and local loop unbundling (LLU) as a means of promoting competition in the fixed broadband market.

There is a global move towards the implementation of universal service plans that include the provision of voice services and Internet access. In 2010, the CITC and the USF announced a 'Final Strategic Plan' detailing the goal of providing Internet service at a bandwidth of not less than 512kbit/s to all households in all localities in KSA with populations greater than 100 persons and which remain at least 10km from the boundary of the nearest universal access coverage location. USF-funded projects are required to have competitive tariffs, below the national average for Internet services in particular. In September 2010, Mobily won a SAR50 million project to extend its own extensive broadband network to underserved areas in the Al-Mahd municipality in the Madinah province, and the municipalities of Kholais and Al-Kamil in the Makkah district. The USF projects will extend to further under-provisioned areas in the coming years.

Around the world, LLU is used as a tool to boost competition in telecoms markets. After the introduction of wholesale and retail competition for Internet services in the KSA market, the CITC has proceeded to encourage access to the local loop of the incumbent, STC. A draft RODA was submitted by STC in March 2006, which provided both bitstream access and line sharing for data service providers, but not for fully unbundled loops. This has been binding since August 2007.

In May 2009, the CITC published the "Regulatory Framework on Unbundling", making it mandatory for the incumbent operator, STC, to provide bitstream access and line sharing on its local loop to newly introduced fixed facilities-based providers (FBPs) which build, own and operate their own network. The incumbent has also been required to offer its existing RODA to FBPs in addition to data service providers.

Figure D.15: Fixed regulatory timeline [Source: TeleGeography]

Date	Event
1998	Creation of STC as a separate joint stock company to administer telecoms services
2001	Telecommunications Act comes into effect, CITC formed
2007	USF and RODA published

Mobile regulatory developments in KSA

Mobile services were first introduced in KSA in 1977, when the incumbent telecoms service provider contracted Ericsson to deploy an analogue network. However, mobile services did not become popular until the 1995 launch of digital services by STC (Al-Jawal), which held a licence to operate a GSM network in the capital.

In September 2002, the government announced plans to license a second national operator (SNO) by the end of 2004; the licence was assigned to Mobily (Etisalat). These existing GSM operators were assigned 3G licences in 2006. In 2007, a third 2G/3G licence was assigned to Zain (MTC). The mobile operators have since launched LTE using TDD spectrum in the 2.3GHz band (Mobily), the 2.5GHz band (STC) and FDD spectrum in the 1800MHz (Zain). Meanwhile, 900/1800MHz operator licences are technology-neutral, so operators could theoretically re-farm their existing spectrum holdings.

In the period since the initial introduction of mobile services in KSA, the government has been steadily liberalising the telecoms market, moving from a state-owned monopoly supplier to one of the most competitive telecoms markets in the region. The various governing bodies have made this possible through several key regulatory decisions, as summarised in Figure D.16.

Figure D.16: Timeline for mobile regulation in KSA [Source: TeleGeography]

Date	Event
1995	**Digital services come to KSA through launch of EAE Al-Jawal's GSM900 service in Riyadh**
1996	MoPTT introduces its own GSM900 offering
1998	Creation of STC as a separate joint stock company to administer telecoms services
May-98	Cellular operations of MoPTT pass to STC
2001	Telecommunications Act comes into effect, CITC formed
2002	Number of mobile users outstrips main lines in service
Sep-02	**Government announces plans to allow competition in mobile market from 4Q 2004**
2004	Direct foreign investment permitted in mobile sector
Jul-04	Etisalat wins auction for second GSM licence
2007	USF and RODA published
Mar-07	**Consortium led by MTC of Kuwait (Zain) wins third national cellular licence**
May-09	**CITC publishes "Regulatory Framework on Unbundling"**

Several spectrum licences have been allocated to the MNOs, and the current status of their holdings can be seen in Figure D.17 below.

Figure D.17: MNO spectrum holdings in KSA, in MHz [Source: GSMA]

	STC	Mobily	Zain	Spare	Total
900MHz	2×15	2×10	2×10	0	2×35
1800MHz	2×5	2×5	2×10	2×55	2×75
2GHz FDD	2×10	2×10	2×10	0	2×30

It appears that while the spectrum is controlled by the CITC, it has to fulfil the objectives and rules laid out in the national frequency plan, approved by the Council of Ministers.

D.2 The ICT ecosystem in KSA

ICT development is one of the key elements of the 9th Development Plan, and this reflects the KSA government's belief that the ICT ecosystem is key to economic development and diversification.

In this section we describe the status of the ICT ecosystem in general, before looking at how the development of the mobile broadband value chain is affecting the wider ICT ecosystem.

D.2.1 The Internet ecosystem

Demand for ICT services

- *Current services*

Broadband quickly surpassed dial-up as the dominant residential method to access the Internet, increasing from 50% of Internet users in 2007 to 96% in 2009.[46] This development has enabled new services and uses to emerge. Residential users are predominantly motivated to use the Internet for basic purposes, such as browsing, communication, entertainment and obtaining information.[46] Much of the entertainment usage comes from females and those living in Riyadh, while downloading is prevalent among the young, who have more interest in gaming and music. This can be contrasted with businesses, whose usage is centred on information sourcing and communication.

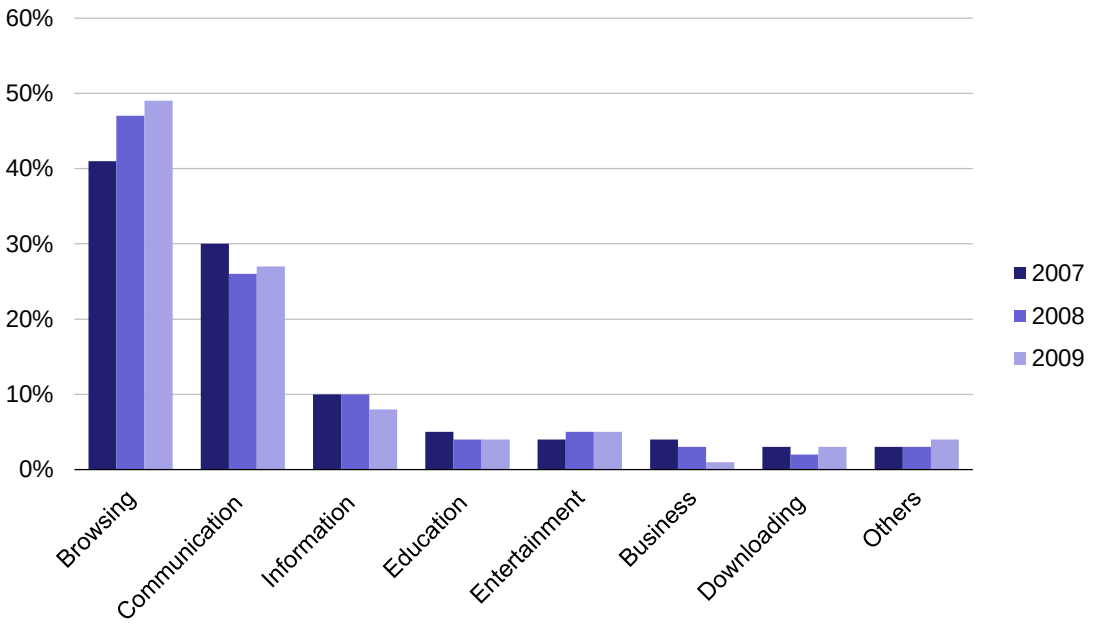
- *Browsing usage*

Within the residential 3G market, video calling and high-speed Internet are the most used services, on average once every two or three days.

Within the business environment, desktops are the dominant device used for Internet connection, although the proportion of laptops is increasing and this is mirrored in the skew towards laptops in the residential demand for personal computers. This suggests that mobility is an important factor in the choice of broadband access devices.[46]

While Internet usage has increased massively in recent years, the main reasons for doing so remain relatively basic, with browsing and communication high among all demographic and regional groups (see Figure D.18). However, downloading is more prevalent among the young, due to their gaming and music interests. The increase in usage for education, entertainment and business purposes suggests that more-advanced applications with greater need for high-speed access are in demand.

Figure D.18: Main reasons for using the Internet in KSA [Source: CITC]



- *E-commerce, social networking, free emails, job adverts, banking*

The CITC survey also found significant use of various ICT services:

- ICT-based payments were used by 37% of field survey respondents and 84% of online respondents, the most common methods being ATM machines and online[45]
- 11% of enterprises provided online payment facilities to their clients[45]
- 1.3% of field respondents and 35% of online respondents purchased products over the Internet, predominantly computer equipment, online and mobile content.[45]

The sophistication of Internet users means that marketers are willing to pay a relatively high price for Internet marketing in KSA (see Figure D.19).

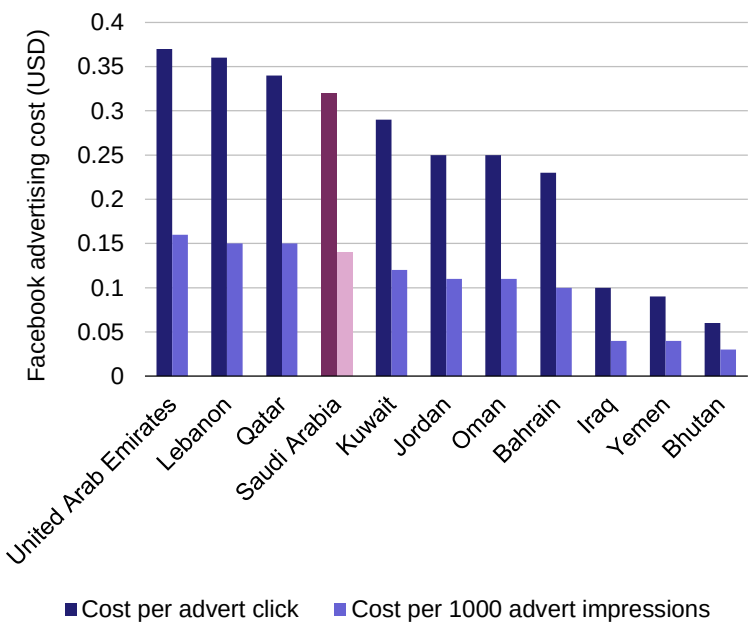


Figure D.19: Cost of advertising to KSA users of Facebook [Source: Social Bakers]

► *Users*

It appears that KSA Internet users are becoming increasingly satisfied with their Internet subscription. Based on the fact that most past complaints related to slow speed, this higher satisfaction can be attributed to the transition from dial-up to broadband. While price perceptions have stagnated, the majority of KSA subscribers feel the Internet is neither "extremely expensive" nor "extremely affordable" and the perceived cost is falling year on year.[46] This is confirmed by the trend in value of the ITU price basket for ICT services, which fell from 1.5 to 1.1 over the period 2008 to 2010, placing KSA 36th globally in terms of price and significantly reducing the cost of ICT services as a percentage of gross national income.

The survey found that average annual spending on mobile personal Internet was between SAR500 and SAR4000, the same level as for fixed Internet access, suggesting that mobile broadband is valued as highly as fixed by the KSA users.[45]

While take-up of wireless services is limited among small companies, wireless penetration stands at 95% for government offices.[45] The majority of this is Wi-Fi, with mobile GSM and mobile 3G services also making up a large part of the total. This demonstrates that the government is leading the way regarding the adoption of new technologies and thus believes in the benefits that wireless broadband access can bring.

► *Future services*

There is a significant problem with the lack of awareness regarding future ICT services.[45] However, among those who are aware there is significant interest coming from the online respondents. For the purposes of this study, these online respondents can be viewed as the early adopters of Internet services and thus those who have the greatest ICT literacy skills and understanding of the benefits of ICT to both business and personal life (as demonstrated by the CITC survey results: 70% of online

survey respondents used mobile Internet services provided by operators, compared with 20% of field survey respondents).[45] The most popular of the future services suggested with this group are IPTV, remote camera monitoring and e-payment via SMS.

Supply of ICT services

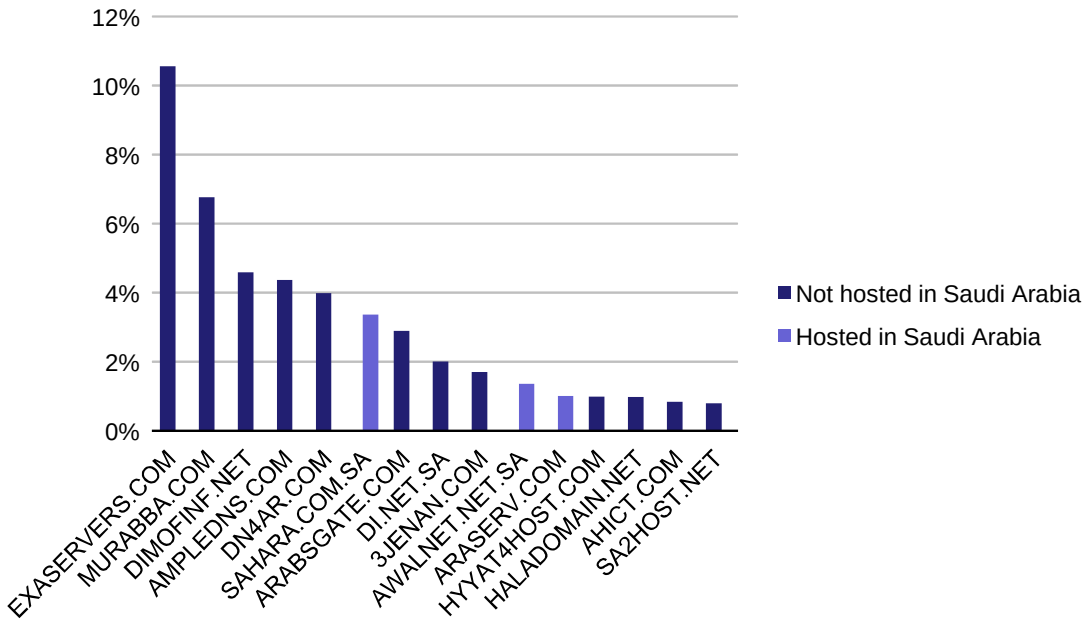
ICT services build on top of the broadband infrastructure, and a vast ecosystem of ICT suppliers (some local and some global) has developed to provide those services. Suppliers can broadly be categorised as infrastructure providers, content providers and professional services suppliers.

► *Infrastructure providers*

KSA boasts competitive markets in Internet services, mobile services and fixed-line services. Thanks to its access to oil reserves and the cheap power these provide, it is an attractive location for a range of activities across the ICT value chain. This, alongside KSA's state-of-the-art communication infrastructure, can be leveraged by ICT-enabled service providers, for example data centres, to serve global clients efficiently. Furthermore, the manufacture of equipment and components is also highly energy-intensive and requires the use of significant amounts of petroleum derivatives such as chemicals and plastics; this translates into considerable cost savings for equipment manufacturers based in KSA. Moreover, the intellectual property rights laws provide software and content providers with a secure environment for commercialisation.

Individuals and even hosting companies prefer to host outside of KSA (see Figure D.20), primarily due to financial considerations. However, government initiatives to reduce the cost of hosting in KSA could change this and generate a boom in local hosting.

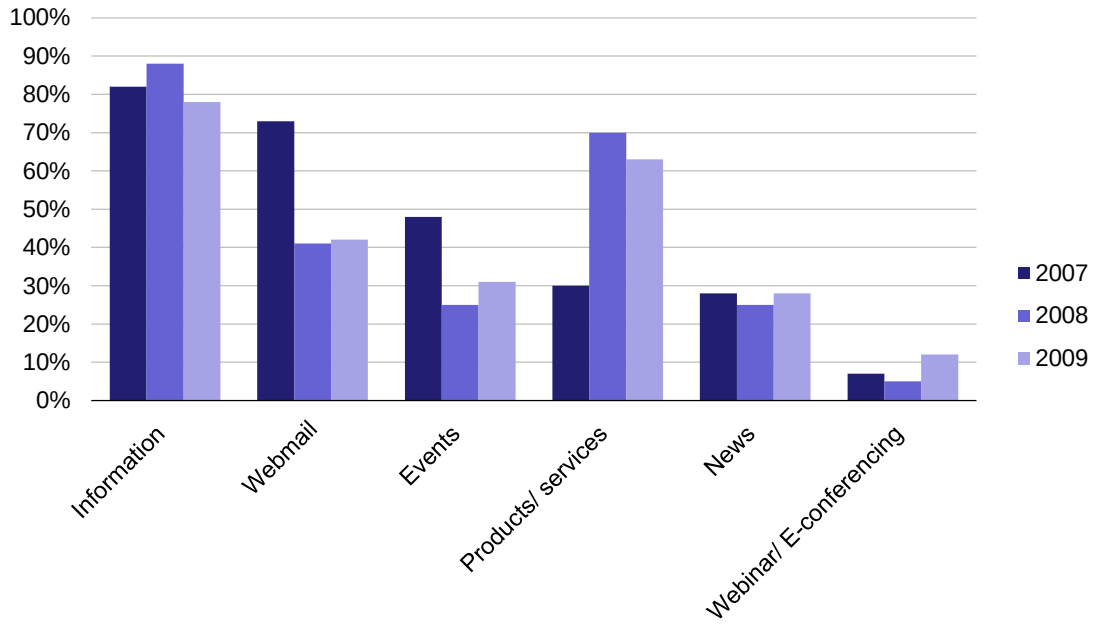
Figure D.20: Top hosting companies in KSA [Source: webhosting.info]



► *Content providers*

While 67% of large businesses in KSA had their own website in 2009, there is still significant potential to expand website presence from both these and smaller companies.[46] There was significant growth in online presence by small companies between 2007 and 2009. These websites predominantly offer services such as information about the company and access to its products, as shown in Figure D.21.

Figure D.21: Services provided by KSA business websites [CITC]



There was also significant web presence of educational institutes (54%) and government offices (54%). However, healthcare institutes lagged behind, with a mere 29% having a website.[46] The majority of these sites are in Arabic; however, they are increasingly adding English as a second language. These websites provide a wide range of information on the offices, staff, industry and services provided.

Foreign websites make up a significant proportion of KSA Internet browsing, with only three of the top-ten websites in KSA being domestic, as can be seen below.

Rank	Website
1	google.com.sa
2	youtube.com
3	facebook.com
4	google.com
5	live.com (Windows Live)
6	maktoob.com
7	yahoo.com
8	sabq.org
9	blogspot.com
10	mediafire.com

Figure D.22: Most popular sites in KSA [Source: Alexa.com]

Between 5% and 17% of individuals own or manage a personal website.[45] The majority of these are generic .com or .net domain names, although the launch of a KSA domain name registration process and the introduction of Arabic domain names (which took place in in early 2011) are expected to increase the usage of local domain names.

57% of government and private enterprises are using various initiatives to promote ICT usage to their employees and the community.[45]

The number of websites provided by businesses, schools, universities, healthcare providers and government offices has also risen, with online presence above 50% in 2009 for all except the healthcare industry.[46]

► *ICT professional services providers*

ICT professional services providers are those companies which supply technologies and services to other members of the Internet ecosystem. These include hardware, software, infrastructure and system maintenance. They are integral to the provision of devices for consumers to access the Internet (PCs, mobile handsets, etc.), and as such have a key enabling role for various stakeholders in the Internet ecosystem. The provision of ICT services and devices is a large and rapidly growing industry in KSA; ICT spending was SAR27 billion in 2010 and is expected to reach SAR43.6 billion in 2015.[46]

The CITC survey conducted interviews with a number of such companies to seek their insights into the KSA ICT value chain or Internet ecosystem. All of those interviewed had had a KSA presence for over 14 years, indicating both their interest in and knowledge of the market. The long duration of these companies' involvement in the KSA market further suggests that their significant experience will lead to a stable market.

Of the companies interviewed, over 62% were involved in the provision of products and services categorised as "Software integration/Business solutions", "Consultancy services", "Maintenance & asset management services" and "Telecom core integration/solutions". Meanwhile, 85% provided both technology and services. These various capabilities build up a picture of a complex and relatively evolved value chain.

With regard to their promotional activities, periodic visits to customers and specialised training courses for potential customers are popular. Respondents felt that there is both high need and demand for a variety of ICT services, including software integration, consultancy service and asset management services. There are highly competitive markets in existence for the provision of all of these services. The high value of the ICT industry, the experienced nature of the companies involved, the wide range of services and products available and the competition within the industry are all factors that lends themselves to a sophisticated market promoting ICT development.

► *Growth perspectives for ICT service providers*

KSA boasts the largest ICT technology market in the Middle Eastern region, with its telecoms and information technology industries representing over 55% and 51% of the total Middle East markets, respectively.[53] This trend looks to continue, as KSA will be responsible for 50% of ICT spending in the GCC between 2010 and 2012.[54]

ICT suppliers have predicted high growth in ICT expenditure (7% on average). However, they feel that the fastest-growing sectors will be those of businesses (9%) and government (8%).[45]

► *The ICT ecosystem is developing rapidly*

ICT service and technology suppliers play a key enabling role among the stakeholders in the ICT value chain. Results from a 2010 survey of ICT services and technology suppliers[45] show that ICT professionals expect annual growth of 20% on average for all ICT services and products. Furthermore, that same survey indicated an expectation that ICT expenditure would grow rapidly (by 7% on average) in KSA over 2009–11,[55] and that software development, maintenance and asset management services, telecoms core integration/solutions, consultancy services and software integration/business solutions were forecast to increase by more than 20% in 2011.

Government/CITC initiatives to promote the development of ICT services

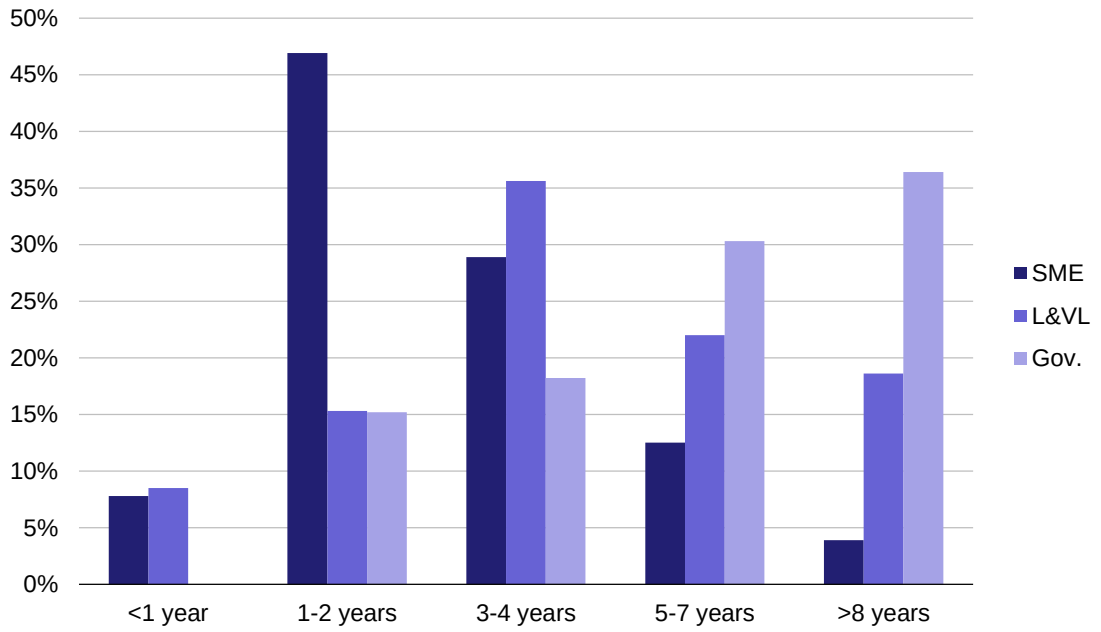
The KSA government has been involved in promoting the Internet to both citizens and businesses. Figure D.23 clearly shows that government take-up of Internet subscription preceded that of private enterprises, and indeed indicates that the prevalence of use of the Internet by the government encouraged adoption elsewhere.

53 Source: sagia.gov.sa

54 Source: Markaz GCC ICT infrastructure report.

55 The data was collected in 2009 and 2010 and therefore represented forecasts at the time it was collected.

Figure D.23: Duration of Internet subscriptions held by establishments [Source: CITC]



The most popular initiatives in which the various government offices are involved are sponsoring computer and ICT training for their employees, providing scholarships for ICT courses, and organising ICT seminars and workshops.[45] Further specific government and CITC programmes are considered in more detail below.

► *CITC Internet services – SaudiNIC*

The Saudi Network Information Centre (SaudiNIC) was set up as the national authority for administering domain name registration and the domain name system (DNS) for the country-code top-level domain (ccTLD). It is therefore responsible for operating the DNS infrastructure required to support KSA ccTLDs, setting policies for the registration of domain names, implementing these policies in the process of enabling the registration of ccTLD domain names, and promoting use of KSA ccTLDs in the country.

When the CITC was set up in 2006, the control of SaudiNIC was handed over from King Abdulaziz City for Science and Technology (KACST, the KSA national science agency and its national laboratories), the previous administrator for the scheme. Since being under the auspices of CITC, SaudiNIC has experienced a steady pace of take-up for .sa and (.السعودية) domain names, and it is notable that there were 57.5% more registrations in 2010 relative to the 2009 results. SaudiNIC has also been responsible for several Internet development initiatives, such as implementing the recommendations of the 1st Internet Development Plan in 2007, revising SaudiNIC's domain regulations in 2009 using feedback from SaudiNIC staff, CITC staff and the general public in its Policy Development Process (PDP), and launching the (.السعودية) Arabic internationalised domain names (IDN) ccTLD in 2010.

The KSA domain name registration process[56] was launched in early 2011, with the announcement by SaudiNIC and the CITC of a Landrush phase of second-level domain names.[57] During this period, any entity or individual can register such domain names on a first-come, first-served basis. However, SaudiNIC retains the right to reserve or make unavailable for registration various domain names, such as those linked to religion or geographical regions.

► *Technology*

The Internet is a limited resource and the CITC has introduced schemes to maximise its use.

With regard to quality of service (QoS),[58] regulations were originally issued to STC in December 2003. However, due to the ongoing liberalisation in the telecoms market, the CITC issued a 2008 public consultation on the revision of these regulations. These regulations have various implications for the dominant Internet services providers (DoSPs) and ISPs that have been active in the provision of commercial services for more than 12 months and have a market share greater than 10%. However, currently only STC fulfils the criteria to be subject to these regulations.

As the most common decision a consumer faces is often not whether to take up a service but which service provider to choose, the QoS metrics do not appear to provide the information that would help make the selection between providers. However, quality of experience (QoE)[59] metrics could bridge this gap and such metrics would potentially be part of a future regime as competition in the market increases and the market matures.

Globally, IPv4 is reaching capacity, and in 2008 the CITC announced its strategy to promote the adoption of IPv6 in KSA and thus prevent the space issue from hindering the growth of Internet services. This was important, as of the KSA allocation of global IPv4 address space, 73.36% was in use, and despite an increase in the KSA address space from 0.050% to 0.089% utilisation has risen to 85.00%.[60] The plan involved two streams, the first to promote awareness and demand for IPv6 services, and the second to gain commercial support for IPv6. A variety of milestones were set and the majority of these have been met.

► *Legal aspects*

A number of laws have been passed by the KSA government to ensure safe use of Internet services. Two of the most significant of these are:

56 Source: Saudinic.net.sa

57 Note: second-level domain names are those composed of two parts only, a label and the TLD (.sa) without the .com, .net, .org, etc. part (e.g. www.nic.sa).

58 "QoS is a form of direct regulation that is used for consumer protection and information. It can also be used as a tool to stimulate competition in the market. Compliance with QoS indicators has implications on the costs, investments and operations of Service Providers (SPs) holding Individual Licenses." – *Public Consultation Document on the Quality of Service Scheme for the Kingdom of Saudi Arabia*, 2008.

59 QoE (also referred to as 'perceived QoS') denotes the overall acceptability of an application or service, as perceived subjectively by the end user. QoE metrics are measured end to end and often include metrics such as latency, jitter and packet loss.

60 Source: "IPv4 Resource Allocations" by Geoff Huston, dated 29 March 2011.

- *The e-Transactions act*[61] – this is a law establishing the regulations for electronic transactions and digital signatures. It was implemented by the KSA government to build confidence in these technologies and facilitate their adoption in the public and private sectors. It has the further impact of consolidating local and international use of electronic transactions and promoting their use in commerce, medicine, education, e-government, e-payment systems and other applications. The act has the potential to reduce abuse cases and fraud in electronic transactions and digital signatures (for example, forgery and embezzlement).

- *The e-Crime act*[61] – this law was implemented to combat electronic crimes and includes specifics on the penalties and fines for hacking into others' personal information and into websites. It includes clauses stating that defamation on the Internet is illegal, using the Internet to acquire information illegally carries a severe punishment and websites supporting terrorism and providing information on how to make bombs will receive heavy punishment. The maximum punishment it sets out is for government website hackers who steal information related to national security.

Conclusion on the Internet ecosystem

Earlier in Section D.2.1 we looked into the components of the KSA ICT ecosystem and found that all of these indicated a positive outlook for the further development of ICT. Significantly, our analysis has shown that KSA possesses:

- a high level of demand for broadband as well as mobile services, including ICT-based payments and new innovations such as IPTV
- a vibrant supply ecosystem, with a full range of products and services (including infrastructure, content and ICT professional services) all being developed within the country
- a supportive government/regulatory environment that is encouraging the adoption of new technologies and a safer operating environment.

All of these factors should encourage growth of the KSA ICT market. Thus, it appears that the key to ensuring that further ICT development progresses smoothly is to continue the growth in broadband connections to bring KSA more closely into line with other leading GCC countries, as shown in Figure D.9.

As seen in Section D.1.2, fixed broadband has stalled and mobile broadband appears to be the technology necessary to increase penetration. Thus it appears that encouraging mobile broadband is integral to encourage ICT development in KSA. The spectrum implications of this expansion in mobile broadband were considered in more depth in Section 4 of the main report.

Section D.2.2 looks in more detail at the potential of the mobile broadband value chain to affect the ICT ecosystem.

61 Source: UN National Profile of the Information Society in the Kingdom of Saudi Arabia.

D.2.2 Mobile broadband value chain

Mobile broadband is not just a new way to access the same content

Mobile broadband is not one but two markets, and as such can be seen both as:

- an alternative to fixed broadband (either because mobile broadband is cheaper or no fixed option is available), and
- a complement to fixed service, where the mobile aspect brings additional value.

In the first case, the effect of the development of mobile broadband is to expand the number of broadband connections (i.e. increase the number of people who can access Internet services).

In the second case, the effect of the development of mobile broadband is to allow the development of services that benefit from the mobility effect. An example of the mobility effect is the personal nature of the relationship to the mobile device. Ericsson's Mobile Broadband Survey[62] found that, globally, people view the Internet as more of a 24/7 necessity than a 'nice to have' luxury product. Furthermore, it concluded that people increasingly view laptops and smartphones as personal devices rather than a shared facility and there is increasing limited willingness to share these devices or the Internet connection. The survey find two types of user: those who feel a single mobile broadband connection fulfils all their needs for both access and convenience; and those, such as business users, who use the mobile Internet to ensure they do not miss out on an opportunity.

In fact, the positive role of mobile broadband on e-commerce (becoming m-commerce) is so important that e-commerce giants now expect reliable mobile broadband as a precursor for their business activities. eBay's recent UK "mobile manifesto"[63] is a clear example of this. The report found that despite the future potential of e- and m-commerce, the UK economy would lose out on at least GBP1.3 billion due to consumer frustrations with patchy coverage, unreliable connections and slow connection speeds. The report made various recommendations for promoting mobile commerce. These include that "consumer and merchant choice must be allowed to continue to drive growth and adoption of the next generation of commerce and payments technologies" and that "mobile applications should be used to enhance the shopping experience". They also suggest that ICT training and education should not focus solely on computers but also on mobile devices to ensure that "students learn how to develop new technologies and software for the next generation of mobile devices". The overwhelming conclusion was that for mobile commerce to take off, Britain needs next-generation mobile broadband. This is a conclusion that can be transposed to other economies, including KSA.

Mobile broadband delivers significantly more benefits than mobile narrowband

While mobile data services in general, including 2G and 2.5G, can meet some of the demand for m-applications, there are significant arguments for mobile broadband providing a better service and a better experience.

62 Source: "This time it's personal: Mobile Broadband User Study".

63 Source: "Seizing the Mobile Retail Opportunity. A Mobile Manifesto".

An Analysys Mason study looked into the relative time spent on different handsets and found that users of high-end smartphones spent significantly more time using these than the owners of low-end handsets. The study used an iPhone as the high-end device for the purpose of the research and found that the time spent on all services is higher (by 50%) than for other handsets.[64] This suggests that as access to enabled devices and mobile broadband increases, the use of broadband services will rise rapidly.

With regard to technology, 3G provides data transfer speeds that are several times higher than those of 2G and 2.5G, and enhanced audio and video streaming due to better data transfer rates. 3G also provides video-conferencing support, web and Internet browsing at higher speeds, and IPTV (TV through the Internet) support.

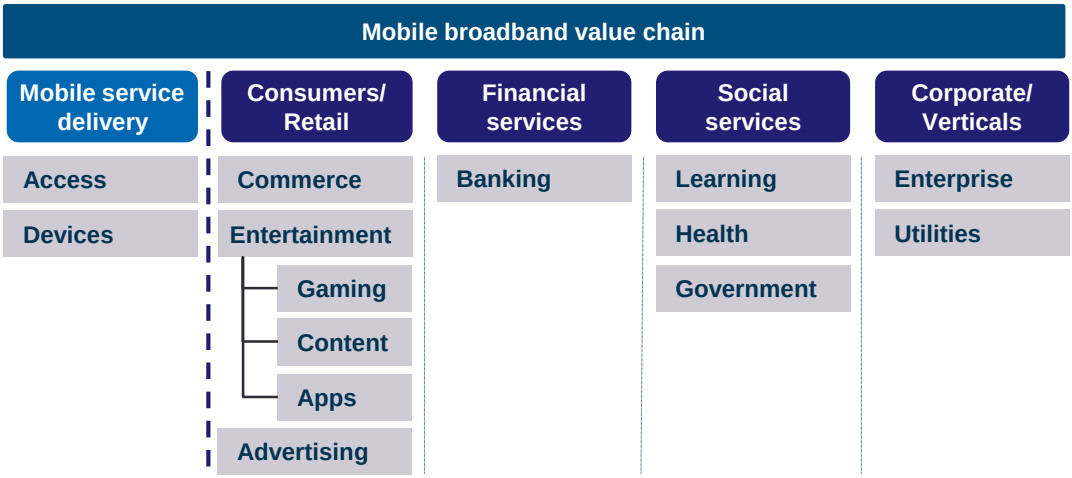
Broadband allows the use of images and video, which as well as improving entertainment provision also has benefits for commerce and advertising, as the ability to view purchases increases the likelihood of purchase. Additionally, broadband reduces latency which can be useful for gaming, learning and health applications.

Given the lower benefits that mobile narrowband services like GPRS deliver, governments and regulators around the world have realised the importance of providing the right amount and type of spectrum for mobile broadband providers so that users do not suffer from saturation or lack of coverage and fall back on GPRS.

Value chain analysis

While the ICT ecosystem is affected by the changes in mobile broadband technology, more details of how this occurs emerge from an in-depth look into the mobile broadband value chain. Figure D.24 presents the grid we have used to analyse the effect of the mobile broadband value chain on the ICT ecosystem.

Figure D.24: High-level impact of mobile broadband on the entire ICT ecosystem [Source: Analysys Mason]



64 Source: Analysys Mason Research.

Analysis of vertical applications with case studies of actual examples

In this section, we refer to both 'e-type' services (Internet portals that can be accessed through a mobile broadband connection over notebooks, PCs, tablets and smartphones) and 'm-type' services (mobile broadband access specifically over mobile handset devices and smartphones).

► *M-commerce*

In 2011, global e-commerce spending reached USD10 trillion, up from USD0.27 trillion in 2000.[65] However, in KSA, e-commerce remains at an early phase of development and implementation, with only 9% of KSA firms (most of them large and very large firms involved in the manufacturing sector) having adopted e-commerce and 39% of adult Internet users in KSA purchasing products and paying for services online.[66] There is a tendency for the products bought to be from international companies rather than KSA ones, and the majority of e-commerce transactions by residents are for airline reservations and tickets, probably reflecting the tendency for new e-commerce users to start with the online services of the brands they already know and trust. This is confirmed by the CITC survey result, which indicated that KSA Internet users overwhelmingly feel that local e-commerce websites require improvement.[45]

This relative lack of interest in the use of e-commerce is likely to be attributable to either an insufficiently developed ecosystem or to a lack of trust and understanding in KSA e-commerce. In the long run, the prospects do appear encouraging, as general attitudes and views of the population toward e-commerce are positive (as it is felt to be an opportunity for KSA society)[67] and as there is a substantial adoption of electronic payment methods such as Sadad, as shown in Figure D.25.

Figure D.25: M-commerce case study [Source: Arab Advisors Group]

Sadad
• By mid-2008, close to three-quarters of KSA residents used electronic methods, such as ATMs and Internet banking, to settle their bills • In 2003, the Saudi Arabian Monetary Agency (SAMA) sat up Sadad, a national bill presentation and payment service. Sadad acts as a link between organisations and local banks, thus allowing customer payments to be collected at all hours • Sadad is used by firms from industries including telecoms, utilities, TV, airline and banks. Furthermore, there are currently 40 government and private sector organisations in the process of integrating with the system • At the 4th Middle East Business Process Management Summit, the introduction of Sadad was pointed to as an example of new and efficient business process

We expect m-commerce to play an important role in the future growth of this sector because of the additional features it can provide. These include:

- NFC (near field communication), enabling a secure connection between the phone and another NFC-enabled device

65 Source: EJISDC.
66 Source: ecommerce journal.
67 Source: Barriers of E-commerce and E-government in Saudi Arabia.

- mobile wallets enabling small purchases. An example of such technology is Google Wallet, whereby users can make payments by simply tapping their phone against specialised terminals
- mobile vouchering delivered into the mobile wallet, enabling 'one-click' purchases.

► *M-content, m-gaming and m-apps*

The global online and mobile gaming market stood at around USD20 billion in 2010[68] and is growing at a significant rate. The international popularity of online gaming is reflected in KSA, where 65.3% of Internet users play games online and 12.9% of these individuals pay to play.[69]

With regard to gaming on other platforms, 76.9% of Internet users in KSA own gaming consoles/handhelds[69] and around 50% of the top-10 iPhone App Store downloads in January 2010 were games,[70] demonstrating that end users are prepared to pay for games.

While in-game monetisation is more developed on fixed platforms, the same techniques will be applied for mobile gaming, the most basic of these being the "freemium" proposition, where initial gaming is available at no cost and users pay only to access advanced features of the game. Mobile games are not only being adopted, but with the launch of STC's gaming portal (as shown in Figure D.26), development in KSA has now begun.

Figure D.26: M-gaming case study [Source: Trade Arabia News Service]

STC's gaming portal
• In early 2011, STC launched a gaming portal, this gives customers access to the STC games' index from their mobile phones • Customers with subscriptions are allowed access to selected games. They can also download additional games from the portal • The subscription fee is SAR0.65 (USD0.17) per day or SAR20 (USD5.33) per month, which includes getting one game weekly with the possibility of buying other games at SAR10 for one game • To subscribe to the service, the customer sends a blank SMS message to the number 816640. A reply is sent, with a link to the application which can be downloaded onto a mobile phone • The portal, exclusively, contains a diverse package of unique BlackBerry and Nokia games

Further entertainment is available both online and from mobile devices, many KSA newspapers now have an online presence, and KSA TV can be streamed from various websites.

iPhone apps are popular in KSA, as in many other markets. The most popular paid application in KSA is social networking service WhatsApp messenger, while the Al Hajj app presented in Figure D.28 came third. As of November 2011, two of the top-ten free applications in KSA were in Arabic.[70]

A recent Yesser survey highlighted the high take-up of Facebook in KSA, and unlike elsewhere in the GCC, the interface language is predominantly Arabic,[71] which could reflect the large English-speaking expatriate population as a proportion of the whole in other GCC countries. Twitter is also

68 Source: PWC: *Global entertainment and media outlook 2011–2015*.

69 Source: Arab Advisors Group: The Arab World's Internet users and Online Media Landscape.

70 Source: appannie.com

71 Source: Arab Social Media Report. Dubai School of Government (Published May 2011) Available at: http://www.dsg.ae/portals/0/ASMR2.pdf

gaining prominence, with approximately 115 000 average users at Q1 2011, or 1.0% of Internet users. KSA is fourth in the Arab world by volume of tweets, with a share of 9.90%, behind Kuwait (16.24%), Qatar (13.47%) and the UAE (12.28%). The popularity of social networking in KSA is such that operators are launching their own mobile social networks such as MyWorld, as described in Figure D.27.

Figure D.27: Social networking case study [Source: MediaME]

MyWorld
• In October 2011, mobile software vendor NewBay announced that Zain KSA had chosen its LifeCache Social Networking Mobile Web solution to power the first operator-branded mobile social networking service in KSA • The service, to be branded as MyWorld, is a cloud-based digital content service that can be accessed from any device and will enable Zain KSA's 9 million customers in KSA to instantly update, socialise and view all activity on the most popular social networking sites including Facebook, Twitter and MySpace • The service will be available in both Arabic and English

Although take-up of mobile applications is spreading across KSA, out of the largest global distribution platforms only the Apple App Store and Nokia's Ovi Store are fully supported in KSA. Google's Android Marketplace has limited support, only permitting users to download or publish free applications[72] and only STC supports BlackBerry's App world.[73] While support for these platforms remains only partial, it acts as a barrier to growth of the mobile application ecosystem.

KSA mobile operators have also started developing their own apps and services. Mobily recently launched a developer community, providing developers with all the resources needed to build mobile apps. The Al Hajj iPhone application is one of a series of planned applications from this partnership to target the Islamic and Arabic world.

Figure D.28: M-application case study [Source: Mobily]

Al Hajj phone application
• Mobily and Info2cell.com, the leading mobile application provider in the Middle East, announced in December 2010 that they had developed an Al Hajj iPhone application, the perfect companion for those participating in the Hajj pilgrimage • The application provides reminders of essential duties to be performed, Islamic verses from the Holy Quran, prayer time alerts and maps of key locations

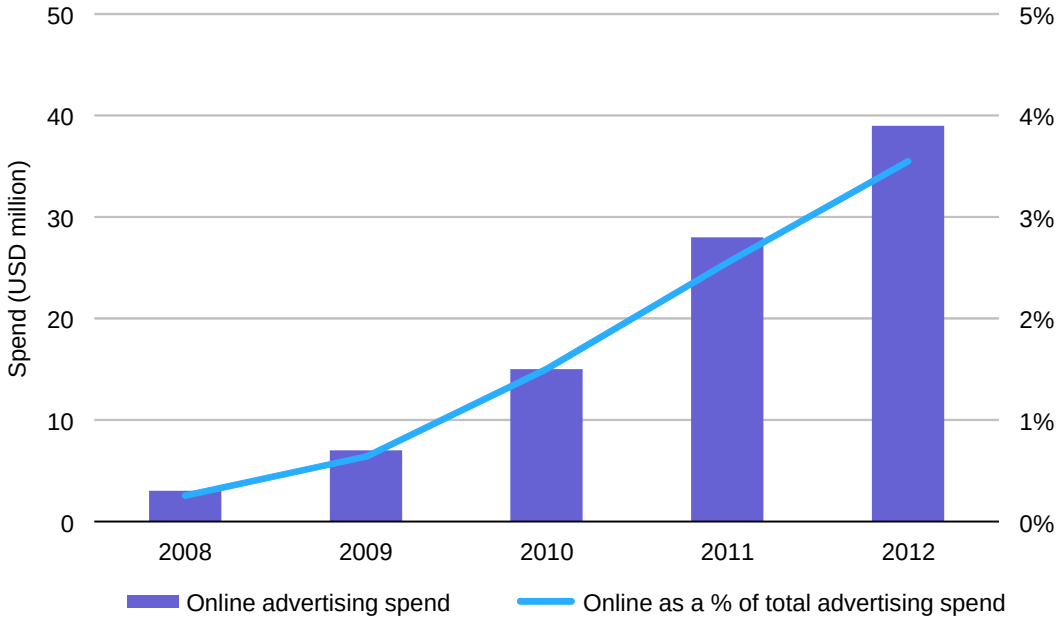
► *M-advertising*

Online advertising is rapidly gaining importance in KSA. It had a high compound annual growth rate (CAGR) of 31% as of 2010[74] and is further increasing its significance as a proportion of total advertising spending in the country. The growing adoption of online advertising is reflected by the increase in online advertising spend, both in terms of real spend and as a proportion of total advertising spend, as illustrated in Figure D.29. The government is leading the way, with 22.5% of its

72 Source: Google Android Market website.
73 Source: BlackBerry website.
74 Source: Trade Arabia.

offices using email and online banners for advertising, while viral marketing has been rapidly adopted by large and very large firms (25.0%).[45]

Figure D.29: Online advertising spending in KSA [Source: Zenith Optimedia]



International evidence shows that mobile advertising achieves nine times the click-through rate of browser banners,[75] and should therefore be rapidly adopted as a key marketing tool. The global mix of mobile advertising is likely to change, as larger-screened mobile devices facilitate more search-related advertising revenue and the growth of mobile broadband will allow the advertising ecosystem to address the opportunity of specific advertising to mobile handsets, smartphones and tablets such as the iPad.

Mobile advertising is beginning to permeate the Middle East, with companies such as Noqoush (which is presented in Figure D.30) gaining ground.

Figure D.30: M-advertising case study [Source: arabcrunch; muxlim]

Noqoush
• Noqoush, a Jordanian mobile advertising start-up, has launched its mobile advertising network for the Arab region called AdFalcon • AdFalcon was developed to bridge the gap between regional mobile application developers and mobile website owners on the one hand, and regional advertisers on the other • It enables marketers and advertisers to reach their targeted audience based on factors like location, interest, device type and model and operators • It has a dashboard and reporting engine to track the campaign performance and provide statistical results • Noqoush has also launched a developers fund and publishers programme, where developers and publishers can sign up to start generating revenues by serving mobile ads on their registered applications • Noqoush currently has offices in Amman (Jordan) and Dubai (UAE), with plans to expand soon in KSA and Egypt

75 Source: mediamind.com

► *M-banking*

Of the 16 commercial banks currently registered in KSA, 14 already provide online banking services. The common motivation for banks to implement e-banking, and thus m-banking, is to provide a faster, easier and more-reliable service to clients, to improve their competitive position and image, and to meet clients' needs.

KSA enterprises are also demonstrating take-up of online banking services, with 33% using services ranging from balance enquiries, managing bills, transferring money, and buying and selling stocks.

Globally, users of mobile banking and related services are forecast to grow at a CAGR of 59.2% to reach 894 million users in 2015,[76] with the potential for m-banking beyond e-banking in the provision of non-traditional services such as the integration of daily life information.

The Financial Access Initiative estimated in 2009 that 62% of adults in KSA used financial services.[77] The types of mobile financial service most likely to interest them would be relatively similar to those offered in developed countries. By contrast, the population without access to financial services today could be interested in more-basic services that provide access to financial services for the first time. It is therefore unsurprising that domestic banks such as Samba Financial Group are beginning to launch mobile banking services, as described in Figure D.31.

Figure D.31: M-banking case study [Source: Samba]

Samba Financial Group
• August 2010 saw the launch of KSA's first m-banking service from Samba Financial Group. It can be downloaded onto the Apple iPhone, BlackBerry handhelds and other mobile phones and PDAs • It is a fully transactional service that allows Samba customers to access their Samba accounts directly, check latest statement, transfer funds, pay credit card bills, make SADAD payments and subscribe to an IPO • Samba launched a '2nd Factor Authentication' security feature which provides customers with an electronic "token" that generates a unique authentication password for every login • Talking about these innovations, the Chairman of Samba Financial Group, Mr Eisa Al Eisa, commented: "Internet and mobile banking services are fast becoming spectacular gateways for information, sales, service and perhaps the most versatile channels for customer interaction. Mobile banking is a direct, convenient and hugely innovative service that proudly reaffirms Samba's place as an innovator in technology-driven customer convenience"

► *M-learning*

The KSA Ministry of Education is aware of the benefits of using e-learning in universities, particularly as KSA universities suffer from a shortage of lecturers. This has led to a situation in which thousands of students are over-enrolled by these institutions and as a result are simply given the course materials to study at home on their own. Another factor stimulating the demand for e-learning is that demand for part-time study options is high.

76 Source: Frontiers of eBusiness Research.

77 Source: *Half the World is Unbanked*, Financial Access Initiative, October 2009.

As a consequence, the Ministry is developing many e-learning and m-learning initiatives; these have included the launch of the National Centre for E-Learning and Distance Education (NCeDL) and the creation of Riyadh-based Saudi Electronic University.[78]

The e-learning market is expected to grow at a CAGR of around 32% between 2008–14 and reach around USD670 million by 2014.[79] As of 2009, 69% of schools had purchased an e-learning system and 60% of university courses were available through e-learning initiatives.[46] The majority of this offering was concentrated in materials such as video lectures and course guidelines and a further quarter offered bulletin boards or forums. While school websites generally remain in Arabic, universities have added English as a second language.

M-learning growth is being driven by emerging innovations in both hardware and software, as well as by changes occurring in the training field, such as reorganising training to fit mobile abilities and managing the resulting virtual teams. Universities such as King Saud University are developing programmes such as the one described in Figure D.32 to leverage the benefits from m-learning.

Figure D.32: M-learning case study [Source: Saudi.gov.sa]

King Saud University
• King Saud University offers an SMS service to enable the university professors, staff and students to communicate with one another regarding the academic syllabus and study materials • This service is also used to achieve effective communications between the university and society as a whole regarding university events • The university has also developed its own iPhone and iPad application to allow access to the university's e-services

► *M-health*

The Ministry of Health created a five-year plan to develop e-health initiatives in KSA, the goals of which are to develop processes for clinical automation, skills development, connectivity and data centres and resource optimisation. The Ministry of Health believes this plan will bring benefits to patients, providers and healthcare managers. In the private sector, service providers and device suppliers are also launching m-health initiatives such as the patient remote monitoring solution described in Figure D.33.

78 Source: mohe.gov.sa

79 Source: Elearn Magazine.

Figure D.33: M-health case study [Source: Trade Arabia]

Mobily's m-health solution
• In December 2010, Mobily and Ericsson teamed up to launch a mobile healthcare solution in KSA, which allows patients to be monitored remotely in a more-effective manner • Mobily's m-health solution provides mobile patient healthcare monitoring and gathering of vital indicators at predefined intervals and durations. This is enabled by a 2G/3G communication device which uploads the information • This remote patient healthcare monitoring cuts out unnecessary travel to medical centres, while not affecting the regular monitoring needed to maintain quality of care. It has the additional benefit of the information then being available to healthcare professionals from any compatible device • Mobily's m-health solution is described as being ideal for the chronically ill, senior citizens, patients recovering at home after hospitalisation, a health-aware population with a desire to self-manage their personal health, and ambulance teams

We expect m-health to play an important role in future, because of the additional applications and benefits it can provide:

- remote data collection and disease monitoring – e.g. applications that relay information (such as vital indicators) from patients' monitoring devices to a central server via a mobile network
- treatment compliance – e.g. SMS-based applications to remind patients to take medication
- diagnostic and treatment support – e.g. consultations by mobile phone; this application targets rural areas in developing countries with lack of access to medical services
- education and awareness – e.g. consultations by mobile phone; this application targets rural areas in developing countries with a lack of access to medical services
- clinical applications – e.g. consultations by mobile phone.

► *M-government*

The KSA government is a strong proponent of e-government and the benefits the concept can bring to the national economy. To develop eGovernance in the country, in 2005 the Ministry of Communications and Information Technology (MCIT) established an e-government programme called Yesser, with the following objectives:

- raising public sector productivity and efficiency
- providing better and more user-friendly services for individual and business customers
- increasing return on investment
- providing the required information in a timely and highly accurate fashion.

By the end of 2009, the Yesser programme had led to the launch of 300 different services for 75 government departments.[80] These services can be accessed using a variety of channels, including the KSA e-government portal, telephones and ATM machines.

Thanks to this and other similar initiatives from the Ministry of Education (see Figure D.34), government online services exist in all sectors of the economy, and mobile and SMS services are

[80] Source: Yesser Annual Report 2010.

beginning to be developed. In the UN's e-government index, KSA was ranked 58th out of 193 in 2010, up from 105th in 2003.[81]

Figure D.34: M-education case study [Source: Saudi.gov.sa]

Ministry of Education
• The Ministry of Education has been sending final exam results to high-school students through mobile phones since 2003 • The main objective of this service is to provide the exam results to students faster than before • STC receives a softcopy of students' final exam results from the Ministry of Education. Students send an SMS message containing a specific student number, and then receive a text message containing their results

81 Source: United eGovernment Survey 2010.

Annex E Public sources used to benchmark global trends in regulating, licensing and operating mobile broadband wireless access systems

Data set	Countries	Source
Bandwidth allocated for mobile/IMT use	Austria, Belgium, Denmark, France, Norway, Sweden, UK	European Communications Office Frequency Information System (EFIS)
Bandwidth allocated for mobile/IMT use	Austria, Belgium, Denmark, France, Norway, Sweden, UK	CEPT mobile bands report
Bandwidth allocated for mobile/IMT use	New Zealand, Australia, Brazil, UAE, Bahrain, Oman	National frequency allocation plans (ITU, NRAs)
Bandwidth allocated for mobile/IMT use	Qatar	Questionnaire on national frequency spectrum management for responding to Resolution 9 of the World Telecommunication Development Conference (NRA)
Number of operators licensed in band	Austria, Belgium, Denmark, France, Norway, Sweden, UK, New Zealand, Australia, Brazil, Bahrain	Analysys Mason Research *Spectrum Tracker*
Number of operators licensed in band	Austria, Belgium, Denmark, France, Norway, Sweden, UK, New Zealand, Australia, Brazil, UAE, Bahrain, Oman, Qatar	TeleGeography
Licence acquisition fees	Austria, Belgium, Denmark, France, Norway, Sweden, UK, New Zealand, Australia, Brazil, Bahrain	Analysys Mason Research *Spectrum Tracker*
Licence acquisition fees	Austria, Belgium, Denmark, France, Norway, Sweden, UK, New Zealand, Australia, Brazil, UAE, Bahrain, Oman, Qatar	Spectrum assignment documentation, NRAs (including auction decision documentation)
Annual radio spectrum fees	Austria, Belgium, Denmark, France, Norway, Sweden, UK, New Zealand, Australia, Brazil, UAE, Bahrain, Oman, Qatar	NRA websites
Services offered	Austria, Belgium, Denmark, France, Norway, Sweden, UK, New Zealand, Australia, Brazil, UAE, Bahrain, Oman, Qatar	Operator websites
Adopted technologies	Austria, Belgium, Denmark, France, Norway, Sweden, UK, New Zealand, Australia, Brazil, UAE, Bahrain, Oman, Qatar	TeleGeography