Annex 4 Planning for the Future: Two Scenarios for Wireless Market Evolution

A4.1. Introduction

The strategy described in Chapter 5 has been developed in response to the spectrum demand drivers discussed in Chapter 4, based on assumptions about how these drivers will impact on spectrum demand in the future. The strategy is intended to cover the next two years (i.e. the period up to the next revision of this strategy document), however the effect of the strategy will extend well beyond that period, since it will set the framework in which business decisions are made concerning future product or service innovations. It is important that the strategy is sufficiently robust to accommodate anticipated developments in the market and minimise uncertainty for market players, whilst retaining the flexibility to cope with a range of possible future market scenarios.

In order to test the effectiveness of its proposed strategy, ComReg has undertaken a scenario planning exercise, in which two distinct future scenarios for the electronic communications market were considered. One scenario assumed rapid and substantial growth in the market for mobile, broadcast and broadband services along with a high degree of convergence, while the other assumed a more gradual evolution of the market. In each case, the implications for spectrum demand were considered. It was clear from the analysis that the greatest implications for spectrum demand arose in the high growth scenario and ComReg has therefore developed this scenario further in the light of responses received to the consultation.

The following sections provide a background to the scenario planning process and describe the high growth scenario that ComReg has developed. By focusing on this high demand growth scenario, ComReg will ensure that its spectrum strategy has the flexibility and responsiveness to cope with significant changes in demand for spectrum should these arise.

A4.2. Background to Scenario Planning

Forecasting the future demand for wireless services and content in a highly dynamic market is not straightforward. Innovations in technology, service delivery and pricing can have a major impact on the take-up of wireless services. For example, the introduction of relatively low cost subsidised pre-pay mobile phones has driven mobile phone penetration to levels far exceeding analysts' predictions of a decade ago. Similar growth in demand for mobile broadband services and content could have significant implications for future demand for radio spectrum to support these services.

In an attempt to assess what the implications of such demand growth might be, ComReg has used a scenario planning approach, under which two contrasting scenarios were developed representing different degrees of demand growth for radio services and the implications for spectrum demand considered. Scenarios in this context are specially developed stories about possible futures, each one modelling a distinct, plausible world in which we might someday have to live and work. Scenario planning is the process of developing such scenarios and consequentially preparing strategies and plans that allow an organisation to act proactively in the event of particular scenarios unfolding.

The two draft scenarios described below represent plausible futures driven by trends and other factors we can see developing today and take account of future uncertainties. This grounds the scenarios in reality whilst providing scope for exploration of potential change and uncertainty.

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A4.3. Two Alternative Scenarios for Ireland – Wireless Boom or Steady Growth

To guide our long-term planning we developed and consulted on two possible scenarios for the future state of radiocommunications services in Ireland, over a ten year timescale. The first scenario, "wireless boom", envisaged a rapid expansion in the market for wireless communication across all sectors, building on the historic growth already evident in the mobile sector, whereas the second scenario, "steady growth" envisaged a more gradual evolution of the market. The first scenario implied major changes in the way spectrum would be used to deliver services, driven by market and technological developments, whereas the second scenario implied a more gradual and ad-hoc approach to accommodate a limited range of new services. Both of the scenarios were based on a view of the sector in December 2004.

In the tables of assumptions presented under each scenario, the likelihood of the assumption arising is based on responses received to consultation document 05/01 and the impact reflects ComReg's own assessment of the how significantly the assumption might affect future spectrum demand for the service concerned.

A4.3.1. "Wireless Boom" Scenario

This is a future of ubiquitous availability and widespread use of wireless based services, including fixed, mobile and broadcast applications as well as convergent services that combine attributes of two or all three of these. In this scenario, most consumer segments are avid users of mobile services and welcome the boost to broadband access that FWA and WLANs have provided. The business sector continues to push the boundaries of wireless usage through mobile, FWA, WLANs, as well as segment specific services such as PMR and PAMR. Businesses report increased productivity gains as employees have access to wireless based services that allow them to work more effectively and seamlessly, wherever they are.

Wireless technology provides all the benefits previously considered only achievable from fixed technologies, notably very high speed data transfers of hundreds of MBit/s. Fixed and mobile services work well together, with earlier interoperability issues sorted out. A wide range of audiovisual content is available, both in real-time broadcast format and on-demand, and accessible via a range of platforms including fixed display devices (e.g. TV) and portable display devices (e.g. PDAs and mobile phones).

Assumptions for Wireless Boom Scenario

Ref	Assumption	Likelihood	Impact
i	3G mobile becomes firmly established, with market penetration approaching the current levels of 2G services and widespread downloading of rich mobile content such as high-quality audio and video.	Medium	High
ii	Continuing growth in the transport and logistics sectors maintains demand for PMR and PAMR services, dedicated to particular user groups, including new digital and data-oriented services using wideband technologies.	High	Medium

Ref	Assumption	Likelihood	Impact
iii	Ubiquitous availability of digital multi-channel TV by cable/MMDS and satellite enables analogue transmissions to cease. Digital terrestrial transmission primarily focuses on mobile TV and other content, and on supporting broadband access in rural areas.	Medium	High
iv	Mobile digital TV and delivery of audio visual content to mobile phones is commonplace, using the DVB-H standard.	Medium	High
v	There is very high demand for broadband access throughout the country, which can be met only by radio in some areas due to remaining deficiencies in legacy wireline networks. Much of the demand growth is on-demand video content which drives bandwidth and quality of service requirements further, leading to pressure for more FWA spectrum in the 26 GHz and 40 GHz band.	High Medium	High High
vi	There is extensive availability of free "community" WLAN services, placing pressure on available spectrum and driving demand for more spectrum including licence-exempt spectrum.	High	Medium
vii	DAB has been launched and has achieved a substantial market penetration. L-band (1452 – 1492 MHz) DAB spectrum has been licensed for a mix of audio and multimedia services.	Medium	Medium
viii	Regional wideband PAMR services have been established to cater for specialist users.	Low	Medium
ix	Backbone radio links have largely been superseded by extensive fibre infrastructure. However there is continuing growth in demand for access and infrastructure links in higher frequency bands (above 12 GHz).	High High	Low Medium

A4.3.2. "Steady Growth" Scenario

This is a future of cautious optimism as society tests wireless based services and slowly acknowledges their potential benefits. End users have become relatively cautious in their adoption of wireless-based services as initial services could not meet their full expectations and as a result will not readily adopt new unproven services. In this scenario many end users hold out for the promise of better services and technologies to come, which provides a high level of inertia.

Although broadband availability has improved considerably, adoption continues at a steady pace rather than exponentially. Wireless-based services are seen as totally separate to other fixed services and interoperability between wireless and fixed services is problematic.

Annex 4 Planning for the Future: Two Scenarios for Wireless Market Evolution Continued

Assumptions for Steady Growth Scenario

Ref	Assumption	Likelihood	Impact
i	Widespread availability of broadband in non-rural areas, backed in part by government initiatives, involving extensive use of FWA technology. But take up of broadband in the market is limited and data speeds are no higher than today, so demand for spectrum has not gone beyond the currently available bands.	Low	Low
ii	Mobile data remains a niche market, 3G coverage restricted to main urban areas, no immediate demand for more spectrum.	Medium	Low
iii	Mobiles are still predominantly used for voice and messaging services, with limited demand for data, so there is no immediate requirement for any spectrum beyond the current 2G and 3G allocations.	Medium	Low
iv	There is only limited use of WLANs in homes and businesses and the existing 2.4 GHz and 5 GHz are sufficient to meet this demand. There is also only limited demand for public WLAN connections.	Low	Low
v	Continuing popularity of 2nd generation mobile technologies and analogue broadcasting constrains scope for new services in these bands and increased pressure on other available spectrum such as the 410-430 MHz band.	High	High
vi	Continuing reliance on radio for backbone networks has led to congestion in some frequency bands.	High	High
vii	Limited availability of terrestrial broadband access networks in rural areas has created demand growth for satellite based broadband access, both for individual users and to provide hubs for local communities who connect using WLAN connections	Low	Low

A4.4. ComReg Wireless Vision for 2010

A4.4.1. Introduction

Based on the responses to consultation document 05/01 and ComReg's assessment of the impact specific developments might have on future spectrum demand, a more detailed future scenario for the potential wireless market in 2015 has been developed. This scenario is intended to represent a plausible vision of a future where a substantial increase in spectrum demand would arise. A key element of ComReg's spectrum strategy will be to provide, as far as practicable, the flexibility to accommodate such demand should it arise. The scenario will be reviewed on an ongoing basis in consultation with industry and consumer groups

A4.4.2. Scenario Overview

The scenario underpinning ComReg's Wireless Vision for 2010 is characterised by a strong 'feel good factor' permeating society, not dissimilar to the late 1990s run up to the new Millennium. The Irish economy is very stable with strong growth based largely on the actions of people exhibiting highly individualistic characteristics. Technology is now really empowering both individuals and businesses and is highly trusted to deliver the required levels customisation and interaction demanded. Consequently, people quickly embrace the opportunities of new technologies.

Overall the scenario is one that is highly socially inclusive, upbeat and optimistic with high levels of pervasive, integrated technology supporting strong uptake of new communications services and applications, including wireless. The scenario envisages ubiquitous availability and widespread use of wireless based services, including fixed, mobile and broadcast applications as well as convergent services that combine attributes of two or all three of these. In this scenario, most consumer segments are avid users of mobile services and welcome the boost to broadband access that FWA and WLANs have provided. The business sector continues to push the boundaries of wireless usage through mobile, FWA, WLANs, as well as segment specific services such as PMR and PAMR. Businesses report increased productivity gains as employees have access to wireless based services that allow them to work more effectively and seamlessly, wherever they are.

Wireless technology provides all the benefits previously considered only achievable from fixed technologies, notably very high speed data transfers of hundreds of MBit/s. Fixed and mobile services work well together, with earlier interoperability issues sorted out. A wide range of audiovisual content is available, both in real-time broadcast format and on-demand, and accessible via a range of platforms including TVs, PCs, PDAs and mobile phones.

A4.4.3. Key Characteristics of the Scenario

ComReg's 2010 Wireless Vision is characterised by:

- highly stable economy with continuing strong growth of GDP at 5% pa;
- growing contribution to economy from telecoms and IT expenditure;
- customers very individualistic and fully embracing opportunities of new communications technology to support their lifestyles;
- cyber crime has reduced following concerted efforts to improve security and safety;
- the majority of businesses online, most with broadband connections and with universal acceptance of the importance of e-commerce and increasingly m-commerce;
- broadband, Internet and 3G mobile are all pervasive technologies interworking to a high degree;
- terrestrial digital TV has been launched and achieved 30% penetration;
- there is room for many players to exist in buoyant market and no major consolidations have occurred. Fourth 3G licence has been awarded and 3G market penetration is now over 80%;
- Niche public wireless networks cater for certain user groups (e.g. transport / logistics), alongside rising PMR and
- PAMR use which remains around 20% below current (2004) levels;
- broadband penetration has reached 80% of households, a quarter of these are served by some form of wireless connection;
- Over 60% of homes now use wireless local area networks to connect computers and/or multimedia entertainment devices;
- market forces dominate and there is little need for high levels of regulation;

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A4.4.4. Socio Economic Conditions

Ireland has emerged from the start of the 21st century as a prosperous, optimistic, well-educated economy and continues on a long-term upward trend. The economy is very stable with strong GDP growth of around 5% pa. Telecoms expenditure is a strong component of the Irish economy with telecoms end user expenditure amounting to over 5% of GDP. People are now much more likely to embrace new services and associated technologies and are willing to try out different options and to create their own combinations of services and applications. People now have a higher recognition of the benefits that technology brings to enhance their quality of life.

Ireland has developed a pattern of diverse working policies to suit and support individuals such as flexible, part-time working and home working. The more flexible workforce also has a broad and deep skills base as competition pushes the need for highly qualified specialist professional, often with skills in more than one discipline. Wi-Fi connectivity is routinely available on public transport services enabling commuters to access their office networks on the move.

Market operation is efficient with relatively short cycles and low levels of waste. Profit levels are maintained at levels which reflect the highly competitive nature of the industry and yet provide real incentives for further investment and market entry. Free market forces dominate and markets are highly competitive with players providing high levels of choice demanded by customers.

A4.4.5. Market Requirements

By 2010, markets are dominated by:

- strong groups of individuals who have a clear understanding of their needs and can translate that into very specific product and service requirements for their providers;
- businesses that have developed clear communications requirements and tend to test and evaluate new services to determine the best ones to support their operations.

Consequently, technology and service adoption is much faster across all markets including consumers, SMEs and large enterprises and a high proportion of services survive product launch and enter mainstream adoption. Buying and selling over the Web has become a way of life for businesses and consumers as they see the benefits of being able to put together individualised packages of products and services very easily in addition to the convenience of making transactions anytime, any place. However, as elsewhere, this has led to an increasing level of disintermediation.

A4.4.6. Consumers

Consumers form the most important customer group in the scenario by virtue of being the largest and most diverse group, driving the individualism in the economy. On the whole, consumers readily embrace the opportunities of technology and are becoming confident enough to pull together their own individual solutions from different technology and service components if necessary. They are willing to try new products and services and will trade up to the next best thing they think matches their needs.

People value their personal time and their individual diversity and enjoy higher levels of disposable income of which communications services and applications are taking a higher proportion. Disposable time is consumed across a wider range of activities which means individuals want much more personal control over how they use their time and want more mobile communications services and content to support their lives. There is now high usage of time-shifting products and services, such as personal digital video recorders and messaging, in response to need for more control and management of personal time. By 2005 most individuals began to use some form of time shifting product to manage their professional and personal lives.

Consumers readily buy goods and services online (increasingly using mobile terminals) as it allows them to shop around easily and make individual choices about the packages of services they need.

Users are very demanding of media and content providers to deliver highly interactive content and programming which users can customise to their individual requirements. They do not want standardised packages or bundles and look to providers to deliver ways of personalising services or content. They look for more mobile content and interaction with content whilst "away from base".

Consumers' key communications requirements centre around:

- personalisation of services to support lifestyle choices;
- mobility and the ability to access applications, services and content over a variety of devices and channels;
- secure high speed online access to goods and services from the home and elsewhere;
- applications and products for the management and control of disposable time;
- personal entertainment and support for finding and delivering digital content.

A4.4.7. Businesses

Businesses have high need for online services to serve consumers and other businesses most of whom are interacting via e-transactions. The majority of companies have websites set up for e-commerce. Over 85% of all businesses are buying goods and services online and over 80% are selling online.

Businesses have responded to the pressure from their employees for more flexibility in the workplace as people have become far more individual in their lifestyles. High levels of flexible working are achieved as individuals seek ultimate control over the balance between work, family and personal life. Visionary companies embrace this and support employees by providing the corresponding environment to allow remote working, including time-shifting working lives, pushing up reliance on broadband and mobile services.

A4.4.8. SMEs

SMEs continue to grow in number as they seek opportunities from the growth in niche markets. They are a strong influence in the economy not only because of the sheer number of SMEs but also because they can operate with almost the same advantages as larger enterprises brought about by high levels of adoption of broadband enabled online services giving them the reach and presence in the niche markets.

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SMEs' key communications requirements are for:

- high degrees of access to online customer databases;
- automation to provide cost advantages in front and back office operations;
- secure transactions to ensure trusted and reliable online commerce;
- secure networks to allow flexibility and access for remote working of employees;
- application and data interworking and sharing to allow SMEs to put together virtual value chains with other players targeting new market niches.

A4.4.9. Large Enterprises / Multinational Corporations (MNCs)

Large enterprises and MNCs represent a large market in terms of value of communications expenditure. Large enterprises embrace most technology advances in the belief that they will provide enhanced competitive advantage, e.g. in terms of speed to market or better market intelligence. Their communications requirements are for:

- pervasive high speed broadband and mobile access for employees;
- secure, integrated voice and data networking solutions providing national and international hub and spoke connectivity;
- high availability (at least 99.999%) for data integrity and security;
- management and communication for remote and mobile employees;
- service pricing related to speed, availability and reliability.

A4.5. Key Communications Technologies and Services

A4.5.1. Overview

The Irish technology base has become highly innovative and diverse. It has become much more user-focused, providing customer-led applications and services, which deliver their promise and reflect individuals' needs for security and protection. Ubiquity of demand has forced technologies to be highly pervasive covering geography and population. This has resulted, over the decade, in the development of a highly integrated communications infrastructure combining the delivery elements of fixed, mobile and broadcast communications.

There are high levels of R&D driving the next waves of innovation. Time to market has reduced, as have pay back periods for successful products as users are much more accepting of technology and have high propensity to try out and adopt the next innovation. There is now greater co-operation between network operators for interoperability – this is more than just interconnect and includes re-purposing of content, mediation, and use of shared network databases as well as roaming requirements across different networks.

A4.5.2. Broadband

High levels of broadband connectivity are required driven by increasing consumer and business demand. Individuals and SMEs readily adopt broadband with high levels of broadband demand and usage driven by high levels of availability of content and applications such as video streaming. Narrowband demand tails off rapidly over the period. Consumers have

a wide choice of quality broadband content which is easily customisable to suit individual requirements. Also, consumer triple-play (telephony, TV & Internet) services are now enjoying a wide appeal and compete strongly with cable offerings. This further drives DSL growth in the market and consumer broadband is now nearing saturation. There is high demand for broadband access by SMEs and most (over 80%) now use broadband as part of an integrated applications and content packages, often with bundled offerings including Internet access, e-mail, firewall and hosting services. ADSL has become the main access method used by teleworkers in SMEs and larger enterprises where DSL becomes an important access method for secure VPNs. Limitations of the legacy cable and fixed line infrastructure has led to fixed wireless networks gaining a 25% share of the domestic broadband market. Business demand for high speed communication links has driven demand for wireless services operating in higher frequency bands (26 GHz and more recently 40 GHz) that can delivery bit rates of up to 155 Mbit/s or more.

Certain rural areas remain unserved by broadband and there is pressure to release some of the UHF TV channels for rural wireless services, based on the IEEE 802.22 standard which has been widely deployed in the US.

A4.5.3. 3G Mobile

Both fixed and wireless technologies co-exist with no one technology claiming dominance as they are both demanded by users to deliver required service ubiquity. 3G mobility is a complement to fixed broadband. As such, 3G mobile is now a highly successful pervasive technology and is in a period of high growth with cheaper handsets, good levels of service support together with a broad range of personalised applications.

Mobile communications services are concentrated on voice, text and multi-media messaging and location or context-based information services are also very important. Customers have rapidly increased the amount of mobile data usage as they increasingly prefer to download content, exchange messages and engage in mobile commerce anywhere. Mobile data revenues have achieved penetration of 35% of total mobile revenues. M-commerce applications account for around 3.5% of mobile data revenues.

Audio and visual content now widely available to mobile devices and there is growing demand for access to spectrum in the TV broadcast band to support low cost content distribution (mobile phones with built in digital TV receivers have been available in Europe for several years).

All phones are now equipped with multimedia messaging capability. Individuals continue to grow usage of person to person messaging (including text messaging and increasingly photos and video). In addition, people readily adopt new forms of content messaging (machine to person) as they find benefit from information delivery to the handset any place, anytime in a way that they can personally configure.

Messaging usage rates and growth are very high as people enjoy the benefits of multimedia interaction on Peer to Peer as well as content delivery.

Plans are being developed for 4G introduced as an evolutionary step from 3G. Standards are by now well-developed and technologies have been agreed by the main players. Growing capacity demand increases pressure to release all of the 2.6 GHz band for mobile applications.

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A4.5.4. WLANs

Wireless LANs are commonplace as businesses quickly recognised the benefits of wireless technology. There is a relatively high penetration of WLANs with consumers as they see the benefits of untethered access to their services and applications in the home. Wireless 'freenets' based on Wi-Fi are well established, driven by community-minded individuals and security has improved since the early days, however these are increasingly supplanted by commercial offerings.

Public wireless LAN hotspots are very successful and commonly available in all major cities especially airports, libraries, branded chains of coffee shops, shopping centres, business parks and motorway service areas. The main users are business travellers, mobile 'road warriors' and the many high-end technically literate consumers who also use WLANs at home. Towards the end of the period, mesh radio and ultra wideband are starting to become potential substitute technologies.

A4.5.5. Internet

Narrowband Internet access has been almost entirely replaced by broadband access. Buying and selling over the Web becomes a way of life for businesses and consumers as they see the benefits of being able to put together individualised packages of products and services very easily in addition to the convenience of making transactions anytime, any place. Nearly all businesses have implemented websites with mission-critical capabilities as they see the benefits in relying on the now proven technologies, in the knowledge that consumers and other businesses have fully embraced the web era – indeed see it as the priority way of interacting.

A4.5.6. Digital TV

Terrestrial digital TV has been launched and achieved 30% penetration; with cable and satellite over 90% of homes now have digital TV. Analogue scheduled for switch-off by 2014. It has fulfilled its promise of providing personalised interaction allowing users to select and effectively manage their own programming. This is now important as there are high levels of cultural and regional diversity. Households and individuals have taken up multiple subscriptions for different family members as strength of individual choice and control is always high. Apart from live events, there is much less synchronised or simultaneous viewing. People are now watching broadcast programmes at a time that suits them.

A4.5.7. Devices

The convergence between computers, mobile phones and consumer electronics doesn't happen as anticipated and there is not one ubiquitous device that does everything. Specialist devices win the battle over multi-purpose devices. Users know exactly what they want from a product and how they want to use it. They are not satisfied with what they perceive to be sub-optimal 'generalist' devices and products. There are now more wearable devices and more connected (online) machines.

Vendors push the limits of technical development and design to introduce the 'next best' device packed with features and functionality. Specialist devices have become technically easier to build with component manufacturers having refined the art of integration resulting in the ability for simple cellular modules on a single chip which makes specialised devices much cheaper to produce. Customers seek out devices that will satisfy specific needs and are happy to have the necessary 'gadgets' for different jobs and applications as they have found from experience that separate devices do not compromise performance in the way that multi-purpose devices can do.

Early 3G handsets had a few teething problems but quickly these are overcome and they prove to be just as reliable as 2G handsets. Battery technology continued to improve to deliver high power and charge capacity to weight ratios. Nearly all individuals are satisfied that using mobile phones is safe, with little or no risk to health and any risks are far outweighed by the benefits.

Feature phones are continuing to sell very well and overtake sales of voice phones in 2005 as the content market opens up allowing individuals to gain easy access to games, music, video clips, etc. Multimedia feature phones also start to become more popular spurred on by developments such as video messaging functionality and the inclusion of digital broadcast receivers.

Vendors realise that users who want both PDA and feature phone capabilities would rather keep them separate in the same way that most consumers still buy their television and video recorders separately. Some individuals will have a core device (e.g. a good feature phone) and a number of other accessory devices which may be temporary or disposable.

Whilst devices are highly specialised, delivery platforms have become more standardised and integrated in order to provide the mechanisms for transporting to the plethora of devices. As such, applications and content are essentially platform independent, reliant on highly customised software which can be downloaded. The development of open standards and web services in particular has supported this platform independence. Multi-channel delivery has become the norm as users decide how they want to receive and access their content and applications; there is extensive re-purposing of content for multiple display devices.

A4.5.8. Service Portals and Digital Content Delivery

All portals are now highly personalised with multichannel access. Context management is now a key feature of portal applications, providing user interface and delivery of content according to the users' access device. Most users are now accessing content over mobile. Multi-channel delivery is now the norm and users have access to the same core content and services irrespective of the devices they use. Their preference is for a single relationship with their content and service provider rather than needing to have separate relationships and contracts according to the services they want. This drives major brand players to develop highly accessible multi-channel portals.

A4.5.9. Digital Audio / Multimedia Broadcasting

After a slow start DAB has made inroads on the strength of added value content and services (e.g. audio / video downloads and new specialist radio channels). Around 30% of homes now have a DAB receiver and an increasing number of mobile phones have DAB / DMB functionality. The latter have prompted the launch of L-band services that have been overlaid on the existing cellular networks.

A4.6. Implications for Spectrum Demand

- **Mobile:** Widespread demand for high speed mobile data means existing 2G and 3G spectrum is fully utilised and pressure is growing for access to other bands such as the 2.6 GHz band which is still being used by MMDS services.

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- **Wireless Broadband Services:** Demand for "wireless DSL" type services means 3.5 GHz band in particular is heavily used and has reached saturation in some urban areas. (10.5 GHz) is used in these areas to provide additional capacity and 5.8 GHz is widely used in smaller towns and villages. 26 GHz is increasingly used to serve business users and trial services are underway at 40 GHz offering STM-1 or higher data rates.

- **Broadcasting:** Digital TV is now in the majority of homes, many of which have multiple sets and rely on a mix of platforms for reception. Regional trials of mobile TV have been successful and there is now pressure from broadcasters and mobile operators to expedite analogue switch off to free up spectrum for national mobile TV multiplexes. DAB in band III is offering a range of new, specialist radio channels and L-band is being used to deliver mobile multimedia content to the latest generation of multi-mode phones. Portable and mobile content (TV and other audio / visual material receivable on hand-held devices) is a big growth market and there is pressure for access to UHF TV channels to deliver services to DVB-enabled mobile phones.

- **Satellite:** Satellite is being used to deliver broadband backhaul to rural areas, which are then served by licence exempt wireless networks, typically in the 5.8 GHz band.

- **Fixed links:** Strong growth in all bands above 15 GHz to provide infrastructure links for mobile and FWA networks.

- **Licence Exempt Spectrum:** In addition to growing demand for licence exempt wireless broadband services, there is also increasing demand for spectrum to accommodate short range applications for broadband connectivity, RFID applications and automotive applications such as collision avoidance radars.

Summary of Anticipated Spectrum Demand trends

The following table summarises the anticipated trends in demand for radio spectrum by various sectors, based on the scenario described above.

Key:
- ↑↑ = high demand growth anticipated
- ↑ = moderate demand growth anticipated
- ↔ = little change anticipated
- ↓ = moderate decline anticipated
- – = demand not anticipated

	Below 3 GHz	3 – 15 GHz	Above 15 GHz
Mobile	↑	↔	–
Wireless Broadband	↑	↑↑	↑
Broadcasting (terrestrial)	↔	–	–
Satellite	↔	↔	↔
Fixed Links	↓	↔	↑
Licence Exempt	↑	↑	↑