The 2.6GHz Spectrum Band
An Opportunity for Global Mobile Broadband

Introduction

Data traffic on mobile broadband networks is growing exponentially as both consumers and business users turn to smartphones, connected laptops, tablet computers and other devices to access the Internet, email, business applications and social networking services.

In developing countries, mobile networks are being used to provide broadband services to the many communities beyond the reach of the limited fixed-line infrastructure. The GSMA believes that mobile networks have the potential to make universal access to broadband services an achievable goal.

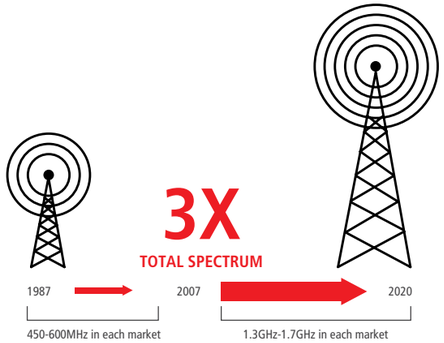
But mass-market usage of mobile broadband, particularly in densely-populated or visited areas, will only be possible if mobile networks have sufficient capacity and that depends on governments making more spectrum available.

It is particularly important that governments allocate 190MHz in the 2.6GHz frequency band for mobile broadband services. As well as offering a major increase in capacity, the 2.6GHz band has the potential to be used for mobile broadband services worldwide, providing equipment makers with global economies of scale, enabling them to lower the cost of devices and network infrastructure.

The allocation of the 190MHz available in the 2.6GHz band would make a substantial contribution towards meeting market demand for mobile broadband services. According to the International Telecommunication Union-Radiocommunication (ITU-R) Report M.2078, by the year 2020, International Mobile Telecommunications-2000 (IMT-2000 or 3G) services will need:

- 1,280MHz for low market demand (rural areas)
- 1,720MHz for high market demand (urban areas)

Increasing Spectrum Requirements

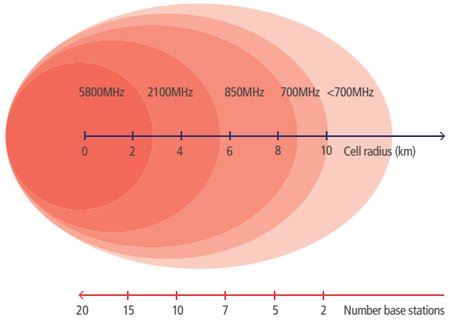


The 2.6GHz band is unique in that it could become a common global band for commercial mobile broadband services. It also offers a substantial amount of spectrum (190 MHz) to meet the growing demand for aggregated bandwidth and high data rates.

The Role of the 2.6GHz Band for Mobile Broadband

The amount of spectrum issued to mobile operators will determine whether they have the bandwidth required to handle the increasing traffic volumes generated by rising demand for mobile broadband, while continuing to deliver high-quality services to their customers. Ideally, mobile operators need a mix of high-frequency and low-frequency spectrum, as different types of spectrum are better-suited to different purposes.

An operator will need a portfolio of spectrum bands to offer commercially viable services across a mix of urban, suburban, and rural areas.



Source: BBC R&D, SFC Associates "The Mobile Provide"

In general, lower frequency bands (e.g. 700MHz) are well-suited to the roll-out of broad network coverage at relatively low cost. Using higher frequencies (e.g. 2.6GHz) increases the cost of coverage, but these bands are better-suited to providing the capacity necessary to meet demand for high-data rates from large numbers of users in urban areas, airports and other heavily-visited locations.

The International Telecommunication Union (ITU) has identified 2500-2690 MHz as a global band for International Mobile Telecommunications (IMT). The definition of a common IMT band across all three ITU regions raises the prospect of equipment makers being able to produce network infrastructure and devices that can be deployed across the world. By being able to generate global economies of scale, equipment providers will be able to maximise cost-efficiencies and ultimately make mobile broadband accessible to everyone, everywhere.

Four spectrum-related factors determine whether mobile operators can provide affordable and high-quality broadband access and services to consumers:

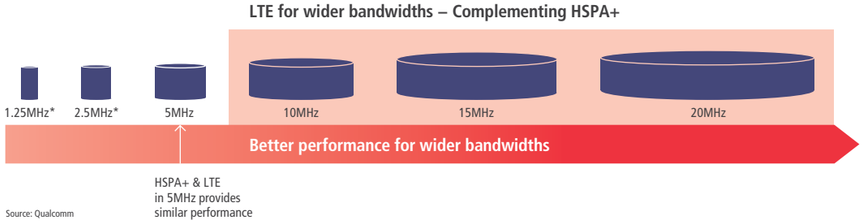
- Access to the right 'type' of spectrum (harmonised bands)
- Access to the right combination of frequency bands (above and below 1GHz)
- Access to sufficient spectrum (enough bandwidth)
- Access to spectrum at a reasonable price so as not to affect deployment and service uptake
- Efficient, fair and transparent spectrum allocation processes

The 2.6GHz spectrum band is the ideal complement to the 700 MHz-800MHz spectrum bands, known as the 'digital dividend' frequencies. Together, these bands can provide the most cost-effective nationwide coverage of mobile broadband services across both rural and urban areas.

Wide Channels Provide Optimum Mobile Broadband Performance

The efficient operation of the latest wireless technologies, such as LTE and WiMAX, identified by the ITU as IMT-Advanced, requires significantly larger spectrum channels than the preceeding (3G or IMT) wireless systems. Unlike their predecessors, these advanced technologies use an Orthogonal Frequency Division Multiple Access (OFDMA) radio interface that requires larger and contiguous blocks of spectrum to be able to operate efficiently.

LTE is designed to leverage new and wider bandwidth



Source: Qualcomm

Advantages of allocating contiguous blocks of spectrum to LTE

- Users are demanding anytime, anywhere access to broadband multimedia services. The demand for data services is relatively high in dense urban areas. In such areas, LTE, with its ability to leverage wider bandwidths, can be employed to significantly increase data capacity, effectively augmenting existing 3G networks.
- LTE's OFDMA technology excels in leveraging wider bandwidths to provide very high data rates and thereby an excellent user experience, making it best suited for new spectrum with bandwidth of 10 MHz or more.
- With a wide channel, a licensee can offer high-quality mobile broadband services, and be able to take full advantage of future enhancements to LTE technology, while gaining even greater spectral efficiency.
- LTE supports bandwidths up to 20 MHz as well as both frequency division duplex (FDD) and time division duplex (TDD) modes, allowing operators to utilize all available spectrum resources.

In general, LTE networks in 2x10 MHz spectrum channels will cost twice as much to deploy as services in 2x20 MHz channels, according to a study by Empiris. The study found the use of 2x5 MHz channels doubles the necessary capital expenditure again.

Minimum monthly cost of LTE service under different spectrum allocations

Source: Empiris

In most countries, the 2.6GHz band is probably the only band with the scope to give operators blocks of 2x20 MHz of contiguous spectrum, enabling them to operate high-speed LTE services at optimum performance.

The Importance of Internationally Harmonised Band Plans and Channelling

The international harmonisation of frequency bands has several key benefits:

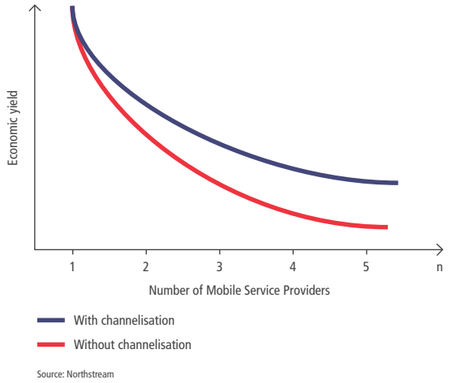
- **Cost-effective roll-out of networks and devices** A reduction of up to 50% in the cost of device manufacturing[1].
- **Drives service uptake** Affordable devices make mobile broadband services accessible to a wider range of people.
- **Reduces cross-border interference and helps facilitate international roaming.**

Adverse consequences can arise if the band is not channelized efficiently:

- **Lower technical efficiency** Fragmentation within an allocation may cause interference problems, introducing the need for extra guard bands and reducing the technical efficiency of the overall allocation.
- **Lower economic efficiency** There will be more uncertainty about the performance of an allocation, reducing its value to all stakeholders including local regulators.
- **Negative impact on service uptake** A band structure which differs from international norms will require the use of special equipment designed exclusively for that market, which will be much more expensive for operators and ultimately consumers.

Defining channel arrangements before licensing provides potential bidders with clear expectations on how the 2.6GHz extension band could be used most effectively. Therefore, channelized bands would receive a higher valuation from investors offering better economic yield for utilisation of this limited resource.

Economic yield to regulators selling extension band



Source: Northstream

Equipment provider Ericsson has estimated that the cost of reducing harmful interference between un-harmonised adjacent operations can be USD 60 million per "mode of transmission border" in a country of about 15,000 base station sites.

1 AT Kearney Asia Pacific Mobile Observatory 2009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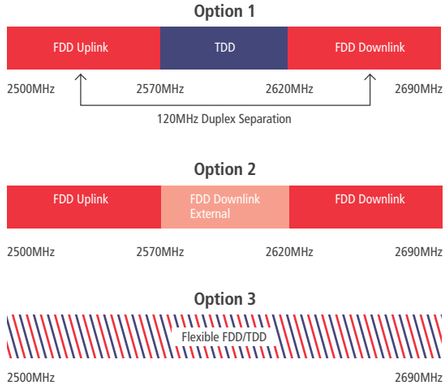
Optimal Channel Arrangements for the 2.6GHz Band

The ITU, in Recommendation ITU-R M.1036-3, has defined three alternative channel arrangements for the 2.6GHz band plan:

- **ITU Option 1:** Preconfigured allocations of paired (FDD) and unpaired (TDD) spectrum - 2x70MHz for FDD and 50MHz for TDD.
- **ITU Option 2:** Paired spectrum only, with the uplink portion of some pairs in another undetermined band.
- **ITU Option 3:** Flexibility - the bidders for spectrum can decide how they want to allocate the spectrum they acquire to paired (FDD) or unpaired (TDD) operation.



The GSMA is campaigning for the 2.6GHz band to be licensed in line with **Option 1**, as this would allow for the deployment of FDD services without interference from TDD services. **This is the only full technology-neutral option**. Option 2 has been widely-rejected because it violates the principle of technology neutrality and does not accommodate demand for unpaired spectrum. Option 3 introduces uncertainty with respect to both interference and business models for technologies working on paired spectrum that needs 120MHz duplex gap separation.

The GSMA believes ITU Option 1 is far superior to ITU Option 3 because it offers significant advantages in terms of:

1. Interference management (no roaming conflicts);
2. Costs and availability of equipment;
3. Coverage and battery life for mainstream devices;
4. Business model certainty and attractiveness to investors;
5. Most efficient use of a national scarce resource.

ITU Option 3 has several weaknesses:

- Multiple, diverse TDD and FDD spectrum blocks will entail loss of coverage, interference between devices (very hard to avoid) and a reduction in usable spectrum due to the need for more guard bands.
- It would likely lead to a number of different national band plans (no practical harmonisation).
- It would require country-specific equipment which will be more expensive (no economies of scale).
- International roaming will be more difficult to implement across different country band plans.

The advantages mean that ITU Option 1 is best positioned to be the mainstream option as it will stimulate market growth by upholding technology-neutrality and a pro-competitive environment.

International Progress on Licensing the 2.6GHz Band

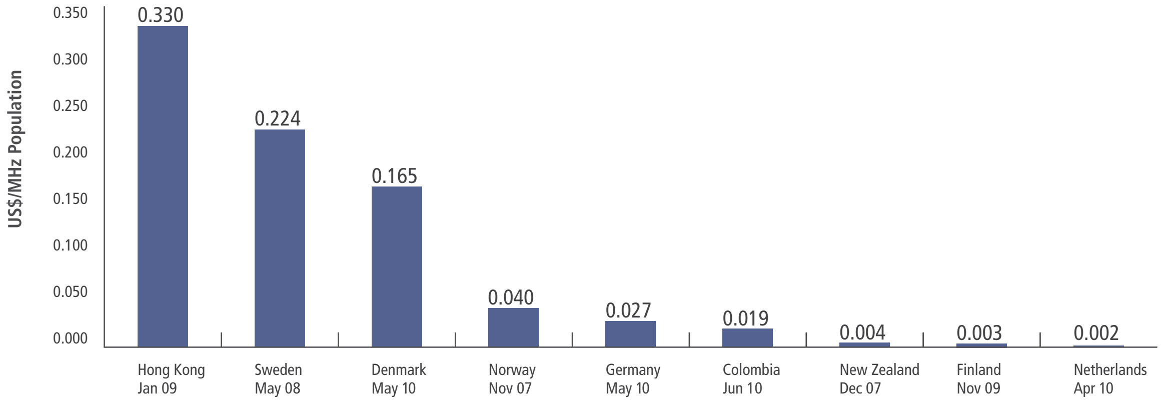
The ITU Option 1 band plan has been widely adopted in Europe following a recommendation from the European Conference of Postal and Telecommunications Administrations (CEPT)[2]. Norway was the first country to license the 2.5-2.69GHz band in 2007, followed by Sweden in 2008, Finland in November 2009, and most recently Denmark, Netherlands and Germany in 2010. Some countries defined the auction adopting the CEPT band plan, while others had let the market decide between FDD and TDD. However, auction results have proven the market favors less uncertainty and harmonisation. In most of the market-driven cases we are seeing a convergence to ITU Option 1 (e.g. Norway and the Netherlands). More European countries are preparing to license the band soon, and there seems to be consensus on the advantages of following the approach that pre-configures FDD and TDD allocations.

Other countries, such as Singapore (which licensed the band in May 2005) and Hong Kong (October 2008), have followed an approach aligned with the ITU Option 1 band plan. Others, such as Chile and Brazil have defined this structure well in advance to licensing the spectrum to give more certainty to prospective investors and vendors on how they would be able to exploit it.

In December 2009, TeliaSonera became the first mobile operator worldwide to deploy LTE services, rolling out LTE networks using the 2.6GHz band in both Sweden and Norway. Building on its existing LTE coverage in Stockholm and Oslo, TeliaSonera is planning to expand the service to another 29 cities in these two countries.


TeliaSonera first in the world with 4G services

Prices paid for 2.6GHz spectrum



Source: GSMA

Ensuring Technology Neutrality
Advanced mobile technologies, such as LTE and WiMAX, will support both FDD and TDD duplex access schemes. This capability has broken the tie between technologies and bands and modes of transmission. Technology neutrality is becoming increasingly dependent on the potential of the business case, in which economies of scale are key. To ensure full technology neutrality, the 2.6GHz spectrum band needs to be structured in a way that will enable the deployment of networks that will be compatible with widely-available infrastructure equipment and devices.

The GSMA continues to encourage more countries to licence the 2.6GHz band using a clear spectrum structure to stimulate more and better mobile broadband services. This would allow next generation technologies to work smoothly, thereby ensuring the maximum economies of scale and multiplying the variety of devices for consumers.

2 CEPT Electronic Communications Committee (ECC) reference ECC/DEC/(05)05; and the Commission of the European Communities decision of 13 June 2008 reference 2008/477/EC

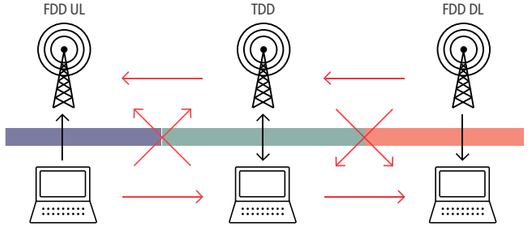
Dealing with Interference and Legacy Uses

Studies performed and discussed in technical international fora show that a minimum guard band of 5 MHz is necessary to address potential interference between TDD and FDD systems operating in adjacent bands in the same geographical area.

ITU Option 1 requires only two interfaces between FDD and TDD spectrum with clear rules for frequency coordination and interference management. As a result, two 5 MHz guard bands should be considered in this model at 2570-2575 MHz and 2615-2620 MHz. Provided that ITU Option 1 is adopted by all neighbouring countries, these same rules apply both across borders and between regions within countries.

By contrast, ITU Option 3 may well introduce significant complications into interference management. The way to reduce the interference between mobile broadband base stations using FDD and TDD respectively, while serving a mass-market in the same area, is to introduce:

- Additional filtering in both receivers and transmitters.
- Additional guard bands or restricted channels.
- Reducing RF power, but this is not a viable option as it will require additional base station sites.



If the frequency arrangement is harmonised between countries, the interference can be controlled. In cases of non-harmonised spectrum arrangements, severe interference problems will occur in terms of complex border coordination and, ultimately, spectrum efficiency, equipment cost and availability of end-user devices will be negatively affected.

Coexistence with Legacy Users such as MMDS
In several countries, the 2500-2690 MHz band is being used for Microwave Multipoint Distribution Systems (MMDS) to transmit broadcast content. However, these services tend to be outdated and to underutilise the spectrum.

Coexistence of IMT and MMDS services in the 2.6GHz band is possible if the frequencies are sufficiently separated. The required frequency separation is 20MHz, but it could be possible to reduce this value if filters can be used on MMDS receivers. Modernization of MMDS systems (going from analogue to digital modulation) will also reduce their need for spectrum.

Several countries that currently have MMDS broadcasting services, such as Brazil, Mexico, South Africa, Saudi Arabia and Canada, are engaged in recuperating underutilised spectrum and reallocating these services in a TDD centre block, enabling the band to converge on international harmonised ITU Option 1.

In August 2010, the Brazilian regulator ANATEL, decided to refarm 2.6GHz relocating existing MMDS operations in a central TDD block of 50 MHz (2570 MHz to 2620 MHz) and in another block of 2x10 MHz FDD with 120 MHz duplex gap separation (2500 MHz-2510 MHz paired with 2620 MHz-2630 MHz) so as to converge with ITU Option 1. Guard bands were decided to be internalized in the TDD part of the band.

According to the major equipment vendors, mobile broadband devices for the 2.6GHz band have been defined with filters that operate exactly within the ITU Option 1 band plan, as it is both the optimum and the most-adopted option.

Summary

- More spectrum is needed to meet demand for mobile broadband.
- Allocation of the 2.6GHz band for mobile services is vital to ensure sufficient spectrum is available to meet growing demand for mobile broadband around the world, particularly in heavily-populated areas.
- The 2.6GHz band needs to be structured in line with international norms.
- ITU Option 1 is the best way to structure the 2.6GHz band.
- Regulators need to begin clearing the 2.6GHz band now and place it on their licensing roadmap.

A harmonised FDD/TDD band plan means:

- Reduced complexity, leading to cheaper and smaller devices.
- Greater economies of scale, leading to more choice for consumers and lower prices.
- More coverage and longer battery life for FDD devices.
- An interference free environment.
- Clear business models and greater investment incentives.

A flexible FDD/TDD band plan means:

- Customized devices for each FDD/TDD segmentation, meaning expensive devices, loss of economies of scale and loss of roaming capabilities.
- Loss of 5 MHz of spectrum due to the need for additional guard bands between FDD and TDD.
- Risk of interference, blocking and international roaming problems.

For more information please see Global View Partners report "The 2.6GHz Spectrum Band: Unique Opportunity to Realize Global Mobile Broadband", January 2010[3].
This report can be downloaded at www.gsmworld.com/gvp_report.

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