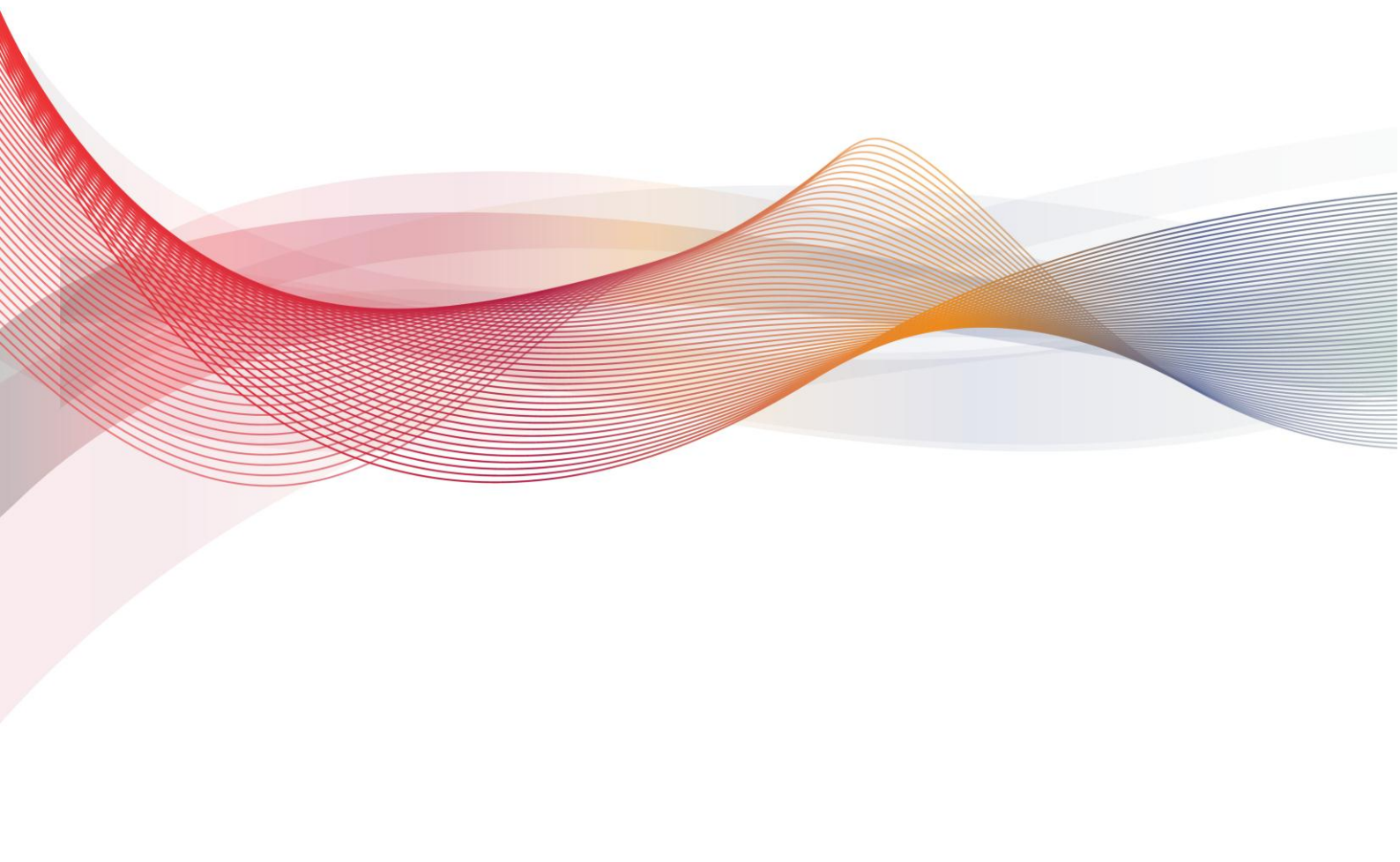
GSMA Public Policy Position

Mobile spectrum requirements and target bands for WRC-15



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Executive Summary

At the World Radiocommunication Conference in November 2015 (WRC-15), administrations from around the world will agree on changes to international spectrum allocations and associated regulatory provisions. The outcome will be the single most important factor determining the future availability of affordable, ubiquitous, high-speed mobile broadband services.

The decisions made at WRC-15 will also have a direct impact on the wealth, well-being and future prospects of all countries and their citizens. For example, the mobile industry (both directly and indirectly) created 3.6% of global GDP (equivalent to $2.4 trillion) and directly supported 10.5 million jobs in 2013 – this is expected to rise to 5.1% of GDP and 15.4 million jobs by 2020.[1]

This document addresses the need for more mobile spectrum, the frequency bands which suit deployments, and proposes how to address the needs of the existing spectrum users. The aim is to inform the policymakers and regulators who are making spectrum allocation decisions and developing national and regional proposals in the lead up to WRC-15.

The tremendous growth in mobile data means that, on average, an additional 600–800MHz of spectrum should be made available for International Mobile Telecommunications* (IMT) at WRC-15 so it is ready for potential use by 2020. This will allow national administrations to continue to support existing services while giving them the flexibility to make new mobile spectrum available, when needed, to avoid a degraded consumer experience.

The GSMA proposes four frequency ranges within which the 600–800MHz could be satisfied most suitably:

- **Sub-700MHz UHF (470–694/8MHz)** can deliver high quality, wide area coverage for mobile broadband services including in rural areas and deep inside buildings. Broadcasting services could be maintained in a smaller amount of spectrum using the latest broadcast technology and coding solutions.
- **L-Band (1300–1518MHz**)** is capable of delivering additional capacity and coverage over relatively large areas, including inside buildings. A portion is already allocated to the mobile service worldwide and another is reserved for digital radio broadcasting, but is largely unused, creating an ideal basis for a wider mobile allocation. Radar and aeronautical telemetry can continue to operate in this spectrum although they may be able to use their assets more efficiently in future.
- **2.7–2.9GHz** would provide important extra mobile capacity, and deployments would be cost-effective because existing cell sites could be used. It is primarily used for civilian and military aircraft navigation and radar-based location as part of air traffic control systems. However, research shows that the band is under-utilised creating the potential to allow the mobile service to operate in a portion. Furthermore, the financial benefits of using part of the band for mobile services amount to over 10 times the costs of relocating existing users into a smaller amount of spectrum.
- **C-Band (3.4–4.2GHz)** provides, due to the size of the band, a unique opportunity to deliver very fast mobile broadband services in small hotspots where mobile networks are under pressure from rapidly growing data usage. It is largely used for satellite services, especially in the tropics where rainfall has hindered the use of other bands. However recent technological developments mean alternative satellite spectrum is able to deliver improved performance and better value services in all areas, including the tropics.

Separately, the GSMA notes the positive progress being made towards meeting the conditions necessary for the release of the 700MHz band for mobile use in Region 1 (i.e. Europe, the Middle East and Africa) which will be addressed at WRC-15 under agenda item 1.2. There is already widespread agreement on a band plan that includes suitable provisions to protect broadcasters. The timely release of this band is essential in order to ensure LTE services can cost-effectively scale to meet growing demand, especially in rural areas, inside buildings and in emerging markets.

* An IMT identification refers to a specific frequency range in a band that is designated for potential use by compatible mobile broadband technologies, including all 3G and 4G networks.

** Except 1400–1427MHz which is allocated to radio astronomy. The GSMA also recognises that recent developments mean the upper limit should be 1518MHz not 1527MHz, which was its previous position.

Future Mobile Spectrum Requirements

Mobile services are undergoing a period of dramatic growth causing a tremendous increase in data traffic which in turn is making new technologies and mobile spectrum essential. The rising data demand is being driven by the growing number of mobile subscribers, and particularly smartphone users, who are connecting to faster networks and consuming higher-bandwidth content and services such as video.

The number of mobile connections is predicted to increase from 6.9 billion in 2013 to 9.2 billion by 2020[2], of which 5.9 billion are expected to be data-hungry mobile broadband connections. A growing proportion of users will be connecting to 4G networks which are having a transformative effect on consumer behaviour. Mobile operators in mature markets, such as KT in South Korea, report that the average 4G user consumes double the data of their 3G counterpart.[3]

These faster connections are being exploited by a rising number of smartphones that are tasked with increasingly bandwidth-heavy applications. The smartphone installed base is expected to grow from 1.5 billion in 2013 to almost 3 billion in 2017[4] resulting in a surge of traffic as these devices generate on average 48 times more mobile data than a basic feature phone.[5] Their larger screens make them especially suited to high-bandwidth on-demand video services which made up more than half of mobile data traffic in 2013 and should exceed two-thirds by 2018.[6]

The ITU's official spectrum demand model assumes that mobile traffic will increase between 44 and 80-fold between 2010 and 2020.[7] In response, mobile operators are investing heavily in new technologies (e.g. LTE and LTE-Advanced) and new network architectures (e.g. small cells). However, such is the speed of data growth that operators will require access to significant additional spectrum in future to efficiently meet widespread demand. Taking into account all other capacity enhancing measures, the ITU predicts that an average total of 1340–1960MHz will be required for IMT/mobile broadband by 2020 (the variation reflects the upper and lower data demand estimates).[8]

The ITU predictions are in line with GSMA research which finds that 1600–1800MHz will be required by 2020. Given around 1GHz has already been identified for IMT/mobile broadband, the GSMA recommends that, on average, an additional 600–800MHz should be sought at WRC-15 worldwide. The amount needed for each national market will vary depending on differing levels of data demand and national priorities.

The new mobile spectrum should comprise a mixture of coverage (i.e. lower frequency) and capacity (i.e. higher frequency) bands to ensure that networks can provide high speed, cost-effective services in rural and metropolitan areas as well as deep inside buildings. It must also be harmonised globally, or at least regionally, to drive the economies of scale required for low cost consumer devices and to enable roaming and minimise cross-border interference.

What's at Stake?

By allocating sufficient additional spectrum for the mobile service at WRC-15, governments will be able to continue supporting existing services for as long as necessary, while also ensuring they have the flexibility to gradually increase the amount available for mobile broadband when required. In the absence of new allocations, their ability to make new mobile spectrum available as data traffic rises will be limited resulting in a poorer user experience and potentially more expensive mobile services. As it takes about eight to ten years to re-allocate, re-assign and re-license spectrum, it is essential that administrations act now rather than reacting when it is too late to meet growing consumer demand.

Due to differing market conditions, some administrations may not see the need for new mobile allocations based on the belief there is insufficient national data demand. However, beyond the fact that additional spectrum will only be made available to mobile operators when there is necessary demand, there are other important reasons for supporting new mobile bands at WRC-15.

First, new mobile bands support all markets regardless of their different near-term spectrum requirements. Growing numbers of early adopters drive the economies of scale that bring down the cost of network equipment and devices for later deployments. This is especially important for

developing markets which benefit most from the low-cost smartphones and network equipment that were mass-manufactured for other countries.

Second, it is possible that future data demand projections may underestimate growth. In 2010, mobile data traffic was five times greater than some of the estimates made in an ITU report from 2005, and had already exceeded some estimates made for 2020.[9] It is possible this could happen again especially given that research into 5G is accelerating and smartphone costs are dropping sharply,[10] making them viable for mass adoption in emerging markets. At the same time, the 'Internet of Things' and 'big data' – which both depend on telecom networks – are routinely predicted to be two of the most transformative technology trends of the modern age.

Over the coming years mobile services could transform society more than at any other time in its history. Faster and more ubiquitous mobile networks are set to create a more connected world where billions of wirelessly-enabled devices will create data feeds that drive new smart cities, industries and whole countries. But the capacity and reach of these networks will always be determined by spectrum. By ensuring sufficient spectrum is allocated to the mobile service at WRC-15, national administrations will have the flexibility to assign the amount they choose rather than having their future confined by existing allocations.

Agenda Item 1.1 – Suitable New Mobile Bands

At WRC-15, agenda item 1.1 addresses additional spectrum allocations to the mobile service and the identification of frequency bands for IMT/mobile broadband all around the world. The GSMA has identified four frequency ranges within which the spectrum requirement for future mobile broadband could be best satisfied and where existing services could continue to use parts of the bands through coordination and spectrum planning. These are based on detailed studies which assess how different services can share the frequency bands and the economic benefits of change.

Although some administrations may pursue other bands based on their individual circumstances, the likelihood of establishing a globally harmonised allocation at WRC-15 may be reduced if there is little international consensus. The following frequency ranges represent credible options because they could be used in most markets across all three ITU Regions creating internationally harmonised spectrum. This will lower the cost of equipment, enable roaming and reduce international interference.

- Sub-700MHz UHF (470–694/8MHz)
- L-Band (1300–1518MHz)
- 2.7–2.9GHz
- C-Band (3.4–4.2GHz)

1. Sub-700MHz UHF (470–694/8MHz)

The GSMA recommends that the 470–694/8MHz band be allocated[11] to the mobile service globally alongside broadcasting and that a significant portion be identified[12] for IMT/mobile broadband. However, this identification should not be pursued at present in Region 1 to ensure it does not jeopardise discussions in Europe on the future of the UHF Band.[13] The band has the right qualities for delivering widespread mobile broadband while existing services could be maintained in a smaller amount of spectrum.

The band would provide a vital means of delivering high quality, wide area mobile broadband services including in rural areas and deep inside buildings. It would augment the existing 700MHz and 800MHz bands, which are proving instrumental in delivering widespread LTE services and narrowing the digital divide, but which could approach full capacity in the coming years leading to a deteriorating experience for consumers.

Furthermore, the sub-700MHz band could use existing 700MHz and/or 800MHz cell sites, providing vital additional capacity across wide areas without major additional deployment costs. Higher frequency bands, such as 2.1GHz, cannot deliver the same nationwide coverage without a prohibitively high investment in infrastructure, making sub-1GHz bands a unique means of building virtually ubiquitous, cost-effective mobile broadband networks.[14]

There is also considerable potential for global harmonisation which would drive low cost equipment and widespread roaming. The entire band is allocated to the mobile service alongside broadcasting in Asia-Pacific and a significant portion is allocated to the mobile service in select countries in the Americas. Furthermore, the FCC is already planning to auction the 600MHz band for mobile broadband use in 2015 in the US.

The GSMA recognises that this band is currently used almost entirely for terrestrial broadcasting services around the world, but the number of consumers using these services varies enormously. Many countries predominantly rely on alternative delivery methods such as cable, satellite and, increasingly, broadband.

In future, broadcasting services could be maintained in a smaller amount of spectrum using the latest broadcast technology and coding solutions leaving a portion for mobile broadband services. This is possible by moving from analogue to digital TV, then to more efficient transmission technologies (e.g. the move from DVB-T to DVB-T2[15] improves spectral efficiencies by 50-60%[16]), and by employing state-of-the-art video codecs which are currently able to reduce the bandwidth requirement for a given quality of content by around 10% per year.[17]

This change will augment access to TV content by improving on-demand services through broadband networks and supporting a wider variety of linear delivery options through LTE broadcast. This complementary content delivery model is increasingly important in developed markets where fewer people are watching terrestrial broadcasts[18], and growing numbers are consuming linear and non-linear content over broadband networks and on mobile devices.

It is equally important in less developed markets where terrestrial TV is less used and there are fewer channels. A portion of the sub-700MHz band could be more productively made available to meet the burgeoning demand for affordable mobile broadband services, which can support a variety of content delivery methods, including LTE broadcast.

However, regulators will decide if and when they make a portion available for mobile use in their countries, based on their situation and in consultation with neighbouring countries. In order to establish a smooth transition for both terrestrial broadcasting and mobile services, the process of readying a portion for mobile broadband use will take time and require a clear roadmap.

2. L-Band (1300–1518MHz)

The GSMA recommends that a significant portion of the 1300–1518MHz band (excluding 1400-1427MHz) be allocated to the mobile service (where not already allocated) and identified for IMT/mobile broadband. It has the right qualities for mobile use and a sizeable portion could be made available for mobile broadband services relatively easily.

The band is able to deliver widespread mobile broadband services because it offers a good balance of capacity and coverage over relatively large areas, including inside buildings. Crucially, a significant portion of the band is already allocated to the mobile service worldwide (i.e. 1427–1525MHz) creating a major opportunity to quickly identify a harmonised band.

The existing mobile allocation contains a portion that is currently reserved for digital radio broadcasting (1452–1492MHz) which is effectively unused sand could therefore easily form the basis for a globally harmonised IMT/mobile broadband identification. This approach is already gaining traction with regulators and a decision has been made in Europe to make this band available for mobile broadband.

The band currently supports a variety of applications including aeronautical telemetry, military and civilian radar systems, fixed link transmission systems, satellite telephony and earth observation satellites. A major portion of this spectrum could be made available for mobile because existing radar and aeronautical mobile telemetry services could use their existing spectrum allocations more efficiently. Studies show that mobile broadband should be able to operate alongside these services with relatively small guard bands under certain constraints.[19]

3. 2.7–2.9GHz

The GSMA recommends that the 2.7–2.9GHz band be allocated to the mobile service and a substantial portion identified for IMT/mobile broadband. It could deliver crucial extra mobile capacity in busy urban city centres where data traffic is rising quickly and deployments would be relatively low-cost because existing 2.6GHz cell sites could be used. It is also clear that current usage of the band means mobile services could be accommodated in a separate portion.

The band is primarily used for civilian and military aircraft navigation and radar-based location as part of air traffic control systems. In the past, studies have shown that these services cannot operate alongside mobile without prohibitively large exclusion zones. However, these conclusions are no longer valid as they were based on less spectrum efficient radar technology and use of the same, rather than adjacent, radio channels for both services.[20]

It is becoming increasingly clear that existing users in the band are not using the full amount everywhere. Although Europe is one of the heaviest users of air traffic control radar, an EC study shows that the 2.7–2.9GHz band is under-utilised in most areas, and this appears to be the case worldwide. A key reason for this is that most airports can already use alternative technologies for monitoring flight traffic and new radar technology is much more bandwidth efficient.

As a result some countries that have traditionally opposed allowing a portion of the band to be used for mobile services are reassessing the situation. For example, the UK is currently assessing allocating up to 100MHz of the band to the mobile service following research that found its radars could occupy far less spectrum.[21]

There is also a compelling economic argument for allowing mobile services to occupy a portion of the band. Research from Aetha Consulting shows that the estimated financial benefit of using the band for the mobile service in Western Europe would be over 10 times greater than the costs associated with relocating existing radar services.[22]

4. C-Band (3.4–4.2GHz)

The GSMA recommends that the 3.4–4.2GHz band be allocated to the mobile service alongside existing satellite services and that a significant portion be identified for IMT/mobile broadband. The size of this band provides a unique opportunity to deliver very fast mobile broadband services in small hotspots, such as coffee shops and train stations, where mobile networks are under pressure from rapidly growing data usage. There is also an opportunity to easily identify a globally harmonised portion for IMT/mobile broadband and evidence that mobile and satellite services could co-exist in separate parts of the band.

The harmonisation potential is especially strong because a significant portion of the band (i.e. 3.4–3.6GHz) has been identified for IMT/mobile broadband in much of Europe, the Middle East and Africa as well as a small number of countries in Asia and Oceania. The situation is also positive in the Americas, and in the Asia Pacific, where most of the C-band is allocated to the mobile service on a co-primary basis (i.e. 3.5–4.2GHz) alongside fixed satellite services (FSS).

The band is predominantly used for FSS, such as broadcast TV, VSATs and satellite broadband, especially in tropical countries where the effect of rainfall has historically limited the use of other bands. However, recent technological developments mean that rainfall is becoming less of a limitation[23], with several satellite providers using higher frequency bands to deliver improved performance and better value services in the tropics (e.g. SES, o3B and Avanti).

Identifying a portion of the band for IMT/mobile broadband there will still allow sufficient spectrum to support FSS services in the tropics and other areas where necessary. This would give national regulators greater flexibility to use the band as they see fit and prepare for the long-term demand of all services. Furthermore, existing services in the entire band can continue to be protected from interference through international coordination between neighbouring countries and the use of appropriate technical and regulatory conditions.

Some satellite providers argue that interference studies show that the two services cannot co-exist in the C-Band. However, this argument is based on sharing studies conducted for WRC-07 using assumptions that were not realistic. More recent sharing studies show that large exclusion zones are not necessary making mobile broadband use possible.[24] In fact, the 3.4–3.6GHz band is already being successfully shared between mobile operators and satellite providers with no known cases of cross-border interference.

Finally, the economic case for change is strong, as research shows the financial benefits of allocating a portion of the band to mobile services – even in areas where FSS is highly used – would surpass the costs of moving existing services elsewhere in the C-Band or into different satellite frequencies. A study of the Asia-Pacific market by Frontier Economics shows the benefits exceed costs by approximately eight times, would increase government revenue by $52 billion, and create in excess of 100,000 new jobs.[25]

Agenda Item 1.2 – 700MHz in Region 1

At WRC-15, agenda item 1.2 will specifically assess the conditions for use of the 700MHz band (i.e. 694–790MHz) for the mobile service in Region 1 (i.e. Europe, the Middle East and Africa).

The band was allocated to the mobile service and identified for IMT/mobile broadband in Region 1 (i.e. Europe, the Middle East and Africa) at WRC-12 but only for use after WRC-15 when technical and regulatory conditions would be established to protect the broadcasting services in the adjacent band. The timely release of the band is essential in order to ensure LTE services can cost-effectively scale to meet growing demand, especially in rural areas, inside buildings and in emerging markets.

The technical and regulatory conditions should ensure regulators have agreed a band plan and emission levels so that mobile broadband services can be rolled out widely and cost-effectively without interfering with each other or broadcasters.

The GSMA has proposed and received widespread support for a band plan for Region 1, including appropriate emission levels, that is compatible with the Asia Pacific Telecommunity's (APT) 700MHz approach[26], which is already gaining traction in Asia and Latin America. By adopting this compatible approach, it will be possible for operators and consumers to benefit from a wide range of lower cost equipment, including handsets, ensuring LTE services can benefit people on all budgets regardless of whether they live in urban centres or rural areas.

[1] GSMA Mobile Economy Report 2014
[2] GSMA Mobile Economy Report 2014
[3] KT reveals huge data growth – 31st October 2013
[4] Mobile economy report 2014
[5] Cisco VNI Mobile, 2014
[6] Cisco VNI Mobile, 2014
[7] Report ITU-R M.2290-0
[8] This factors in an element for Wi-Fi offload. See report ITU-R M.2290-0
[9] ITU-R M.2243
[10] $25 Smartphones on Firefox OS to Rock MWC
[11] The goal is to achieve a 'primary' allocation for mobile in each of the target bands. This means that mobile services would have the same rights to operate in the band as other services with 'primary' status. However, the mobile service would be prioritized over other services allowed in the band that have 'secondary' allocations and must therefore accept interference from 'primary' services.
[12] An 'identification' for International Mobile Telecommunications (IMT) means that a specific frequency range in the band is dedicated for use by compatible mobile broadband technologies, including all 3G and 4G networks. The practical effect is to improve harmonization by providing clarity to equipment manufacturers and encouraging governments to align the use of the spectrum specifically for mobile broadband services.
[13] In particular, the High Level Group established by EU Commissioner Neelie Kroes.
[14] E.G. 2.1GHz networks require around four times the number of base stations and three times the CAPEX to deliver the same coverage as 700MHz networks.
[15] The evolution from DVB (Digital Video Broadcasting — Terrestrial) to DVB-T2 (Digital Video Broadcasting – Terrestrial 2nd generation) technology provides improved spectrum efficiency allowing more data to be carried
[16] Plum 2014
[17] Plum 2014
[18] According to the EC Special Eurobarometer: e-Communications Household Survey March 2014 (p59) terrestrial broadcast made up 53% of EU TV owning households in Feb/Mar 2011 (i.e. 23% analogue + 30% DTT) and fell to 43% in Jan 2014 (i.e. 6% analogue + 37% DTT)
[19] Numerous studies for the ITU show existing services can share the L-band with mobile services including:-
- JTG4567/195-E: Studies relating to compatibility/sharing between IMT and fixed links in 1350–1527 MHz
- JTG4567/356-E: Preliminary Compatibility/sharing study between IMT and radiolocation systems in 1300–1400 MHz
  JTG4567/357-E: Studies relating to compatibility/sharing between IMT and fixed links in 1350–1527 MHz
- JTG4567/542-E: Sharing between IMT systems and radars in the 1300–1400 MHz band
- JTG4567/543-E: Analysis of required mitigation for IMT systems and radars to share the 1300–1400 MHz band

[20] Numerous studies for the ITU show radars can share the 2.7–2.9GHz band using adjacent channels including:-
- JTG4567/353-E: Sharing between IMT systems and radars in the 2700–2900 MHz band
- JTG4567/541-E: Analysis of required mitigation for IMT systems and radars to share the 2700–2900 MHz band

[21] Ofcom's 'Mobile Data Strategy', 21st November 2013, p50 (section 6.55)
[22] The findings from the study are discussed in JTG4567/193-E: Consideration of the 2.7–2.9GHz band and economic benefits that would arise from making this band available for IMT
[23] JTG4567/550-E: A study of rain fade depth on FSS frequency bands
[24] Numerous studies for the ITU show FSS services can share the C-band with mobile services without prohibitively large exclusion zones including:
- JTG4567/354-E: Studies relating to compatibility/sharing between IMT and FSS in 3.4–4.GHz
- JTG4567/355-E: Study into adjacent channel compatibility sharing between IMT and ubiquitous FSS earth stations in 3.4–4.2GHz

[25] The findings from the study are discussed in JTG4567/343-E: Consideration of the 3.4–4.2GHz band and the economic benefits that would arise from making part of this band available for IMT
[26] This involves using 2x30MHz based on the lower duplexer of the standard APT band plan which uses 2x45MHz

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