Socio-economic benefits of harmonisation of the S-band CGC in Europe

6 November 2015

Executive summary

In 2009 two satellite operators --Solaris Mobile Limited, now EchoStar Mobile Limited (EML), and Inmarsat -- were granted licences to operate an S-band mobile satellite service (MSS) in combination with a Complementary Ground Component (CGC) throughout the European Union (EU).

Both companies have excellent track records in the commercialisation of innovative services based on satellite technology and next year both intend to launch new satellites to deliver the MSS component throughout Europe. Inmarsat intends to offer a range of aviation services while EML intends to offer MSS, CGC and hybrid services throughout Europe on a wholesale basis through partnerships with regional and local operators. Potential services that could be offered by EML's partners include machine-to-machine (M2M) communications, public protection and disaster relief (PPDR) services, mobile broadband, support for private networks and mobile virtual network operators (MVNOs) and lower cost mobile satellite services.

The EU S-band regime was intended to give the S band licensees the means to offer advanced voice and data services throughout Europe using both the MSS and the CGC to avoid the service gaps typically associated with either a stand-alone MSS or terrestrial service. However, the ability of EML to press ahead and launch the full range of the commercial services that were envisaged by the EU, including those that rely on the CGC, is constrained by the fact that some member states have not yet implemented the rules or created a licensing regime for the S-band CGC while others are proposing to adopt a narrow interpretation of EU rules – specifying, for example, that the CGC must carry the same traffic as the MSS (effectively forcing the CGC to be used as an MSS repeater only).

This last obligation is inefficient since the potential capacity of the CGC is far greater than the capacity of the MSS and cannot, as a practical matter, be utilised by any party other than the MSS operator due to interference considerations. Analysys Mason estimates that if the CGC is unable to carry any traffic that is not carried by the MSS, then up to 99.9% of the potential capacity of the CGC may be lost. This would clearly be a waste of spectrum resources at a time when there is intense pressure to find additional spectrum for a variety of telecommunications applications, including those which the S-band licensees intend to provide.

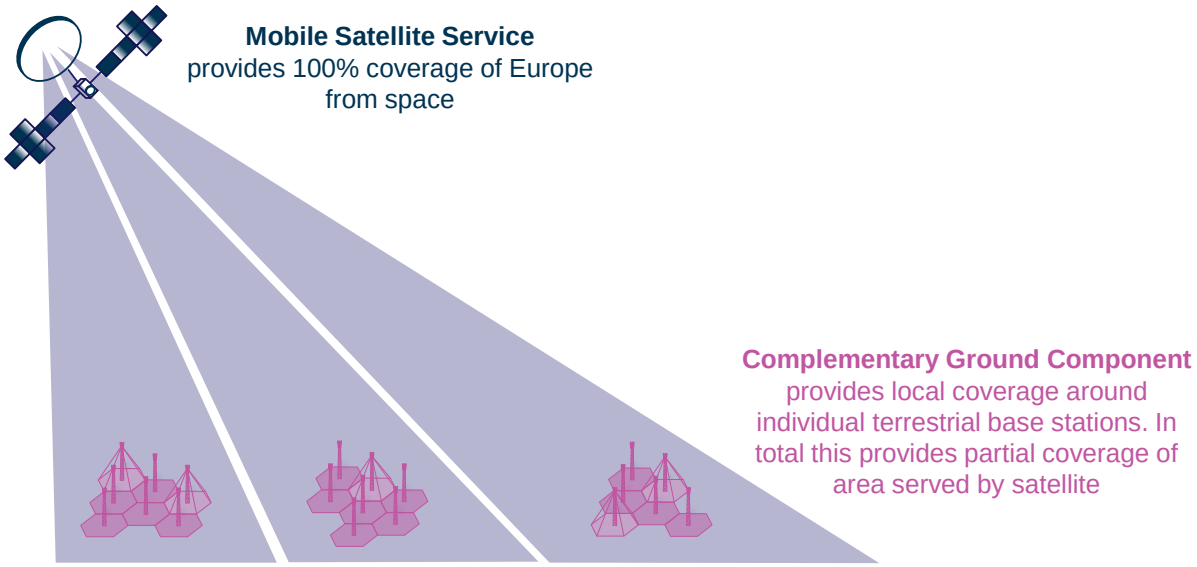
The European Digital Single Market strategy intends to promote a common EU framework for regulating radio spectrum across the EU in order to ensure consistency and predictability across Europe. Creating harmonised guidelines for member states to apply that enable the full and efficient use of the CGC spectrum in combination with the MSS would best realise the benefits of this regime while allowing the CGC to carry traffic that is not carried by the MSS would make best use of the potential additional capacity of the CGC.

Introduction

In May 2009, two satellite companies, Solaris Mobile Limited (now EchoStar Mobile Limited, EML) and Inmarsat, were awarded spectrum licences in the S band (i.e. spectrum at around 2GHz) on a pan-European

basis. The licences were expected to support new mobile and Internet services that would deliver benefits similar to current terrestrial-only wireless and mobile broadband services[1]. The licensees were granted permission to operate a mobile satellite service (MSS) and a complementary ground component (CGC) (see Figure 1). The use of an MSS in combination with a CGC aimed to achieve superior coverage compared to satellite-only or terrestrial-only systems and increase the efficiency of spectrum usage[2], while the award of two licences was intended to bring the benefits of competition in S-band services to EU citizens.

Figure 1: Illustration of the difference between MSS and CGC coverage [Source: Analysys Mason, 2015]



Moving forward six years, the situation has not evolved as originally envisaged. Regulatory obstacles created by the lack of a harmonised approach to the licensing of the CGC have increased the commercial risk associated with deploying an EU-wide MSS and CGC service. Meanwhile, EU customers are missing out on a truly EU-wide voice and data service offered through one dedicated infrastructure without roaming. There are increasingly vocal demands for access to more spectrum from mobile operators, organisations operating public protection and disaster relief (PPDR) networks and other spectrum users. Such demands could be addressed, to some extent at least, by enabling them to obtain S-band connectivity from one or more of the MSS operators on a wholesale basis. At present that connectivity is also being put at risk by the fragmentation of CGC regulation.

The S-band spectrum is made up of two 30MHz blocks at 1980–2010MHz and 2170–2200MHz that are harmonised throughout the EU (see Figure 2). This spectrum is adjacent to the 2.1GHz band that is already harmonised and used throughout Europe (and elsewhere) for UMTS (3G) services and increasingly for 4G services[3]. The licences awarded across Europe at 2.1GHz typically have long licence terms (e.g. 20 years from around 2000 onwards), and networks are well established.

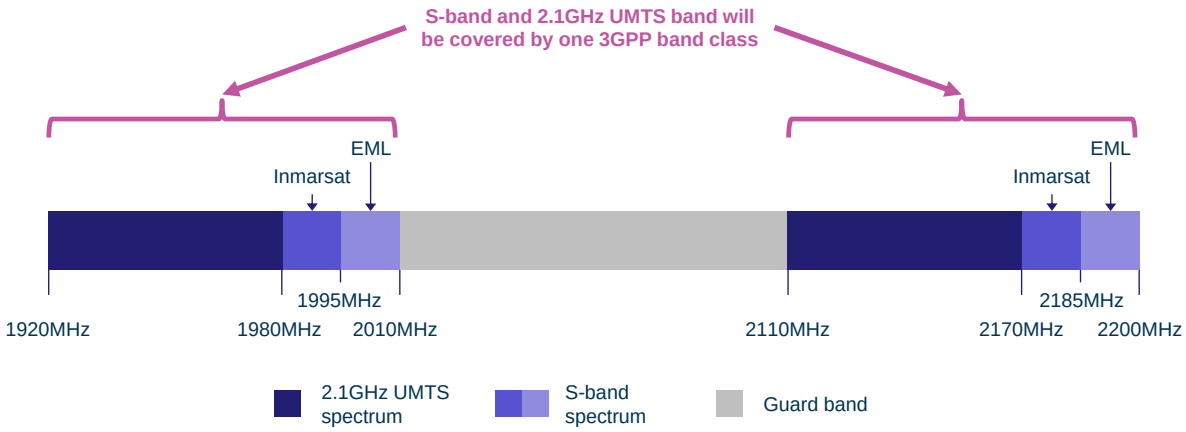
1 EC Decision 2009/449/EC on the selection of operators of pan-European systems providing mobile satellite services (MSS). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:149:0065:0068:EN:PDF. The licence holders can run services across all 28 European Union member states

2 See section 2 of ECC Decision (06)09 of 1 December 2006, amended 5 September 2007 (2007/98/EC), on the designation of the bands 1980-2010 MHz and 2170-2200 MHz for use by systems in the Mobile-Satellite Service including those supplemented by a Complementary Ground Component (CGC)

3 See, for example, https://www.telegeography.com/products/commsupdate/articles/2015/07/16/tele2-estonia-using-2100mhz-for-4g/

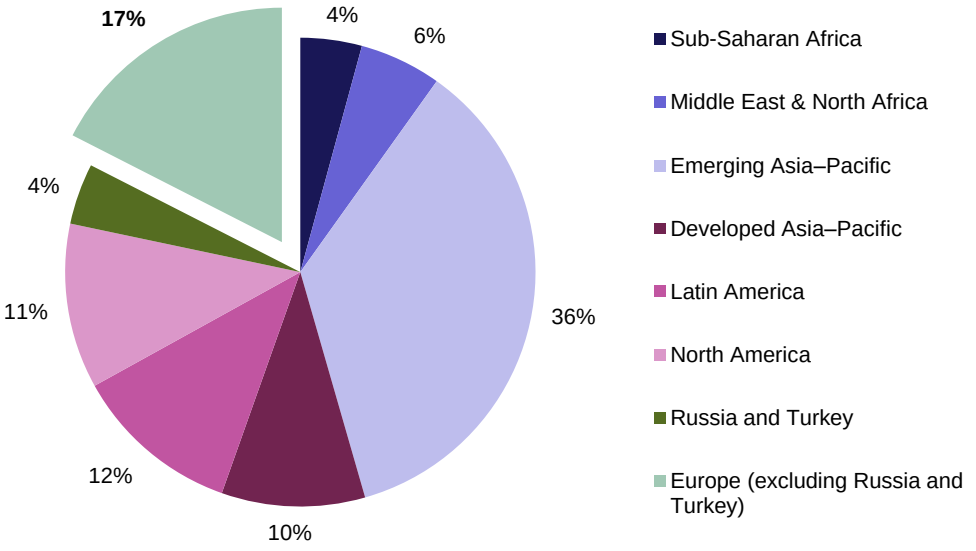
As the 3GPP continues to refine Release 13 mobile broadband standards (due to be finalised in 2016)[4], the S-Band spectrum has come into focus as a valuable potential asset, in large part due to the fact that it is immediately adjacent to an existing UMTS band.

Figure 2: Illustration of the S-band and 2.1GHz UMTS spectrum [Source: Analysys Mason, 2015]



There are strong incentives to ensure this band is used effectively and efficiently across Europe. In addition to obviating any potential frequency co-ordination issues associated with other co-channel users of the spectrum in neighbouring countries, there is a clear advantage in terms of economies of scale for equipment manufacturers (and consequent knock-on effects throughout the industry). Equipment and device manufacturers may struggle to build a viable business case to develop devices for individual countries or operators, but can easily do so for the EU as a whole (which, as shown in Figure 3, accounts for approximately 17% of the world's total 3G and 4G connections)[5].

Figure 3: Proportion of global 3G and 4G mobile subscriptions in 2014 [Source: Analysys Mason, 2015]



4 http://www.3gpp.org/specifications/67-releases

5 Derived from Analysys Mason's Wireless network traffic worldwide: forecasts and analysis 2014–19 connection numbers for Western Europe and Central and Eastern Europe net of Russia and Turkey

Pan-European harmonisation and deployment offers a scale that allows much lower unit costs, which in turn makes possible a range of additional services and business lines. Harmonisation makes key innovations connected with machine-to-machine (M2M) or Internet of Things (IoT) services affordable and it becomes worthwhile for manufacturers to support the S band in handset and vehicle chipsets. Once S-band device chipsets are available, deployment of LTE priority-access features could make public protection and disaster relief (PPDR) services more affordable (if adopted by a sufficient number of public safety users across Europe).

EML intends to offer MSS, CGC and hybrid services throughout Europe on a wholesale basis through partnerships with regional and local operators who will offer retail services tailored to the needs of particular vertical and national markets. The partners may be established operators who will use EML's capacity to supplement their existing operations, or new entrants who will use EML's capacity as way of entering the market and rapidly building up a service offering across Europe. With the upcoming launch of its EchoStar 21 satellite supplementing EML's existing capacity on Eutelsat 10A, the company would be well positioned to move forward if the regulatory barriers relating to CGC licensing could be addressed.

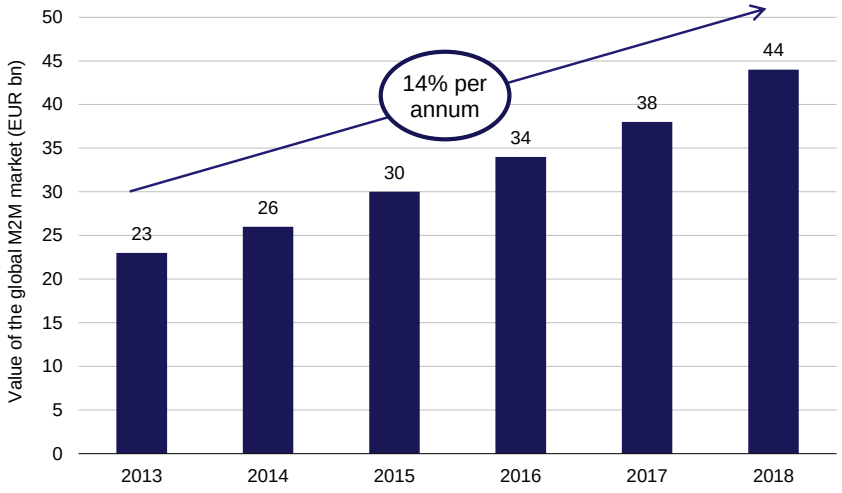
EML's downstream partners will ultimately determine the services offered at the retail level, but the following sections describe some of the services that are likely to be supported by EML's S-band networks.

Potential uses of the S-band spectrum

Machine-to machine/Internet of Things (M2M/IoT)

There is a fast-growing global market for technologies that enable wireless and wired systems to communicate directly with other devices (referred to as M2M/IoT). In 2014, this market generated revenues of EUR26 billion and is expected to grow at 14% per annum to reach EUR44 billion in 2018, as shown in Figure 4 below[6]. The satellite component of this market has been estimated at EUR1.1 billion in 2014 growing to EUR2.0 billion by 2024.[7]

Figure 4: Value of the global M2M market [Source: Vodafone, 2015]



6 www.vodafone.com/content/dam/group/investors/downloads/presentations/Vodafone-M2M-Investor_Webinar-presentation.pdf

7 http://www.nsr.com/news-resources/nsr-in-the-press/nsr-press-releases/m2miot-remains-key-growth-market-for-satellite-companies/. Original figures in USD (USD1.2 billion in 2014 and USD2.3 billion in 2024)

The GSM Association estimates that at the start of 2014 approximately 28% of global M2M connections were within Europe, where about two thirds of mobile operators have an M2M offering[8].

While the majority of M2M applications can be supported by commercial mobile networks, satellite systems enable the provision of M2M connectivity to the most remote regions on land, at sea and in the air. The use of the S band for M2M applications will potentially enable them to use terrestrial mobile and satellite connectivity in a more integrated manner and avoid any issues associated with roaming if M2M terminals move between countries. We note that while a range of other radio solutions (including various licence-exempt, short-range wireless technologies) may also be used to deliver M2M services, it is unlikely that these can be used to serve all parts of Europe in the way that S-band services could because of range and coverage limitations and the fact that they are not available on a harmonised basis.

M2M applications that could benefit from the ubiquitous coverage of S-band networks include smart metering (e.g. connecting meters in remote areas and mobile 'not-spots'), automotive (e.g. vehicle tracking, broadcasting vehicle software updates and expanding the coverage of the new EU eCall system)[9], security (communications fall back) and military (tracking combat assets).

The EU directive on energy end-use efficiency and energy services 2006/32/EC states that 80% of European consumers are expected to have smart energy meters installed in their homes by 2020, and the eCall directive will deploy an emergency calling device in all new vehicles sold after March 2018 (although the current version of eCall only makes use of mobile networks).

Public protection and disaster relief

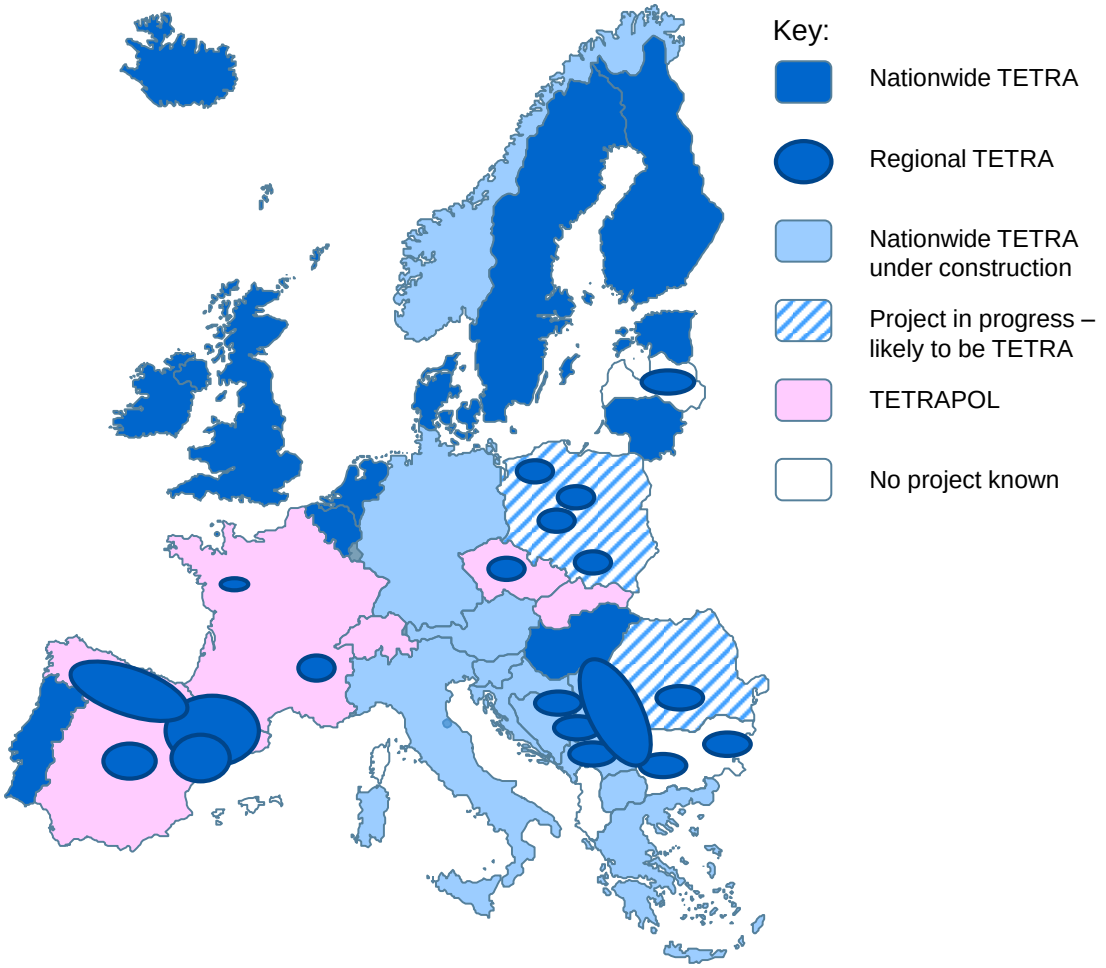
PPDR in Europe is mostly supported using TETRA and Tetrapol terrestrial networks currently operating over dedicated spectrum in the 380–385MHz and 390–395MHz bands that have been harmonised for public safety. There are currently 250+ TETRA networks operating worldwide, the two largest of which are in Germany, with around 500 000 users, and the UK, with around 350 000 users[10]. As shown in Figure 5 below, TETRA and Tetrapol networks have been or are being deployed in many European countries, although not all of the deployments are nationwide.

8 gsmaintelligence.com/research/?file=140217-m2m.pdf&download

9 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0585&from=EN

10 TETRA fact sheet: www.tandcca.com/about/page/12030.

Figure 5: Map of TETRA and Tetrapol PPDR networks in Europe – Public Safety Q1 2013 [Source: CEPT, 2013]



A key drawback of the current TETRA and Tetrapol standards is that they only support narrowband data. There is a growing need for broadband data connectivity to support applications such as database access, robotics control and video from the field to headquarters (the transmission of video from drone vehicles and person-worn cameras is of particular interest)[11]. The CEPT Electronic Communications Committee (ECC) considers that harmonising adequate spectrum for the provision of PPDR services is one of the major challenges that the ECC and CEPT Administrations need to address over the next five years[12].

Some countries outside Europe have allocated dedicated spectrum for future broadband PPDR use. For example, the USA and many administrations in the Middle East and the Asia–Pacific region have allocated spectrum in the 700MHz band to PPDR. In Europe this has not yet happened although there is sustained interest in doing so[13]. Some EU countries – including the UK – have already commenced large-scale procurements for replacement TETRA networks without a harmonised European solution being in place. This is being done on the presumption that existing mobile operators can offer a PPDR solution using the latest features being developed within the 3GPP standards, deployed in their existing licensed spectrum[14].

11 WIK Consult discussion paper, "The need for PPDR Broadband Spectrum in the bands below 1 GHz", 2008

12 http://cept.org//files/1051/ECC/Who%20are%20we/ECC%20Strategic%20plan/ECC%20Strategic%20Plan%202015-2020%20web-ready.pdf

13 WIK Consult discussion paper

14 Release 13 of the 3GPP standard is expected to include various PPDR-specific features

The European S-band spectrum would also be suitable for PPDR use and offers a number of advantages:

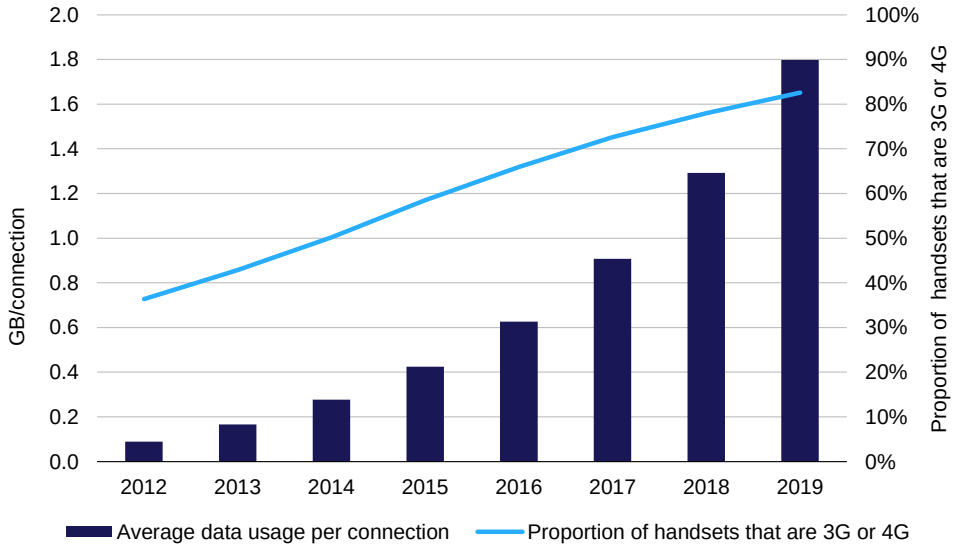
- to be effective, PPDR typically requires an extremely high level of geographical coverage (including coastal waters) with additional capacity in major urban centres. PPDR could therefore make effective use of both the MSS and CGC components of the S-band spectrum
- existing harmonisation of the band at EU level would permit cross-border use and provide economies of scale for manufacturers
- since the S-band spectrum is adjacent to existing 3G spectrum, S-band PPDR networks could potentially use the existing grid of 3G mobile sites (reducing the number of new sites needed) after modifying the RF equipment to support the S-band.

While the S band does not have the existing PPDR ecosystem of the 700MHz band and therefore will not offer as much benefit independently, it could serve as an important complement to a 700MHz deployment, particularly if a 700MHz deployment was focussed on the guard bands of the currently proposed CEPT-ECC mobile band plan in that band.

Mobile broadband, private networks and MVNOs

In 2014, global revenues from mobile telecoms totalled around EUR700 billion (of which around EUR140 billion was generated in Europe)[15]. Europe is experiencing rapid growth in mobile data usage, with monthly usage per subscriber growing from roughly 90MB per connection in 2012, to 420MB per connection in 2015 (see Figure 6). This is expected to grow to 1.8GB per connection in 2019 driven in large part by the increasing popularity of multimedia applications involving video content: one minute of video content typically requires data equivalent to 20 web pages or 175 emails[16].

Figure 6: Growth in European average data usage per connection and proportion of 3G and 4G handsets in the market [Source: Analysys Mason, 2015]



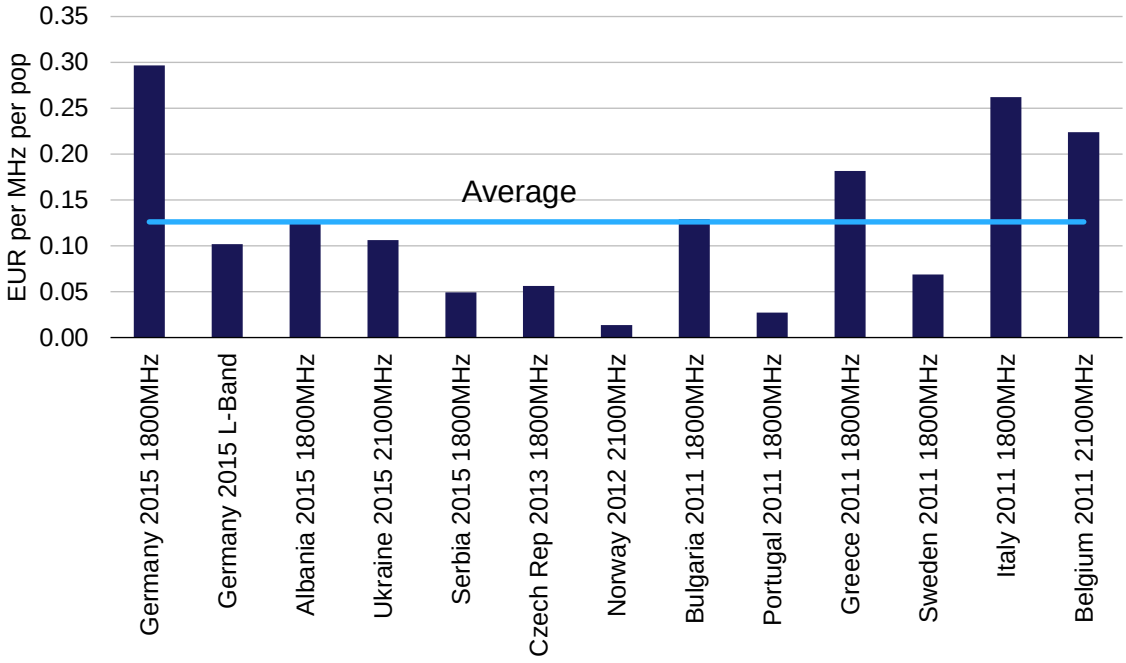
15 Analysys Mason Global telecoms market: interim forecast update 2014-19

16 http://www.sasktel.com/wps/wcm/connect/content/Home/Tools/datacalculator

This growth in data traffic per subscriber is partly driven by the rapid adoption of 3G and 4G smartphones in Europe, which currently account for around 58% of handset connections, but are expected to reach 83% in 2019[17].

The growth in mobile data traffic creates a high level of demand from mobile operators for capacity and for access to additional spectrum. The prices paid in recent European mobile spectrum auctions (see Figure 7) show that demand for further capacity remains high. Once incorporated into 3GPP standards and subsequently adopted by device manufacturers, the S-band CGC is likely to be particularly useful to mobile operators because it is adjacent to existing 2100MHz allocations and it is available throughout the EU.

Figure 7: Results of European auctions of 1800MHz, 2100MHz and L-band spectrum in the last five years [Source: Analysys Mason, 2015]



Mobile satellite services

MSS generated worldwide revenues of EUR3.0 billion in 2014 and is expected to grow to EUR4.9 billion in 2019[18].

MSS currently supports a number of markets, including critical safety-of-life applications in the aeronautical and maritime industries, other connectivity applications in the aeronautical, maritime and offshore industries, and defence applications. The expansion of traditional MSS applications towards smaller users – small commercial and leisure vessels, mountaineers, farmers, rural workers and so on – is primarily held back by the high cost of existing equipment and services. The entry of a new player in Europe and the additional competition should therefore be welcomed as it would be likely to drive down costs.

17 Analysys Mason, Wireless network traffic worldwide: forecasts and analysis 2014-2019

18 "Mobile Satellite Services Market by Services (Video, Voice, Data, Tracking and Monitoring Services), by Access Type (Land Mobile, Maritime, Aeronautical) - Worldwide Market Forecasts and Analysis (2014 - 2019)" Markets and Markets

Due to technical developments such as the large S-band antenna on EchoStar 21, EML's new MSS terminals can be much more compact than current satellite broadband terminals. They are therefore particularly suitable for addressing the market for MSS amongst private individuals and small maritime vessels. EML is developing, as a first-to-market product, a Wi-Fi hotspot terminal for use in the MSS market as well as other markets such as PPDR. As EML's resellers are identified, additional products are likely to be developed to support a wide range of MSS services including terminals for voice and narrowband data.

Making the EU more competitive by enabling MSS/CGC services on a an EU-wide basis

The acquisition of Solaris by EchoStar has opened the way for EML to access capacity on a state-of-the-art S-band MSS satellite, EchoStar 21, which will have the capability to cover both the terrestrial and maritime territory of the EU. When operational in 2016, EchoStar 21 will bring additional MSS capacity to the EU on top of that already provided by EML's S-band payload on the Eutelsat 10A satellite, which has restricted capability due to a technical defect that was discovered as Eutelsat 10A was being deployed.

EML's parent, EchoStar, is one of the world's leading exponents of S-band satellite technology. It operates two MSS satellites over North America today for its sister company, DISH, which is licensed in both the USA and Canada, and it holds an authorisation in Brazil for another S-band satellite.

However, while EML's satellite is expected to be available next year, its ability to press ahead and launch a full range of the commercial services that were envisaged by the European Union, including those that rely on the CGC, is constrained by the fragmented and unfinished regulatory environment across the 28 EU member states. This raises the question: is there more the EC and member states can do to expedite the roll-out of these valuable services to European consumers, businesses and public service users?

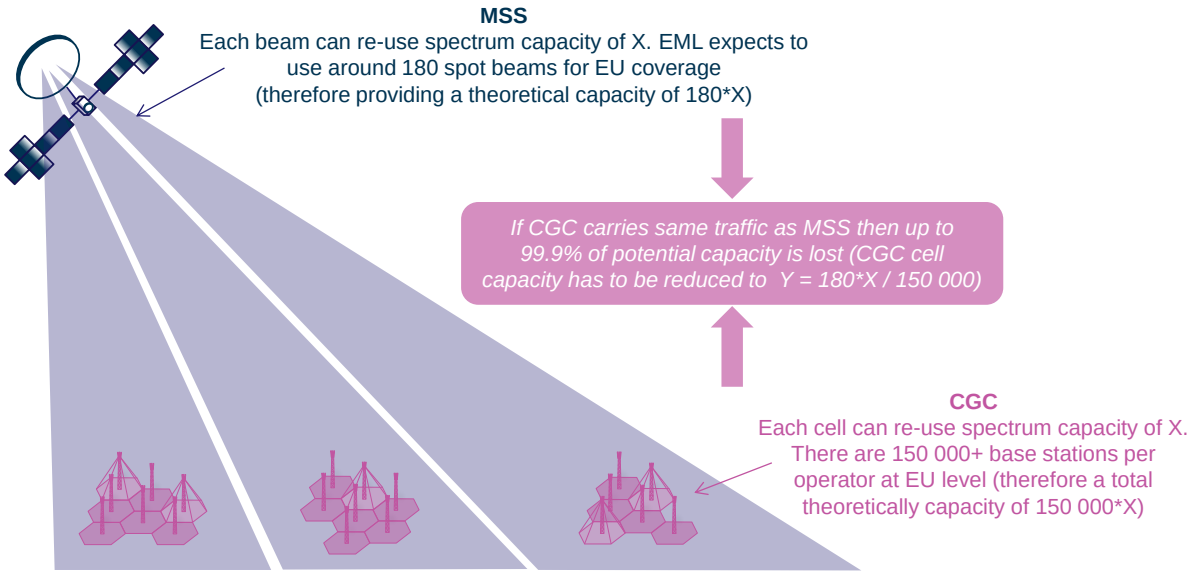
Barriers created by lack of regulatory harmonisation

Although the MSS authorisation in the S-band licences is EU-wide, the CGC licences are issued by individual member states and there is a lack of harmonisation in the timescales and the licensing approach being followed by different countries. Some member states have not yet implemented the rules or created a licensing regime for the S-band CGC while others are proposing to adopt a narrow interpretation of EU rules – proposing that the CGC must carry the same traffic as the MSS (effectively forcing the CGC to be used as an MSS repeater only). Such an obligation is clearly inefficient since the potential capacity of the CGC is expected to be very much greater than the capacity of the MSS and the CGC cannot, as a practical matter, be utilised by any party other than the MSS operator due to interference considerations.

If the CGC is forbidden from carrying any traffic that is not carried by the MSS, we estimate that up to 99.9% of the potential capacity of the CGC may be lost (see Figure 8). This figure is based on Analysys Mason estimates that there were around 560 000 3G and 4G mobile base stations across the EU at the end of 2014[19]. Given that major markets typically have three or four mobile operators, the likely requirement for one network to achieve 'Europe-wide' coverage can be calculated as around 150 000 base stations. Given that EML expects to use around 180 spot beams for EU coverage, this implies that the potential CGC capacity corresponds to over 800 times the capacity of the MSS (150 000/180).

19 http://www.analysysmason.com/Research/Content/Reports/Base-station-deployments-forecast-May2012-RDTN0

Figure 8: Illustration of the loss in potential CGC capacity if CGC networks are forced to carry the same traffic as MSS [Source: Analysys Mason, 2015]



Conclusion

Given the unique nature of the S-band award – comprising an MSS operated in conjunction with a CGC – it is important that the CGC is regulated in a uniform, service-neutral and non-restrictive way across Europe to facilitate the deployment of commercial services that will benefit a wide range of European business users and consumers. The imminent launch of new satellites by both EML and Inmarsat makes resolving CGC regulation a matter of urgency.

The EC's Digital Single Market strategy[20] aims to provide better access for consumers and businesses to online goods and services across Europe, create the right conditions for digital networks and services to flourish, and maximise the growth potential of our European Digital Economy.

The strategy document clearly sets out the objective to have radio spectrum managed by Member States under a more harmonised framework that is consistent with the need for a Digital Single Market, stating that "*the sector … suffers from isolated national markets, a lack of regulatory consistency and predictability across the EU, particularly for radio spectrum*"[21]. In the preface to the Digital Single Market strategy, European Commission President Jean-Claude Junker makes this point even more clearly: "*I believe that we must make much better use of the great opportunities offered by digital technologies, which know no borders. To do so, we will need to have the courage to break down national silos in telecoms regulation, in copyright and data protection legislation, in the management of radio waves and in the application of competition law.*"

The European Digital Single Market strategy intends to promote a common EU framework for regulating radio spectrum across the EU in order to ensure consistency and predictability across Europe. Creating harmonised guidelines for member states to apply that enable the full and efficient use of the CGC spectrum in combination

20 http://ec.europa.eu/priorities/digital-single-market/

21 http://ec.europa.eu/priorities/digital-single-market/docs/dsm-communication_en.pdf

with the MSS would best realise the benefits of this regime while allowing the CGC to carry traffic that is not carried by the MSS would make best use of the potential additional capacity of the CGC.

Note: This paper was commissioned by EchoStar Mobile Limited but the views contained herein are those of Analysys Mason Limited.