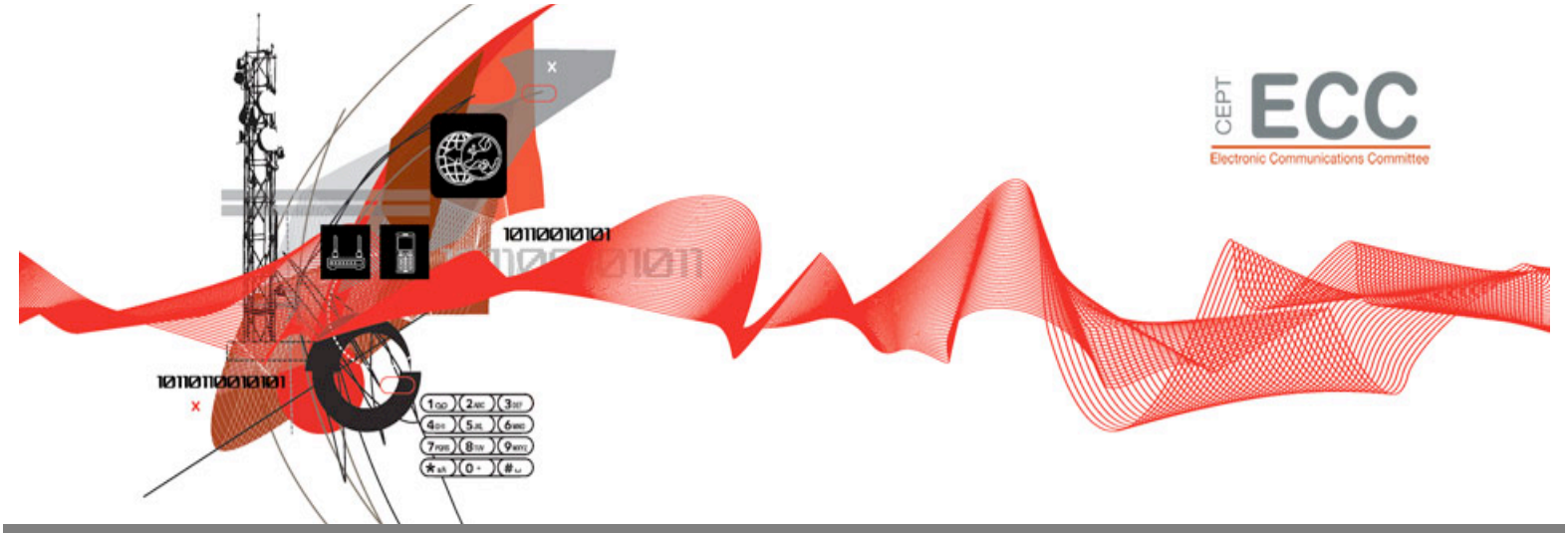

ECC NEWSLETTER **October 2014**

The UHF Battleground: how to plan for the future when you can't really predict it

One year ago in the ECC Newsletter we ran a set of three articles about the UHF frequency band 470-790 MHz. The articles explained why these frequencies are so highly prized and the focus of a huge amount of attention in the spectrum policy domain. We set out what we planned to do on the subjects of the 700 MHz band, of the long-term vision for UHF, and on Public Protection and Disaster Relief (PPDR). Here we update the position, first with this overview, and then with two articles respectively about 700 MHz, and the 'long term UHF vision' below 694 MHz. We hope this is timely, with the recent publication of the report of the high-level Group set up by the European Commission's Commissioner Kroes to consider the future of the UHF band, and, amongst other studies, a review of the subject also underway in the EU's Radio Spectrum Policy Group.

Although the demand for wireless broadband services is the current main driver for change in the band, the requirements for terrestrial television remain strong in many of Europe's countries. The terrestrial TV platform itself is also undergoing change, in both its core technology and its modes of use. Along with this there are possibilities for major developments in Public Protection and Disaster Relief (PPDR), and a stronger recognition of the requirements of the Programme Making and Special Events (PMSE) sector. These all come together to require a holistic view to be taken of this premium band.

Therefore in parallel with activities within national regulators, and at the European Commission, the ECC decided to look closely at the short-term and the long-term development of the range. The two different time horizons correspond to the two principal areas of ECC study on the frequency range in the last year.

First, the interest in using the 700 MHz band (c. 694-790 MHz) for wireless broadband (WBB) instead of broadcasting is more advanced and more tangible than at lower frequencies. It has inevitably become a pressing short-term issue. There are a number of reasons for this. To begin with, Europe in any case needs to prepare a suitable harmonised technical framework for WBB given that some countries have already decided to make the switch from broadcasting to mobile in the 700 MHz band (e.g. France), and many others are very actively considering the possibility (e.g. Germany, and the United Kingdom).

Then there is the need to have a common European position on 700 MHz for the 2015 World Radiocommunication Conference (WRC-15). WRC-15 will decide the details of implementing the decision of WRC-12 to allocate the range to wireless broadband, co-primary with broadcasting.

Further, although the UHF TV band would look significantly smaller than it did in 2006 (when the current digital broadcasting plan for the region was agreed in Geneva in the GE06 agreement), a continued use of frequencies below 694 MHz quasi-exclusively for TV broadcasting still leaves 28 TV channels available, compared with the 40[i] available before the transfer of resources to wireless broadband began after 2006. This is still, in context, a large amount of spectrum which can support a significant offering of TV to the markets it seeks to address.

However, the longer term evolution of the frequencies below 700 MHz is another matter, and the subject of concern and conflicting assumptions and viewpoints. We believe this story will run for a long time, although some certainty and stability is needed already by the relevant sectors in order to maintain planning and investment.

Therefore the ECC decided that its strongest contribution to this subject at this stage would be to analyse trends in the relevant sectors, and the synergies that may develop between them, rather than to attempt in some way to 'pick a winner'. And there is anyway a great benefit as well in looking at the longer term as a backdrop for the more immediate work on 700 MHz.

Terrestrial TV

There is a widespread view that terrestrial TV use is in (eventually) terminal decline, and a widespread opinion that takes the opposite conclusion from the evidence. Some figures do point to a declining trend, while others suggest a robust core of viewing demand that is irreducible – although there may be more spectrally-efficient ways to do it, at least in theory. But the trends as well as the level of public use vary significantly between different countries.

The predicted demand levels also depend upon the model of use envisaged. It is possible to envisage Digital Terrestrial Television (DTT) as a provider not of 'every conceivable technological development', but of more practical objectives like HD/SD[ii] 'everyday' programming, and video on the move. Crucially, the fragmentation of models of video consumption (notably into linear and non-linear) require a better vision of how broadcast-meets-mobile in the future: or at least, how it might do so.

As a matter of policy, many countries value terrestrial TV significantly either for its role in providing platform competition, or particularly as a core delivery mechanism for free-to-air TV, carrying the most popular channels to a wide audience. There is also a range of opinions about the significance of high-definition and super high definition TV on the terrestrial platform, but that is a more speculative debate.

This underlines that terrestrial TV needs adequate provision there for the foreseeable future. However, the ECC did not set up its Task Group 6 to estimate what that means specifically, but to look at possible evolutionary trends. In other words, to look to a longer term vision.

Wireless broadband

Although not new, there is now increasing scrutiny given to the forecasts of capacity demand for wireless broadband, on which much of the present case for increasing allocations to it rests. Some have questioned the ITU's core recommendation on the subject, Rec. M-2290, particularly challenging the assumptions made about population density and the dangers of simple extrapolation in time (and space!). Others, of course, robustly defend these calculations.

However, the demand in the UHF range, and notably for the 700 MHz band, is less linked to capacity alone (there are other frequencies available) as much as it is to utility. The WBB demand at 700 MHz also comes from the related but separate question of reducing the cost of network provision more generally. This consideration is significant in relation to the longer term vision for the band: although the 700 MHz can make a big difference, yet more frequencies below 694 MHz would inevitably have a relatively lesser impact on wireless broadband availability.

Other observers have drawn attention to the importance of recognising the price elasticity of mobile broadband demand, instead of simply saying 'potential demand is X and we should try and meet it to avoid constraining its growth'. But this also introduces a complex relationship with 700 MHz capacity compared with capacity provided at higher frequencies. In the era of triple play (bundling internet access, mobile and TV services), itself influenced by the volatile issue of how to monetise services provided on the internet, these business dynamics around a particular issue do not exist in isolation: there is no walled garden. But the relationship between an asserted exponential demand (if unconstrained) and the revenues needed to fund a corresponding supply side can seem unclear when looking longer term.

A balance?

It seems too early to predict what is the optimum balance between TV and mobile, a balance which itself is heavily influenced by local market factors. Perhaps the debate will shift to defining what is a minimum credible quantity of spectrum for either application, and making sure that that at least is secured in the first instance?

Mark Thomas,
Director of the ECO

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i Some countries have specific reservations for other uses of certain channels, e.g. Channel 38 for radioastronomy.
ii High definition/standard definition

Ready when needed: technical conditions for mobile broadband at 700 MHz band

Previously in our Newsletter, we set out how the European Commission had issued, in summer 2013, a mandate to the ECC to study the possible use of the 700 MHz range (694 to 790 MHz) for mobile (or 'wireless') broadband. This was against the background of a significant programme of work which we had already started to enable our preparation of coordinated positions for WRC-15. At the very least, the decision of WRC-12 to give this range co-primary status for mobile and broadcasting could change the dynamics of how countries apply the overriding Geneva 2006 agreement on the use of the UHF band for television and other services. This summer, the ECC completed two draft reports, CEPT Report 53 and ECC Report 221, on the issue; the CEPT Report will be finalised later this year, after a public consultation.

Throughout this process, the ECC has recognised that wireless broadband demand runs side-by-side with demand for terrestrial television and also other services. A one-size-fits-all allocation approach is not appropriate, or at least, it would be premature for the foreseeable future. Likewise, the European Commission has been careful to point out that the mandate is designed to assist future harmonised use of the band for those countries that decide to allocate 700 MHz to mobile, instead of terrestrial TV, and it should not indicate a decision to force an identical approach throughout the EU. However, the technical incompatibility of broadcasting with mobile service uplinks in particular – co-channel exclusion zones can stretch for hundreds of kilometres – does bring significant pressures for some degree of European harmonisation.

Therefore the EC mandate was in no way pre-emptive, although the Commission has been clear that it is considering developing an EU-level political agreement. Accordingly, the ECC's response to the mandate is technically driven, with the consideration to maximise strategic usefulness of the band, taking account not just of wireless broadband but other demands, notably PMSE[i], PPDR[ii], and possibly machine-to-machine communications (M2M).

Channelling Plan

The core issue to address with the 700 MHz mandate work was the channelling plan. The adoption by the Asia-Pacific Telecommunity (APT) of a firm plan offers an opportunity for global harmonisation with significant economies of scale and consumer benefit. However, this plan does not fit neatly into the adjacent band constraints in Europe. These are not only the existing TV channels below 694 MHz, but also the 800 MHz mobile broadband band above 790 MHz, which is already harmonised and licensed in Europe, with EU member countries obliged to put the band to this use, within specific technical parameters. This effectively reduces the bandwidth available for the usual symmetrical channelling arrangement for mobile, compared with the APT basic plan.

However the ECC's Project Team 1 (PT1), chaired by Didier Chauveau (France), the ECC group responsible for developing CEPT Report 53 in response to the mandate, considered that the global harmonisation benefits outweighed the relative disadvantage of only being able to accommodate 30+30 MHz of capacity. PT1's thinking is also influenced by the fact that the necessarily large duplex gap of this symmetrical plan opens up some possibilities for efficient use overall. It is not only wireless broadband which can deliver benefits by using these attractive frequencies.

Another firm outcome of PT1's work was to confirm 694 MHz as the preferred lower boundary of this range (WRC-12 has left this detail open, for resolution at WRC-15). The recommended band plan set out in draft CEPT Report 53 is shown in the figure below:

694-703	703-708	708-713	713-718	718-723	723-728	728-733	733-738	738-743	743-748	748-753	753-758	758-763	763-768	768-773	773-778	778-783	783-788	788-791
Guard band (1)	Uplink						Duplex Gap					Downlink						Guard band (1)
							Gap (1)	SDL (1)										
9 MHz	30 MHz (6 blocks of 5 MHz)						5 MHz	20 MHz (up to 4 blocks of 5 MHz)				30 MHz (6 blocks of 5 MHz)						3 MHz

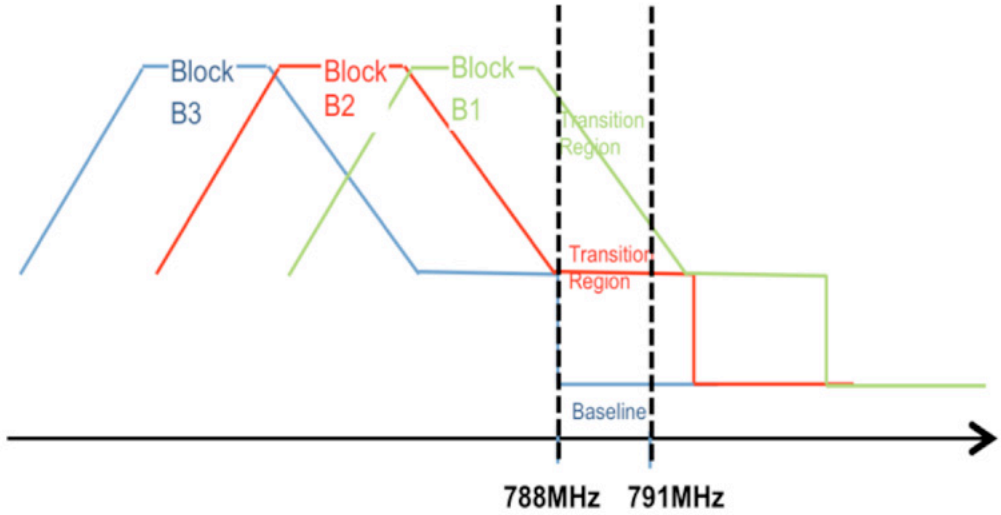
CEPT Recommended Band Plan for mobile services in the 700 MHz band

The large 20 MHz centre gap can offer additional capacity for supplementary downlink mobile broadband services. This would be a convenient way to address the very asymmetrical nature of much broadband wireless traffic; and the predictions of high growth in demand usually centre on asymmetric applications with more emphasis on download than upload (e.g. video content). Alternatives would be to use the band in whole or part for PMSE, or for some plan involving PPDR. The Commission mandate requested the ECC to take these demands into account in its plans, and this scenario does that.

However, the draft CEPT Report 53 does not recommend any one of these additional options above another, and envisages that the decision could be left to national process based on the applicable priorities in the country concerned.

Technical Conditions for Use

The other key part of the draft CEPT Report addresses the mandate requirements to define least restrictive technical conditions for wireless broadband services (under the umbrella of 'MFCN' – Mobile/Fixed Communications Networks). The main elements of this are the maximum transmitted power of base stations and mobiles, and the block edge mask (BEM) which they should respect in terms of spectral occupancy. This has become a standard way in the ECC to allow for flexibility in technology use over time, and to avoid being unnecessarily prescriptive in how the conditions are met; it is the outcome rather than the means of achieving it which is most important. The BEM's use is not limited to mobile/fixed networks, but in the interests of spectral efficiency its design is based on this assumption. But the Report also defines a BEM for supplementary downlink in the duplex gap.



The BEM also avoids unnecessary restrictions on channels further away from the band edge, restrictions aimed at protecting other services which are typically planned and regulated under a different regime and at another time.

Programme Making and Special Events

An important part of the CEPT Report in response to the mandate, was to set out technical conditions which would apply to PMSE equipment to avoid it interfering with MFCN. This indicated a significant possibility to deploy PMSE both in the band and the duplex gap. However, the main constraint would be where MFCN interferes with PMSE: just think of an artist 'crowd-surfing' at a concert while the smartphones in the crowd are transmitting!

Danish artist Mø makes a habit of crowd-surfing in her energetic performances. But festival organisers don't like it for safety reasons, they aren't thinking of possible interference in a future frequency planning scenario! (Photo: BT/ Jonas Skovberg Fogh)

The ECC has also studied this in some detail (in PT1 and Project Team SE7). ECC Report 221 on this subject – also referenced in CEPT Report 53 – has just been published. The conclusion is that this frequency range could be very useful to the wider PMSE sector, although the constraints – the risks – may be too great for high quality professional applications.

What next from the ECC?

ECC Decision: Having brought CEPT Report 53 to the stage of public consultation, the ECC is now following up with two related strands of work. First, the provisions of the CEPT Report will be used to develop an ECC Decision, which will enable any country which has already decided to use 700 MHz for wireless broadband to do so in a harmonised way. Of course that would still be subject to the relevant coordination with neighbouring countries, which is a significant practical constraint, but a different issue. This harmonisation is mainly about giving clarity to manufacturers, and to other users in the sector.

PPDR: Second, at the time that PT1 was completing its work some ideas came forward for using guard bands and the centre gap of the 700 MHz channelling arrangement for a paired block of spectrum for PPDR use. The likely density of deployment of PPDR and its different dynamics compared with general public mobile services could make such an arrangement achievable with relatively little opportunity cost to other services, or constraints to PPDR. However, there would, at least in principle, be a risk of pre-emption of use of the band, including below 694 MHz. Also, this is only a partial response to the requirements for broadband PPDR identified in the ECC's FM 49 group. Therefore, the ECC has resolved to study this but also other options which may be applied at a national level, including frequencies outside the 700 MHz range.

Mark Thomas,
Director of the ECO

i Programme Making and Special Events. Here referring to wireless microphones.
ii Public Protection and Disaster Relief.

Long term vision for the UHF TV

As the related article 'UHF Battleground' in this edition of our Newsletter explains, the ECC set about its technical background work on the 700 MHz band as a short-term priority, even though some of the policy implications remain a matter of debate, and positions in Europe are quite diverse. We also considered it important to create a better understanding of the technical possibilities which could drive the future use of the remaining part of the UHF broadcasting band, especially in the range below 694 MHz. We set out the reasons for this in our Newsletter article on the subject last year, where we described the establishment of the ECC's Task Group 6 (TG6), chaired by Jaime Afonso of Portugal, the ECC Vice-Chair.

TG6's report is a necessary step towards providing clarity and certainty for all stakeholders about the future use of this band – stakeholders who need a stable environment for future investment. Since its establishment TG6 has attracted a very large participation from the broadcasting and mobile sectors, as well as from the administrations. Meetings typically have about 80 participants. The group also developed an interesting dynamic, tending to focus more on what would be possible rather than arguing about what wouldn't.

It is well-known that 'High-Power-High-Tower' broadcast services, which seen through the mobile services' lens are essentially large-scale downlinks, are incompatible with mobile service uplinks. Co-channel reuse distances can be many hundreds of kilometres; and this is the core problem in seeking to accommodate a heterogeneous European approach. But that is only a part of the story.

The fact that terrestrial TV remains the dominant means of delivering the heavily-used public free-to-air services underlines that it needs adequate provision for the foreseeable future. A simple extrapolation of numerical reductions in its use in recent years would not be an adequate predictor of future spectrum demand. Another complicating factor is the evidence that growth of non-linear video consumption (You Tube, catch up TV etc.) is not balanced by a corresponding reduction in linear TV consumption.

TG6 was not set up to quantify what that means, nor to estimate the impact of different bandwidth availability on the development of mobile broadband. It would be very damaging, but not without precedent, to make regulatory allocation decisions based on a current or short-term appreciation of consumer behaviour and technology, extrapolated into an era where these have changed. Therefore, at the heart of TG6's mission was to identify the likely scenarios for trends in mobile and broadcast use, and particularly to consider – but not to predict definitively – the extent to which the applications and technologies would converge over time.

The convergence issue is particularly worthwhile to explore, given that the predicted source of traffic demand both for wireless broadband, and of course for broadcasting, are generally agreed to be in the area of some form of audiovisual material. This in itself suggests an increasingly asymmetric distribution of spectrum requirement for downlink and uplink components of wireless broadband. This is in parallel with some increasing interest in greater interactivity in the broadcasting world.

Against this background, TG6 was set up to:

- be forward-looking;
- set out frequency management options;
- address the flexibility which may be required in different countries, particularly considering the cross-border issues;
- consider how broadcast-mobile convergence might evolve (not how it will evolve) and to try to develop an understanding of its implications and role; and
- to maintain a technical focus.

TG6 has now produced its draft ECC Report (no. 224), which has been subject to public consultation; the results of which will enable it to finalise its work and publish the final report in November 2014. The report includes a large amount of data gathered by administrations and elsewhere, particularly about video consumption by different media, as well as practical considerations such as existing rights of use in the band, and the impact of technology development in both broadcasting and mobile domains.

The draft Report sets out four alternative scenarios.

- **Class A**: Primary usage of the band by existing and future DVB[i] terrestrial networks
- **Class B**: Hybrid usage of the band by DVB and/or downlink LTE[ii] terrestrial networks
- **Class C**: Hybrid usage of the band by DVB and/or LTE (including uplink) terrestrial networks
- **Class D**: Use of the band by future communication technologies (not just 'mobile as we know it')

The group did not offer these scenarios as individual 'one-size-fits-all' solutions; the Report includes an analysis of the extent to which they might co-exist, especially given technical constraints of mutual radio interference.

It further concluded that the long-term usage of the band 470-694 MHz would mainly be foreseen for downstream audiovisual content distribution. These services may be linear or non-linear, with a huge variation in the number of receiving users served by a particular content provider: from one up to several million users, and that in turn would influence the technology used.

But even with differences in the technology and the network density used, downlinks, including broadcasting, are much more technically compatible with each other than they are with mobile uplinks. And this will - or should - be the dominant consideration in future planning and evolution of the band.

Another important part of the group's work was to identify indicators of progress towards any of the various case scenarios, testing the assumptions used to develop them. These centred mainly around patterns of consumption (e.g. linear and non-linear) and equipment (e.g. product lifecycles). The Report suggests what these might be, although it recognises that further work is required to develop ways to measure and monitor the indicators with more confidence. It also identified a long list of 'non-binding' but very practical factors which would determine how the scenarios would evolve.

In order to facilitate the different scenarios considered by the Report, TG6 identified that it could be necessary to introduce more flexibility in the regulatory environment governing the use of this band. This

may entail seeking corresponding changes in the Radio Regulations (the ITU framework), notably where technological advance blurs the historic distinctions between the mobile and the broadcasting service. There is also significant flexibility in the ITU regulations and the GE06 agreement, which could be used in the shorter term.

ECC Report 224 is timely. The subject of UHF and its future is receiving close attention in a number of fora and the Report is a useful contribution to inform and influence these processes. At the global level, there is the WRC-15 agenda item 1.1 seeking increased allocations for mobile broadband. Within the EU, the European Commission has also identified the need to clarify the long-term vision for UHF. A 'High-Level Group' of senior industry figures set up by outgoing Commissioner Kroes has already delivered its report[iii]. The Commission has also commissioned a study from consultants (Plum Consulting) on some of the dynamics and possible economics of broadcast-mobile convergence. This attempts to be more predictive than TG6's study on some specific convergence propositions, but tentatively concludes that the economic case for convergence is not yet persuasive. In addition, the Radio Spectrum Policy Group, a high-level advisory group of EU member states to the Commission, has also started work to develop a report on the subject of a UHF long-term vision.

So far, the common theme in all of these activities is to develop a good understanding of evolution and dynamics. But there seems to be a wide recognition that it is too early to pick specific winners and scenarios at this point in time.

Mark Thomas,
Director of the ECO

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i Digital Video Broadcasting

ii Long Term Evolution

iii The 'Lamy report' recommends (a) dedicating 700 MHz to wireless broadband by approximately 2020, (b) safeguarding frequencies below 694 MHz for terrestrial broadcasting (presumably to the extent required) until 2030, and (c) reviewing the market position in (about) 10 years' time.

Earth Exploration Satellite Service: learning about our planet

Much of the ECC's work that attracts widespread public attention is in high profile areas like mobile communications and broadcasting and some unlicensed applications like Wi-Fi. However, Europe's spectrum regulators are equally dedicated to services which are perhaps less well-known but which fulfil vitally important functions. One of these is the Earth Exploration Satellite Service (EESS), which provides a wide range of valuable information about the state of the Earth and its environment and processes, enabling a variety of applications valuable for scientists, policymakers and the public itself. CEPT is committed to protecting these important services, and to enabling new frequency ranges under the right conditions so that they can become even more useful.

There are three types of EESS spectrum use:

1. EESS (passive), that is, non-transmitting instruments, only receiving naturally transmitted signals from the Earth (i.e. radiometers);

2. EESS (active), that is, instruments transmitting a signal and receiving the echo from the Earth, i.e. radars such as synthetic aperture radars (SAR), radio altimeters, and scatterometers; and

3. EESS communication links, which are necessary to operate the satellite, (i.e. telecommands and ranging (uplink); telemetry and ranging (downlink)), and to transmit back to Earth the payload data.

Protecting Earth sensing

'Passive' services are every bit as much a user of spectrum as the services which use transmitters. The ECC has been active by triggering – after years of extensive studies – a decision in the 2007 World Radiocommunication Conference to secure protection of some existing frequency bands for passive radio services. The ECC further decided to improve the security of these provisions in 2010 and 2011 by adopting a set of three Decisions (10)01, (10)02, (11)01. The aim was to establish mandatory limits to protect those bands from interference in contrast to the recommended limits approved at the ITU-R[i] level. This action clearly shows that these important frequencies will be protected in the long-term, and that Europe recognises the societal and economic values of these spectrum-based applications.

These satellite services are typically non-commercial and gather vital measurement data on rain, snow and sea state, and soil moisture (the 10.6 GHz band). Similar services using a higher frequency (the 31.3-31.5 GHz band) gather information on temperature and other atmospheric parameters. Together with data from essential frequencies such as the 23.6-24 GHz band, this data informs scientists and policymakers about climate monitoring and the prediction of certain natural disasters, as well as more routine forecasting. ECC Decision (10)01 calls for mandatory limits to protect EESS (passive) from fixed and mobile services on the same frequency (at 10.6 GHz) and ECC Decision (10)02 deals with mandatory limits to protect EESS (passive) from unwanted emissions of fixed and mobile services operating at 30-31 GHz. ECC Decision (11)01 applies to the frequency band: 1400 to 1427 MHz, which is used to assess ocean salinity and soil moisture.

Looking forward

Now the CEPT/ECC is engaged in plans to expand the frequency range used for EESS (active and operational communication links) to enable it to take a step forward and increase its effectiveness.

As this is an expansion for use by space stations, it is a worldwide issue, and so CEPT's efforts are directed towards finding appropriate solutions for the 2015 World Radiocommunication Conference (WRC-15) Agenda Items 1.11 (related to EESS communication links) and 1.12 (related to EESS (active)).

Both Agenda Items were proposed for WRC-15 by CEPT countries, which see this as a good opportunity to add significantly to the understanding of Earth's topology and other short and long-term change observations (climate) as well as the response to, and mitigation of, threats from natural disasters.

Seeing through the clouds

The big breakthrough is the high resolution images (< 25cm) which can be achieved with Synthetic Aperture Radars (SAR) planning for operation at around 9.6 GHz, combined with the fact that these frequencies can 'see' through the clouds. These satellites look similar to the existing TerraSAR-X shown in Figure 1 - this image shows the German SAR satellite TerraSAR-X which has been operating and providing data since 2009.

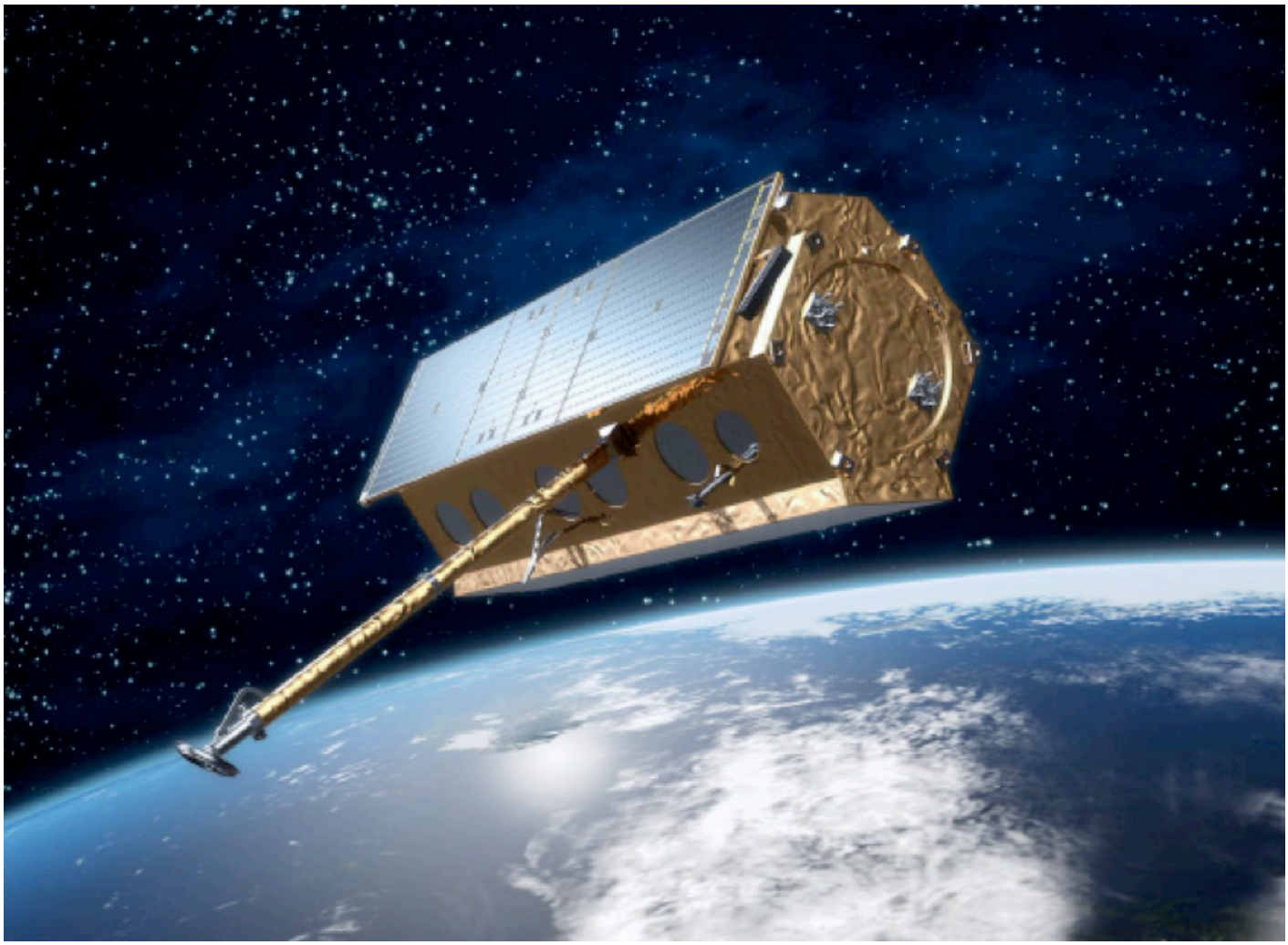

Figure 1: TerraSAR-X radar satellite currently in orbit (the next generation will look quite similar) © Airbus DS/Infoterra GmbH

The picture resolution of the next generation of SARs will be in the same order of magnitude as for optical space-borne instruments. This is about much more than removing the minor curiosity of the occasional small cloud on 'Google Maps'. Figure 2 shows how the new technology creates a much clearer picture.

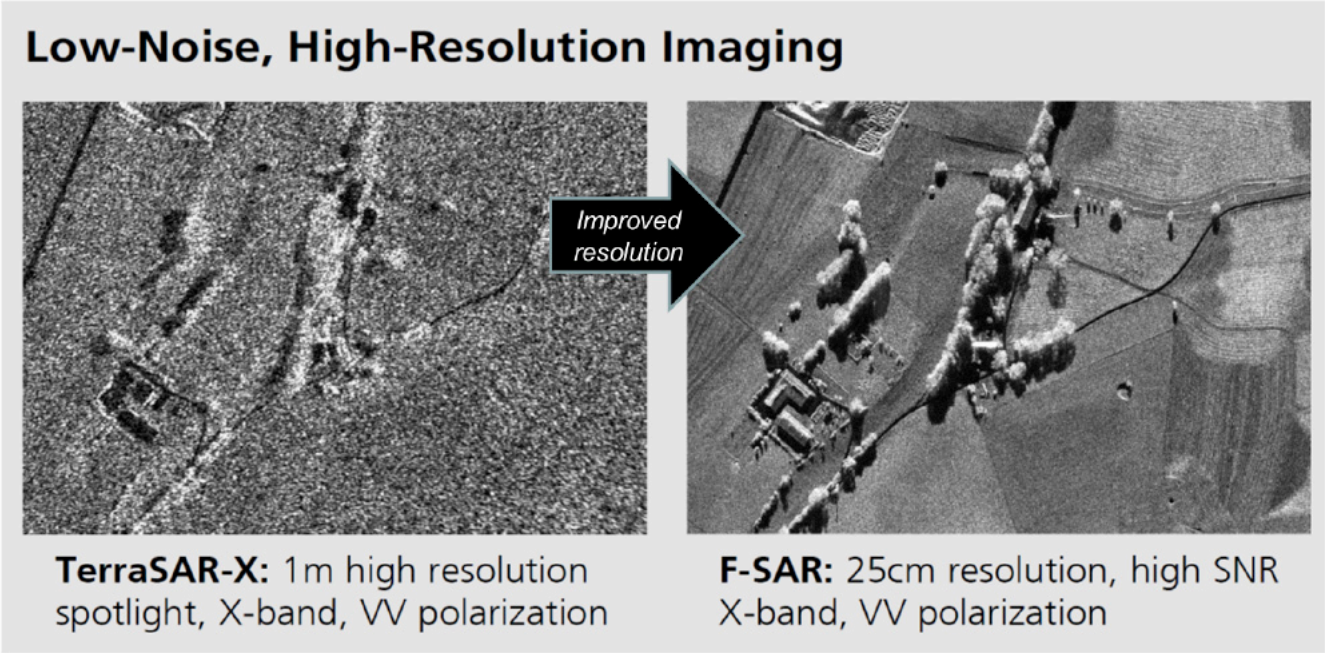

Figure 2: Comparison of current and future SAR resolution (Source: © DLR, Distribution Airbus DS/Infoterra GmbH)

Main applications of EESS (active):

- Disaster relief and humanitarian aid actions require ad hoc access to up-to-date geo information especially for remote areas of the globe. Safety of energy supply: to ensure sustainable oil and gas production, these sites need to be carefully monitored in terms of managing the extraction. In addition, vast pipeline networks require monitoring in terms of their integrity to avoid – or at least to detect – leakages and severe environmental pollution. For this, reliable and weather independent monitoring is required.

- City management and agricultural planning: especially for countries in the tropical regions suffering from substantial cloud coverage requires an affordable, reliable and weather independent mapping capacity.

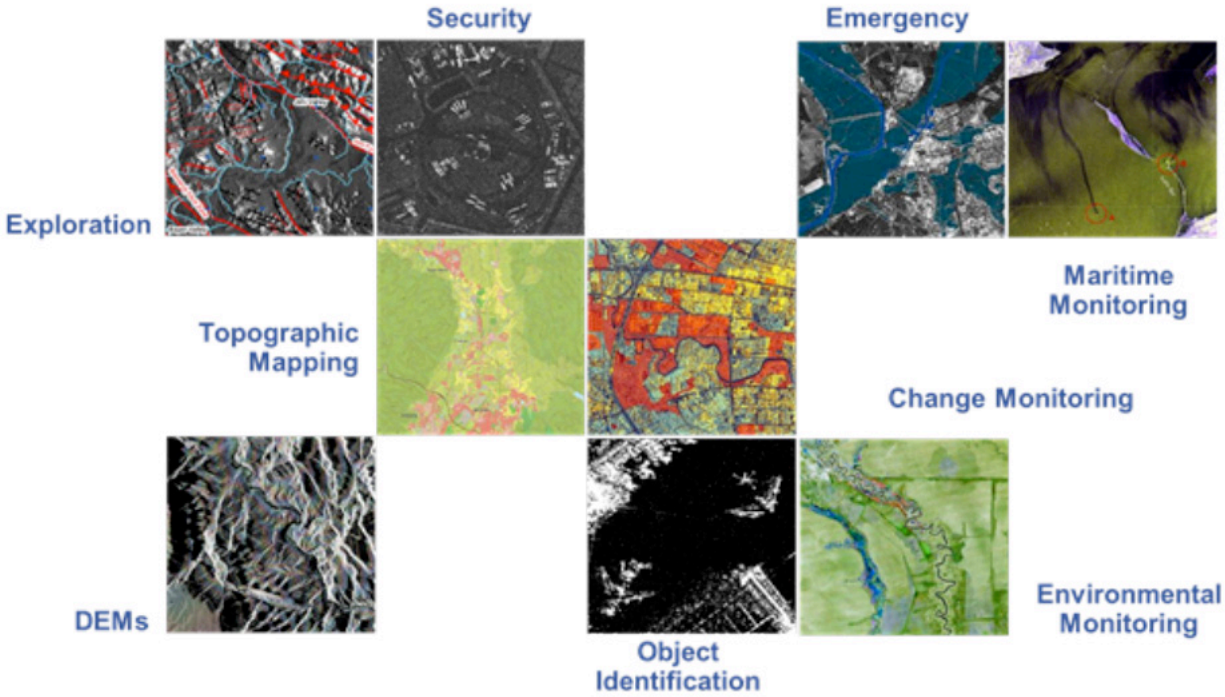

Figure 3: Application areas for SAR (DEM – Digital Elevation Model) (© DLR and Airbus DS/Infoterra GmbH)

Benefits from high-resolution EESS (active)

Satellite Remote Sensing is a challenging technology for acquiring up-to-date information under all weather and all light conditions over large geographical areas, even at variable scales, and is also the only practical way to obtain information from inaccessible regions. High precision geodetic references for SAR pictures enable coherent and interferometric long-term observations taken over months or years to reveal long term evolution of the Earth's features, e.g. landscapes, islands, coastlines, volcanoes, icebergs, etc. Report ITU-R RS.2178 states that: "One can improve prediction of the Earth system only through comprehensive, systematic Earth observation. Observing what is happening today and analysing what has happened in the past, is the key to understanding and predicting what will happen in the future."

Worldwide emergency management and disaster relief: the concept has evolved from pure post-accident activities to prevention, preparedness and mitigation of crisis through observation of trends and gradual developments on the Earth's surface, focusing on the role of pre-crisis activities too, in order to avoid or mitigate the consequences of a disaster.

During the 1990s, the World Bank estimated that an efficient warning system could decrease the impact of natural disasters by 240 billion US dollars. In 2011, the total estimated impact of natural and industrial disasters was 365 billion dollars. As stated by the World Disaster Report issued by the Red Cross in 2012: "...the number of people reported affected by natural disaster (209 million) in 2011 is the fourth lowest of decade, but is much higher than the minimum of 2006 (147 million). In 2011, almost 70 per cent of people reported affected were victims of floods."

The same year, the total number of people reported killed by natural disasters (drought/food insecurity, earthquakes, tsunamis, extreme temperatures, floods, forest/scrub fires, insect manifestation, mass movements, volcanic eruptions, windstorms, industrial and miscellaneous accidents) was about 37,000. The total number of people reported killed by natural disasters in the decade 2002-2011 was 1,240,000. In the same decade, the total number of people affected by the above mentioned phenomena was almost 2,690,000.

Technical requirements and Agenda Item 1.12 (WRC-15)

The next generation of satellite remote sensing will provide the highest possible resolution needed for global environmental monitoring which requires a corresponding transmission chirp[ii] bandwidth of 1200 MHz. Resolution 651 (WRC-12) invites the ITU-R to study options for the extension of the current EESS (active) allocation in the band 9300-9900 MHz by up to 600 MHz anywhere within the frequency ranges 8700-9300 MHz and/or 9900-10 500 MHz.

Keeping Environmental Satellites in orbit; keeping them in touch

EESS of course needs frequency spectrum not only to look at the Earth as we describe above. We need to keep them in orbit, and to get the data they gather back to Earth.

Agenda item 1.11 with res. 650 (WRC-15) aims to identify a primary allocation for the Earth exploration satellite service (EESS) (Earth-to-Space) in the 7-8 GHz range.

EESS systems typically operate in non-geostationary, so-called 'sunsynchronous', orbits with near-polar inclinations. Earth stations that support these systems are located worldwide and are usually positioned at high latitudes to take advantage of the orbits of many EESS missions. Only when a satellite is in line-of-sight of an Earth station, can a communication link be established. The planning of communication operations between an Earth station and the satellite is dependent on capabilities of the on-board data system, the satellite power system, the observation goals, mission parameters, and the available communications capacity.

The EESS missions currently perform the functions of Telemetry, Tracking & Command (TT&C) in the S-band. The 2025-2110 MHz band is used to uplink the command and ranging signals, and the 2200-2290 MHz band is used to downlink the spacecraft telemetry and ranging signals. Both up/downlink bands are shared with the space research service (SRS) and the space operations service (SOS). The EESS missions perform the payload data download in either the 2200-2290 MHz or 8025-8400 MHz bands, depending on the data rate requirements.

Some future EESS missions will require larger bandwidth for TT&C in both directions (commanding and telemetry). The frequency coordination of these missions would be very problematic in the S-band, due to the congestion in this band.

Benefits from an EESS uplink in X-Band

An EESS (Earth-to-space) allocation in the 7-8 GHz range would allow some EESS missions with larger data rate requirements to use this new uplink allocation for TT&C in combination with the existing EESS (space-to-Earth) allocation in the 8025-8400 MHz band, thereby alleviating the congestion problem in the S-band, mitigating the frequency coordination problem, and eventually leading to a simplified on-board architecture and operational concept for these future EESS missions.

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i ITU-R: International Telecommunication Union – Radiocommunication Sector

ii A 'chirp' is transmitted by sweeping an unmodulated carrier over a given bandwidth creating a short pulse of e.g. 50 µsec followed by a 100 µsec period of silence before the next sweep occurs.

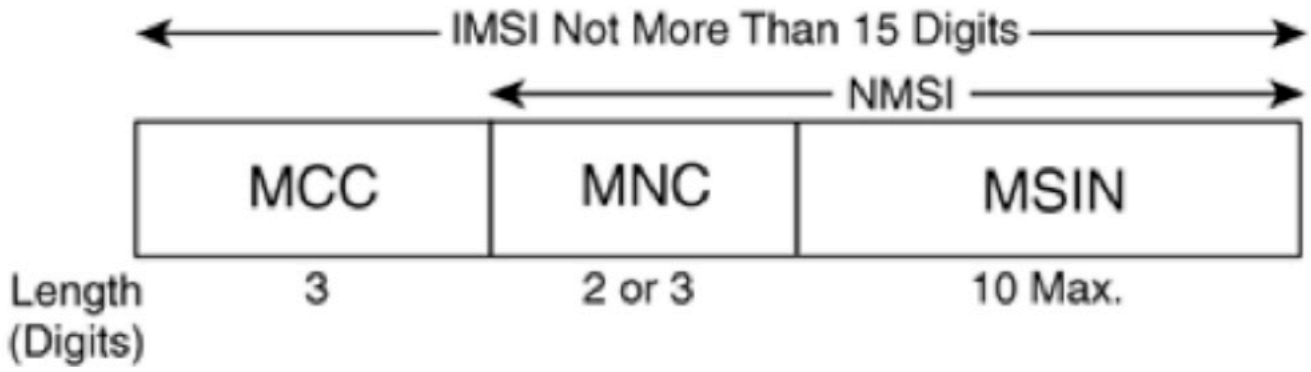
Efficient Management of Mobile Network Codes and the need to keep Europe at the forefront of innovation and competition

A key objective of the regulatory framework for electronic communications in Europe is to remove the barriers faced by new market entrants so that competition and innovation can thrive. Facilitating regulated access to networks, the removal of restrictive licensing regimes, and ensuring equal and non-discriminatory access to critical resources such as radio spectrum and numbering have all played a significant part in transforming the competitive landscape in electronic communications over the past 20 years. Since the 1990s competition has been a cornerstone of European countries' policies for delivering connectivity to consumers.

As business models and consumer preferences continue to evolve, regulators must continue to be vigilant in order to identify potential bottlenecks which may lead to problems at a later stage. One such issue currently being addressed by the ECC's Working Group on Numbering and Networks (WG NaN) is the evolving uses of Mobile Network Codes and a reassessment of the eligibility criteria for access to those resources.

What is a Mobile Network Code?

Mobile Network Codes (or MNCs) make up part of the International Mobile Subscription Identity (IMSI), which is primarily used by Mobile Network Operators (MNOs) to identify individual subscriptions on mobile networks. Every SIM card in every mobile device in the world is programmed with a unique 15-digit IMSI number. The IMSI structure is defined by the ITU Telecommunication Standardization Sector's (ITU-T) Recommendation E.212 and can be illustrated as follows:



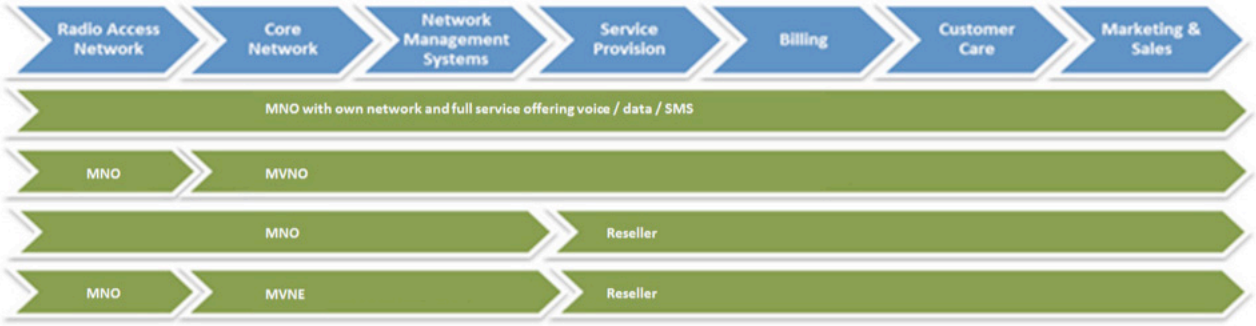
IMSI Structure

The first three digits identify the subscriber's home country. This is called the Mobile Country Code (MCC). The next two or three digits identify the subscriber's home network. This is called the Mobile Network Code (MNC) and is configured in almost all countries around the world with only two digits. The remaining nine or 10 digits make up the Mobile Subscription Identification Number (MSIN) which is used to identify individual subscribers. These IMSI numbers are not numbers that are dialled (and are therefore invisible to the everyday user) but they are critical for authenticating and registering subscribers on mobile networks particularly to facilitate roaming. The capacity of this addressing space provides for the possibility of a 1000,000,000,000,000 (a quadrillion!) unique IMSI numbers. Therefore, the issue being addressed by WG NaN is not a capacity issue *per se*.

However, as the structure of the IMSI is rigidly defined, the problem lies at the fourth and fifth digits. Each country allocated an MCC by the ITU typically only has a 100 MNCs (that is 00 to 99 in a two-digit configuration) to allocate to electronic communications service providers. In the past this was probably more than enough but times are changing.

Traditional business models

The E.212 structure was developed at a time when MNOs were the only stakeholders in the mobile value chain with a justifiable need for MNC resources to facilitate authentication, roaming, billing and routing and it was probably not envisaged at the time that there would be a need for more than a 100 MNCs per country. MNCs are also allocated to Mobile Virtual Network Operators (MVNOs) and Mobile Virtual Network Enablers (MVNEs) where these entities have some level of core network infrastructure and only use the radio access network of the underlying MNO. The traditional business models are illustrated in the diagram below:



The traditional mobile value chain

Emerging Business Models

As business models have evolved, the demand for MNCs has increased and accordingly national regulators in Europe have received applications for MNCs from new market players. In almost all cases these applications have been rejected as the assignment criteria at the national level are consistent with the assignment criteria specified in ITU-T Recommendation E.212 which currently restricts the assignment of MNCs to "*public networks offering public telecommunication services*".

However, the widening range of applications which mobile networks can and will serve is changing the game, and this is bringing a need to reappraise how these all-important codes are handled. ECC Report 212 on '*Evolution in the Use of E.212 Mobile Network Codes*' was recently published by the WG NaN Project Team on Future Numbering Issues (PT FNI) and it identifies several emerging business models with a justifiable need for MNC resources. These emerging business models typically consist of private entities, with a significantly large number of devices, who need to conclude agreements directly with MNOs.

One example cited in the Report is the need for MNC resources by utility companies to facilitate communications for smart metering. In certain circumstances, utilities companies may enter into agreements with MNOs to provide coverage in areas where other communications solutions are impractical or cost prohibitive. Each smart meter (and there could be millions!) requires an active SIM card. If a SIM card provided by the underlying MNO is used then the utility company is effectively 'locked in' to that supplier as swapping out millions of SIM cards to facilitate a new supplier is simply not a viable option.

If the utility company had its own MNC then it could generate its own SIM cards and, with a minimum level of infrastructure, have an independent IMSI range for its smart meters. A change of provider is then conceivably possible with configuration changes at the network level. This type of arrangement would also allow the utility company to enter into national roaming agreements with several MNOs to provide network redundancy if needed.

The issues identified in the smart metering example also apply to the emerging Machine-to-Machine (M2M) sector where there may be millions of devices installed over a wide geographic area or in devices that are inherently mobile (e.g. intelligent transport systems in vehicles such as e*Call*).

Potential solutions

After identifying these examples, the Report then investigates possible solutions at both technical and administrative levels. At the technical level a possible solution may be on the horizon with 'Over the Air' provisioning of IMSI numbers. This solution would allow an IMSI number to be changed without physically replacing the SIM card in the device. There are security concerns with this type of solution but the GSMA has recently developed a specification for the embedded SIM. This is a very promising development but the timeframe for standardising and certifying this solution may take several years to complete.

At the administrative level, the Report identifies several proposals to change the E.212 Recommendation including to make the assignment criteria more liberal and to mandate three digit MNCs in all newly assigned MCCs to provide a tenfold increase in capacity in the future. The Report also identifies solutions for MNC sharing.

Next steps

The challenge for numbering plan managers is to balance the needs of market players in the interest of promoting competition and innovation while at the same time ensuring efficient management of a scarce resource. In this Report, WG NaN advocates more liberal assignment criteria but only to cater for those emerging market players with a justifiable need for an MNC that is independent of the underlying MNO.

Following publication of the Report, WG NaN submitted a contribution document to the ITU-T which contained several detailed proposals, based on the conclusions of the Report, to amend Recommendation E.212. In the coming months, WG NaN will be active at the ITU-T level in Study Group 2 to push forward with these proposals in the interests of keeping Europe at the forefront of innovation and vibrant competition in electronic communications.

ECC Report 212 is available for download here.

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