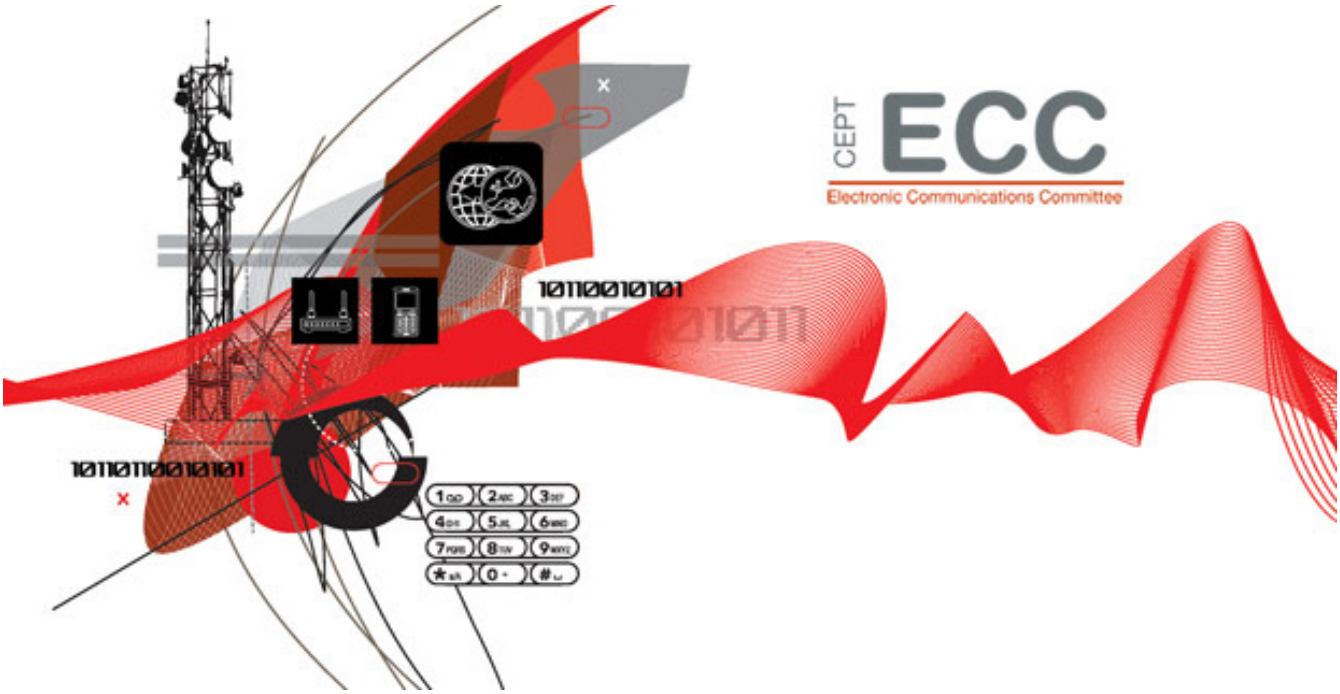


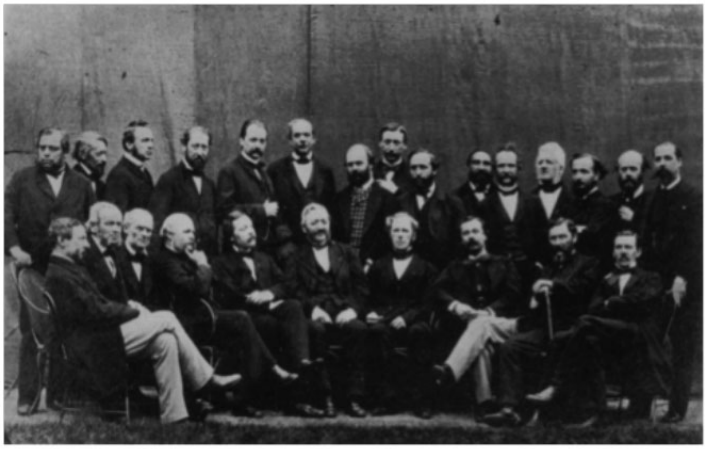
ECC Newsletter May 2018

Harmonised dialling codes and their continued importance

In 1840, it took 10 weeks for a written communication from the United Kingdom to reach India and for a reply to be sent back. By 1870, the same message could be sent and a reply received in just 4 minutes via telegram. In today's parlance we would refer to the technology behind telegraphy as "disruptive".

The effectiveness of telecommunications technology has always been, and continues to be, based on the protocols and standards governing its use. In the earliest days of the telegram problems were encountered where lines crossed national borders. Messages had to be stopped and translated into the particular system of the next jurisdiction. To simplify and streamline processes, regional agreements were forged.

In 1865 representatives of 20 countries gathered in Paris at the International Telegraph Conference to find ways to overcome barriers and make services more efficient. They would create a framework to standardise telegraphy equipment, set uniform operating instructions and lay down common international tariff and accounting rules[1].



Early "harmonisers" at the first International Telegraph Conference (Paris, 1865) (Source: ITU)

Since those early days, harmonisation and standardisation initiatives have served the telecommunications industry and society well as technology has evolved and as the uptake of telephony reached mass market. As operator switchboards became redundant and international telephony became completely automated, standard approaches to dialling became essential.

In 1960, the newly formed International Telegraph and Telephone Consultative Committee (CCITT) of the ITU met in New Delhi, India. From that point on, a major effort was made towards formulating and implementing plans for standardised national and international dialling.

Country codes were assigned to countries based on the geographic regions of the world and behind those country codes, national numbering plans were implemented. It also became increasingly apparent that harmonised approaches for accessing certain services were also required, such as directory enquiry services, operator services and emergency services.

Harmonisation initiatives in Europe

In order to place a call, national or international, a prefix was first required to inform the network that a call was going to be initiated. In Europe, "0" was adopted as a national trunk prefix code and "00" as an international prefix code in most countries. Short codes for services were also harmonised such as 112 for emergency services and 118 for directory enquiry services.

CEPT, the European Conference of Postal and Telecommunications, was at the forefront in driving these initiatives. As early as 1972, CEPT adopted Recommendation T S/F 1 which was the first major step to introducing harmonised trunk prefixes and short codes for emergency services, operator services and directory enquiries.

Fast forward to 2018, and it is rare that we find ourselves standing in a telephone box trying to remember the telephone number of a family member, friend or a particular service. If we are not contacting them on social media, we have powerful handsets which contain our address books and

the need to actually remember a digit string has become largely redundant. Nevertheless, these harmonisation measures remain critically important for end-users of telephony services even if they are unaware of them.

European citizens can now access emergency services on 112 from anywhere in Europe. Awareness of the number remains low but is increasing with each passing year. Handset manufacturers take account of 112 in designing the handset software, which can give special treatment to an attempt to dial 112 including, for example, by attempting to complete a call to the emergency services from a mobile handset which does not have a valid SIM card. Another example is the road safety initiative eCall, which is largely based on providing connectivity to the single harmonised European emergency number 112.

For international access ("00" in Europe), handset manufacturers have also taken these harmonised codes and implemented them in their handset software. Users can then store numbers in a full international format using "+" as a universal international prefix. So if you are dialling a European number from China, North America or Australia, you do not need to remember to prefix your number with 0, 011 and 0011 respectively. A "+" will do and the handset and the network will take care of the rest.

ECC Decision (17)05 – Harmonised prefixes and short codes in national numbering plans

The ECC's Working Group on Numbering and Networks (WG NaN) recently reviewed all ECC deliverables relating to harmonisation and standardisation of dialling prefixes and short codes. It was apparent that some of the harmonisation measures previously implemented were now redundant such as harmonised short codes for international operator services.

It was also apparent that some deliverables did not take account of current national and European regulatory frameworks, or more recent harmonisation initiatives such as the 6-digit numbering range beginning 116xyz for harmonised services of social value. Critical services, such as a hotline for missing children on 116000, are now available on this short number throughout Europe.

WG NaN decided to consolidate important elements of harmonisation from different deliverables into a single ECC deliverable. As these harmonisation measures are very significant, WG NaN considered that it would be most appropriate to enshrine them in an ECC Decision to ensure that European countries considering changes to their national numbering plans are aware, and can take into account, these harmonisation measures. Following a period of consultation with industry stakeholders, ECC Decision (17)05 was adopted at the 47th ECC Plenary meeting in Lisbon on 02 March 2018.

The Decision requires that four harmonisation measures are retained or introduced as follows:

1) The digits "00" as an international prefix;
2) The digit "0" as a national trunk prefix;
3) The digits "112" as a short code for emergency services
4) The 6-digit numbering range beginning 116xyz for harmonised services of social value in accordance with ECC Decision (07)03.

The Decision also recognises the continued importance of directory enquiry services in some national markets and requires that CEPT countries already using short codes beginning with 118 for national directory enquiries continue to do so as long as needed by the market.

These harmonisation measures should continue to serve European citizens well in to the future.

ECC Decision (17)05 is available at the European Communications Office's Documentation Database - www.ecodocdb.dk.

Freddie McBride, Numbering and Networks Expert, European Communications Office

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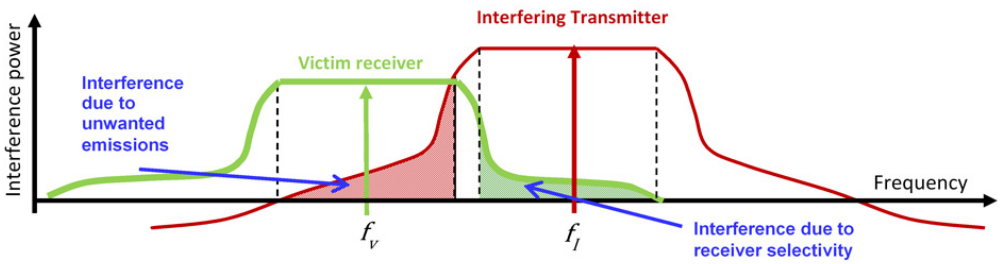
[1] https://www.itu.int/en/history/Pages/ITUsHistory.aspx

The role of unwanted emissions and receiver performance in spectrum management

Spectrum engineering has a role in ensuring that different systems can coexist in a spectrum efficient way without causing harmful interference to each other. In particular, sharing and compatibility studies are important ways to assess that role. We discussed both of these points in a previous newsletter article in May 2017, but what about the role of both transmitter and receiver parameters in spectrum management? Here, we take an in-depth look at the function of both, and examine the recent and ongoing work within the ECC around transmitter and receiver parameters in spectrum management.

Transmitters versus receivers: Two sides to the interference coin

Both transmitters and receivers play a role in ensuring efficient use of spectrum. Transmitters need to be designed with sufficient filtering to ensure their unwanted emissions don't cause interference to neighbouring users of the spectrum. However, at the same time receivers also need to ensure they have sufficient filtering (selectivity) to reject interfering signals from neighbouring users. In some cases, either the transmitter or receiver is found to be the dominant factor in interference; in other cases both play a role.



The role of transmitter and receiver filtering in interference

Examples of both cases can be seen in the developments within the UHF spectrum range (470-862 MHz) in recent years. When the '800 MHz' band — from 790-862 MHz — was studied for mobile (4G) usage, compatibility studies (see CEPT Report 30) showed that both unwanted emissions from mobile systems and selectivity of the digital terrestrial television (DTT) receiver could have an impact on DTT reception. However, the studies also found that reducing further unwanted emissions of 4G base stations beyond a certain level would not provide additional mitigation because receiver selectivity would then be the dominant interference effect.

Later, when the '700 MHz' band (694-790 MHz) was studied for mobile usage (see CEPT Report 53), it was found that unwanted emissions from mobile terminal devices were predicted to be the dominant effect. This differs from the 800 MHz case due to a number of factors, among them the

fact that in the 700 MHz band the uplink portion, where mobile devices transmit, is closer to the DTT spectrum, whereas at 800 MHz the downlink portion, where base stations transmit, was closer. Also, there was a lower guard band between the two systems.

Defining unwanted emissions performance of transmitters

Minimum requirements for unwanted emissions from transmitters need to be specified in order to prevent interference. Within the European regulatory framework ECC and ETSI co-operate to ensure this. ECC carries out sharing and compatibility studies and liaises with ETSI to ensure the results are mutually acceptable to both parties. Results of these studies are then implemented consistently in ECC deliverables (Decisions or Recommendations) and ETSI Harmonised Standards.

There are two categories of unwanted emissions: *out-of-band* emissions, which refers to modulation-related emissions directly outside the transmitter's channel bandwidth; and spurious emissions at higher frequency offsets, which include harmonic and parasitic emissions as well as intermodulation products. The boundary between the out-of-band and spurious emission domains is usually defined as 2.5 times the transmitter's bandwidth, but there are some exceptions to this rule.

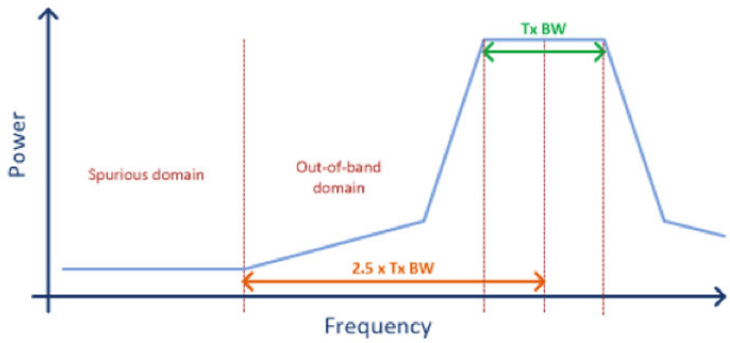
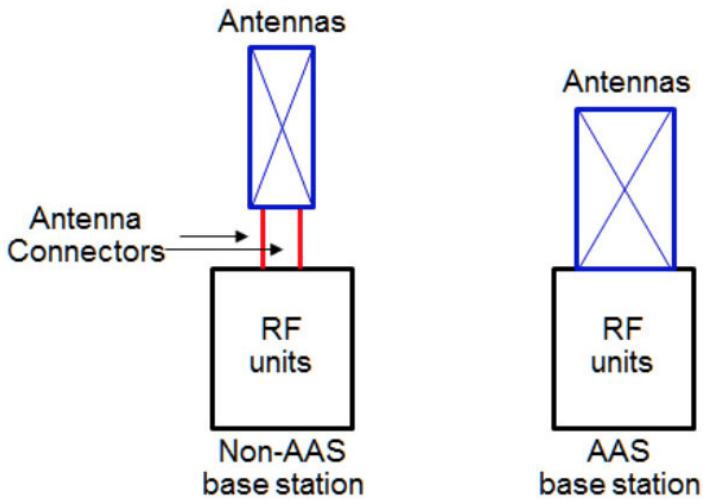


Illustration of boundary between out-of-band and spurious domain

ETSI Harmonised standards define specific requirements for the *out-of-band* domain. General requirements for spurious emissions in all frequency bands are provided for in ERC Recommendation 74-01. The relevant limits from this recommendation are reflected in the relevant ETSI standards.

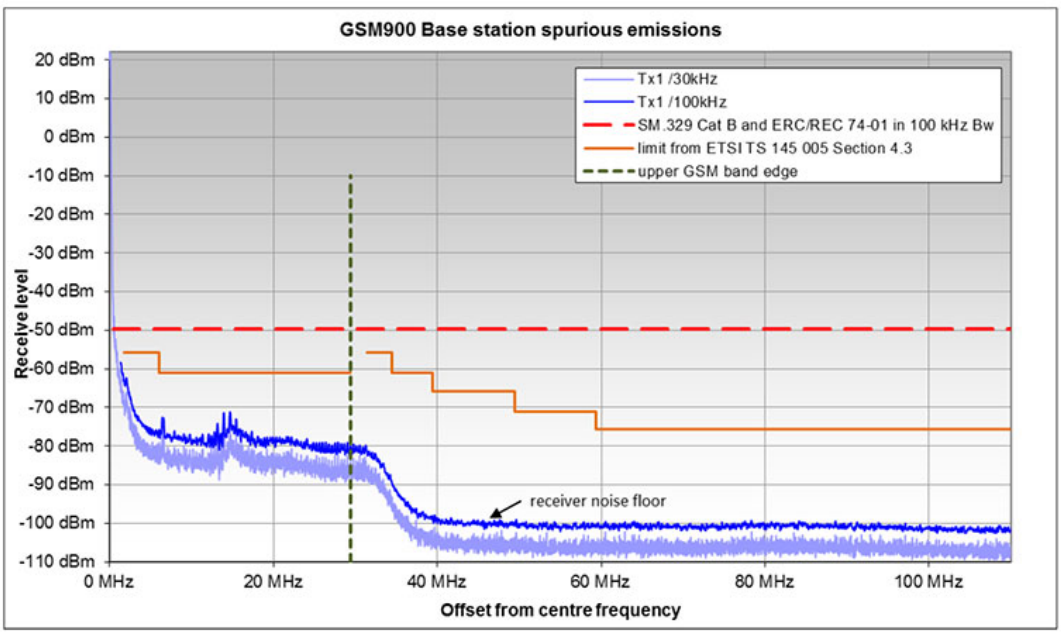
ERC Recommendation 74-01 is currently under review to ensure the spurious emissions limits contained within are still fit for purpose and relevant for new and upcoming technology.

Particular challenges in this ongoing review are raised for 5G technology using active antenna systems (AAS). In this case, the antenna array is integrated in the device, which means that unwanted emissions cannot be as easily measured. It has also been reported that it will be difficult for 5G systems in millimetre wave bands (26 GHz and above) to meet the existing limits, due to constraints on filtering technology.



Comparison of non-AAS and AAS architecture. In the AAS case no antenna connectors are available for measurement

While minimum regulatory requirements must be sufficient to prevent interference, it is also important to accurately quantify equipment performance in sharing and compatibility studies. In ECC Report 249, published in 2016, measurements of a range of different types of transmitters showed that typical equipment generally exceeds – by some margin— the minimum requirements for both out-of-band and spurious emissions. Therefore, assessing interference based on the minimum requirement represents a worst-case scenario which may limit opportunities for sharing. The report concluded that sharing and compatibility studies should reflect actual equipment performance in order to ensure efficient use of spectrum. Ideally a statistical distribution of unwanted emissions should be used in the studies to capture the spread in performance of different equipment models.



Example of measurements on a GSM base station which show that unwanted emissions are significantly better than the minimum requirements (Source: ECC Report 249)

As a follow-up activity, an ECC Recommendation is under development within Project Team SE 21, which aims to provide guidance on how to incorporate typical equipment performance in sharing studies, when appropriate. This will be useful for ECC project teams and administrations, who will be able to make use of the best available information to ensure accurate studies.

Receiver performance and the Radio Equipment Directive

Receiver requirements are typically only mandated through ETSI harmonised standards. Previously, there was no mandatory requirement for minimum receiver performance, which was problematic for spectrum management as it could give rise to interference problems, particularly for receive-only devices (e.g. broadcast TV receivers) and some categories of licence-exempt short range devices. This changed with the introduction of the EU Radio Equipment Directive (RED), which came into force in 2016. The directive requires that radio equipment (covering both the transmitter and the receiver sides) "shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference".

Under the RED, ECC's Spectrum Engineering Working Group (WG SE) has been monitoring the development of new and updated harmonised standards within ETSI. The aim is to ensure requirements, including receiver parameters, are sufficient to provide protection from interference.

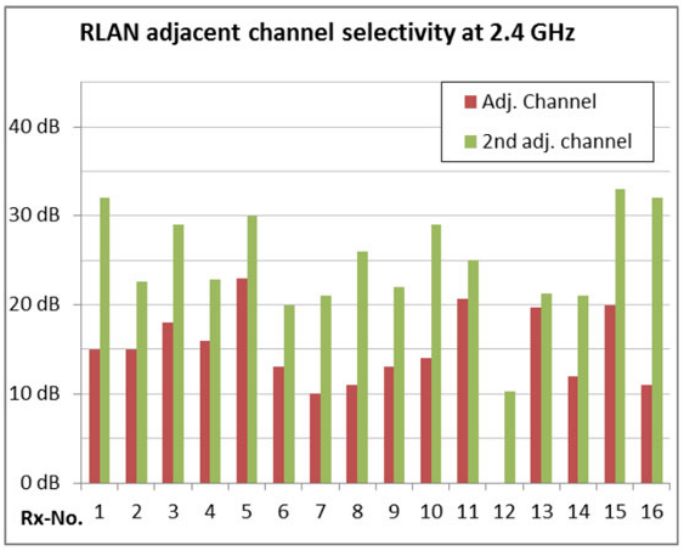
Inclusion of receiver requirements in the RED is a positive development for administrations and the ECC as it provides better certainty of equipment performance, and also better information for use in sharing and compatibility studies. However, it also brings challenges for industry and can result in higher costs to devices if improved filtering is mandated. There is an additional challenge to define performance requirements for ‘non-classical’ radio equipment, including ultra wideband (UWB) and inductive devices, such as autonomous lawnmowers, as well as automotive radar and short range sensors. ETSI is currently working on alternative ways to specify performance for these types of devices while meeting the requirements of the RED. ECC is cooperating with ETSI on this work.

Separately, work is underway within Project Team SE 21 to study the role of receiver parameters in the context of sharing studies. One aspect of this is to determine common definitions for key parameters, as different communities currently use different terminology. The outcome of this work will be an ECC Report which will provide guidance on how to accurately model receiver performance in sharing and compatibility studies.

The importance of measurements

In the context of ECC Report 249, measurements can play an important role in understanding typical equipment performance. However, ensuring a representative set of measurements can be challenging.

In addition to the examples of transmitter measurements above, receiver measurements can also be useful. Our work is supported by ongoing measurement campaigns on different types of receivers, including Wi-Fi, LTE and DECT devices to highlight the role that receiver parameters play in sharing studies.



Example of measurements of selectivity of a range of different RLAN devices showing a spread in performance (Source: ongoing work in PT SE 21)

Conclusions

In summary, it is important that both transmitters and receivers have well-defined requirements in relevant regulations. When undertaking coexistence studies, it should be recognised that the minimum requirements represent the worst case scenario, and therefore it is important to attempt to quantify the performance spread of real equipment. The ongoing work which ECC is undertaking to better quantify and understand both unwanted emissions and receiver parameters will help to ensure accurate coexistence studies, which will in turn allow different users of the spectrum to coexist in a spectrum efficient way without causing harmful interference to each other.

Peter Faris, Spectrum Expert, European Communications Office