Comments on: Plum Consulting-
"The future use of UHF spectrum in ITU Region-1"

As at: 12 July 2021

Executive Summary

- The study is not an independent one. The study was commissioned by the Global Mobile Suppliers Association (GSA). Plum Consulting is an Associate of GSA.
- The tendentious figures and statistics mentioned incline to be interpreted in favour of the mobile internet.
- The CEO of Telefónica Deutschland announced in person that by 2024, there would not remain a single dead spot in Germany. This clearly shows that the spectrum 470 – 694 MHz is not needed for mobile internet.
- Broadcasting is just as spectrally efficient as mobile radio with DVB-T2 and single frequency networks.
- The Plum study inadmissibly compares the needs of rural regions in Africa with rural regions in Central Europe or Germany.
- The successful coexistence of PMSE with terrestrial broadcasting cannot be continued with mobile radio[1] due to the nature of the system, so that the question arises as to how PMSE could be used at all in the future.
- Plum Consulting recommends a co-primary frequency allocation of the 470-694 MHz UHF spectrum to the Mobile Service (for IMT) and to the Broadcasting Service. Such co-primary allocation does not provide the claimed "flexibility" in the choice of use per country. Europe is so small-scale that a European-wide decision must be taken in favour of one or the other type of service.

Comments on the study of Plum Consulting

In June 2021, Plum Consulting published a study on the future use of the UHF band 470 MHz – 694 MHz. The study takes a closer look at the situation of the mobile radio, broadcasting and PMSE[2] and draws conclusions for the frequency band that has been allocated on a primary basis to broadcasting until now. The study comes to the conclusion that a co-primary allocation of frequencies to broadcasting and the mobile service would be ideal, since at the national level the needs are different and thus the greatest possible flexibility could be achieved at the national level itself.

In the following, some of the study's claims are examined in more detail:

[1] Mobile radio in the sense of the standardisation body 3GPP. The corresponding ITU term is “Mobile Service”

[2] PMSE: Programme Making Special Events – wireless production tools like cordless microphones

The study is not independent

The study was commissioned by the Global Mobile Suppliers Association (GSA). The GSA is an organisation that represents industrial companies worldwide that are involved in mobile communications (systems, components, devices, services and applications). Executive Members of GSA are: Ericsson, Huawei, Intel, Nokia, Qualcomm, Samsung, ZTE. And Plum Consulting is an Associate of GSA.

Tendentious numbers and statistics

The study mentions a lot of numbers and statistics. However, many of them are taken out of context or placed in a wrong context:

a. **Assertion:** *The demand for mobile radio frequencies is increasing as greater bandwidths will be needed in the future due to increased video use.*

The justification for increased demand for frequencies is not valid. In the future, it is likely that significantly more video will be used via the internet, but much of this video use will take place on a big screen, which is usually wired and therefore does not need any mobile radio frequencies.

Similarly, there is no mentioning of the fact that video use on mobile devices often takes place in Wi-Fi environments (home, office, hotel, restaurants, bus and train, hot spot providers, etc.) and that mobile frequencies are not needed here either.

The increased demand is also justified by applications such as gaming and XR (meaning augmented and virtual reality). In addition, use cases such as "ultra-reliable low-latency", "industrial automation" and "advanced manufacturing" are mentioned. For these requirements (permanently high bandwidths and simultaneously low latencies[3]), the frequencies in the required sub-700 MHz spectrum are not suitable due to the relatively large targeted cell sizes, especially in rural areas.

In the same way, the presentation of the increasing number of mobile devices in use in contrast to the number of fixed connected devices (Fig. 2.6 - 2.8) is deceptive: behind every fixed connected device is a household with around three users.

On 1 July 2021, the CEO of Telefónica Deutschland, Markus Haas, announced in a Focus[4] interview that there would not remain a single dead spot in Germany by 2024. To this end, the company is cooperating with Vodafone and Deutsche Telekom within the framework of a so-called "white spot sharing". Within this framework, some 6000 additional sites will be built. In addition, the federal government is erecting another 5,000 sites in "extremely remote areas" so that "absolute area coverage" will be achieved by 2024.

[3] Latency: Delay or, in this case, runtime of a signal.
[4] German news magazine: https://www.focus.de/digital/dldaily/markus-haas-beim-dld-summer-telefonica-chef-verspricht-bis-2024-kein-einziges-funkloch-mehr-in-deutschland_id_13453608.html
A pertinent text in English can be found on https://sos-save-our-spectrum.org/muchas-gracias-senor-jose-maria-alvarez-pallete-hope-for-the-world-radiocommunication-conference-2023/?lang=en

This clearly demonstrates that the sub-700MHz frequencies are not needed for the development of rural areas - as evidenced by the statement of the Head of Telefónica Deutschland.

b. **Assertion:** *The use of digital terrestrial television is declining.*

This judgement is justified by stating that the use of linear television is declining. But this is not correct. It is correct that the use of linear television is lower in the younger generation than in the older generation. Nevertheless, the younger generation also uses linear television. Overall, the linear use of television is still dominant with 72% of the entire video usage time per capita (compared to non-linear services) in 2020 in Germany.

c. **Assertion:** *The demand for frequency spectrum for DTT is decreasing*

The need for spectrum was clearly expressed by the ITU administrations in responses to an ITU questionnaire (Report ITU BT.2302-1): the vast majority of countries in ITU-Region 1[5] stated that they need at least 224 MHz of spectrum or even more (95 countries particularly in Europe and Africa), while only seven[6] countries reported less than 224 MHz of demand.

d. **The diligence and quality of the research is questionable**

For example, the study misstates the decisive Shannon-Hartley theorem.

This may be a careless mistake, but it demonstrates the lack of accuracy in the preparation of the study.

Broadcasting is efficient

In section 3.2, the study claims that broadcasting would not use the spectrum efficiently. This statement is justified by the fact that mobile radio works with a re-use factor of 1 while broadcasting requires 4-5 channels per programme multiplex. Re-use factor 1 means that mobile radio uses the same mobile radio channel in neighbouring cells, which broadcasting can only do if it uses so-called single frequency networks (SFN).

A precondition for SFN operation is that the broadcast content is identical throughout the SFN. In regions where this is possible for programming reasons, The German broadcasters use SFNs, for example in Hamburg/Schleswig-Holstein or in Berlin. In certain multiplexes, however, locally and regionally different content is to be provided and therefore the single frequency operation is deliberately dispensed with. These are content-related and not technical reasons.

Through smart frequency planning and owing to the most powerful video compression system HEVC[7], the efficient DVB-T2 system today offers up to 41 channels locally (e. g. in the greater Munich area). Assuming an average data rate per multiplex of approx. 25 Mbit/s, this results

[5] ITU Region 1: Europe, Africa, the Near East and the countries of the former Soviet Union
[6] Egypt, Finland, Israel, Kuwait, Saudi Arabia, Slovenia and United Arab Emirates
[7] HEVC (High-efficiency video coding), common name for the MPEG (ISO/IEC) and ITU Standard H.265

in a continuous, area-wide data stream of 150 Mbit/s[8], which can be accessed simultaneously by any numbers of users 24 hours a day, seven days a week, with full bandwidth.

Now physics cannot be cheated. As for most TV broadcasting services, in mobile radio, too, the content of the neighbouring cell is not identical. Broadcasting and mobile radio are at least equally efficient. Broadcasting operates its services under full load, i. e. the data capacity of a broadcast multiplex is fully used all the time. Mobile radio, on the other hand, can only use the same channel in the neighbouring cell because, on average, only about 20-25% of the data capacity can be used. Neighbouring mobile radio cells cannot use all subcarriers of the same frequency at the same time. If a mobile radio cell were to be run "full load", this would have the consequence that the neighbouring cells would have to stop their operation entirely because no free subcarriers would be available anymore on this frequency.

Moreover, the accusation of ineffectiveness can be returned to mobile radio. For example, the frequency ranges for uplink and downlink are always symmetrical and spectrally of the same size, although the data rates for the downlink (e. g. video streaming) are usually significantly higher than those for the uplink. In cable-based internet supply, this circumstance is already taken into account, e. g. via ADSL, in the form of asymmetrical frequency ranges. In mobile radio, too, the unused frequencies in the uplink range could be used for downlink by means of a different system design. This would counteract the alleged shortage of frequencies.

Furthermore, there is also unused spectrum in mobile radio. The duplex gap between uplink and downlink is, due to the system design, unusable. Hence, in the 700 MHz band, 17 MHz of spectrum in the duplex gap cannot be used (ref. Figure below).

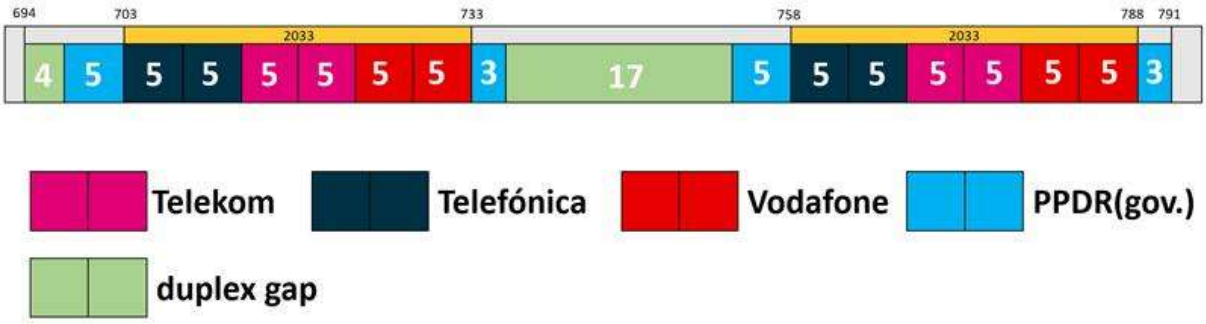

Figure 1: Frequency assignment in the 700 MHz band in Germany

Mixing the needs of the different geographical regions

The study refers to ITU Region 1, which includes Europe, Africa, the Near East and the countries of the former Soviet Union. The need for mobile spectrum - specifically for covering rural areas - is strongly emphasised in the study. However, little attention is paid to the differences between rural regions: rural regions in Africa cannot be compared with rural regions in Europe. In Europe, and especially in Germany, it would be much easier and more economical to close existing coverage gaps if individual mobile network operators would just built up additional base stations in their existing frequency bands. The closing of the gaps could

[8] Assumption: 6 multiplexes with an average useful data rate of 25 Mbit/s

be alleviated by allowing national roaming[9] and through the consistent use of the MIG[10] infrastructure in rural areas, which will be generously funded by the federal government for several years to come.

The frequencies of the 700 MHz band have been largely unused by the Mobile Service up to now. They provide similarly good propagation characteristics as the sub-700-MHz frequencies now required and should first be used before further requests are made for additional spectrum.

In contrast, in rural areas such as in Africa much greater efforts must be undertaken to provide mobile radio coverage. However, it seems contradictory to demand a frequency range that is, according to the ITU questionnaire, urgently needed for terrestrial television, especially in Africa. Here, other technologies can offer more economical solutions. For example, satellite network operators such as OneWeb[11] or Starlink[12] offer internet access for remote areas via low-flying LEO[13] satellites in the Ku[14] and Ka bands.

The 470-694 MHz frequency range is needed for PMSE and other secondary services

The existing primary allocation to broadcasting allows for frequency coexistence with other radio services, such as radio astronomy, PMSE and wind profiler radars, which, in turn, increases the efficient use of the frequency band 470-694 MHz.

In particular, the coexistence of PMSE with terrestrial broadcasting is being successfully practised on a large-scale day by day. Coexistence of PMSE with mobile radio is not possible as the comparatively small radio cells of mobile radio base stations and the smartphones themselves cause interference with PMSE.

Certain professional applications, such as In Ear Monitoring (IEM), require low-latency transmission and therefore do not currently allow a transition to digital equipment and continue to require the use of analogue transmission methods (ECC Report 323).

A preservation of the status quo is also necessary as there are many users (churches, conferences, schools, theatres, museums, etc.) who cannot simply replace their equipment at great cost.

The claim is wrong that the number of wireless PMSE devices is only slowly increasing. The number of events with PMSE is constantly increasing (e. g. music festivals), as musicians today often earn their money with live performances rather than by selling audio or audio-visual carriers. The ratio of "microphone to IEM" is now almost 1:1. The same applies to TV events, such as talk shows: everyone carries a clip-on microphone and thus also a PMSE transmitter. This results in a constantly increasing number of PMSE equipment.

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[9] National roaming: a customer of a certain mobile network operator can also use the mobile network of another operator

[10] MIG: A mobile infrastructure company funded by the German federal government to provide infrastructure in rural, economically less interesting areas; ref. https://netzda-mig.de/

[11] www.oneweb.world

[12] www.starlink.com

[13] LEO: Low Earth Orbit

[14] Ku-band: around 12GHz; Ka-band around 20 GHz

One proposal currently under discussion is to integrate PMSE into the 5G "ecosystem". However, 5G has yet not proven that it actually works for PMSE and other similarly critical applications. The necessary basic research is still ongoing[15].

In addition, cross-border regulations are necessary, as international events use their own equipment, which has to function across borders.

The study's recommendation for co-primary allocation does not offer flexibility

The study concludes that, due to strong regional differences, a co-primary allocation of frequencies to mobile radio and broadcasting is recommended, so that it can be decided quite flexibly, on a national basis, which service is to be used in this frequency band. However, this flexibility is only pretended, since in Europe, for example, no country can flexibly decide for itself alone without significantly affecting its neighbour(s).

Various studies have shown that the use of mobile radio and broadcasting in the same frequency ranges requires very large separation distances (in some cases several hundred kilometres) in order to allow interference-free operation. In densely populated Europe, this would lead to either completely unserved areas for terrestrial broadcasting or to wide areas in which mobile radio cannot use the sub-700 MHz frequencies at all. Spectral inefficiency would be maximised. A co-primary allocation to the Broadcasting and the Mobile Service would mean that the whole of Europe would have to decide uniformly to either continue the use of the 470 – 694 MHz frequency band for terrestrial broadcasting and PMSE as well as for the other secondary service to which the band is allocated (Radio Astronomy and Windprofil Radar), or to give these frequencies exclusively to mobile radio. The flexibility claimed by the PLUM study for a co-primary allocation therefore does not exist.

Broadcasters in Germany are strongly committed to innovation in general and to the further development of 5G broadcasting especially. However, for a long-term development to be possible, broadcasting needs a secure perspective for planning beyond 2030. This is essential both for the acceptance of 5G broadcasting by the users of terrestrial TV as well as for the protection of broadcasters' investment.

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[15] https://d1p0gxnqcu0lvz.cloudfront.net/documents/Nokia_Low_Latency_5G_for_Professional_Audio_Transmission_White_Paper_EN.pdf