The Dynamic Spectrum Alliance input to the RSPG Questionnaire on the Role of Radio Spectrum Policy to help combat Climate Change

12 April 2023

The Dynamic Spectrum Alliance (DSA)[1] welcomes the opportunity to comment on the questionnaire issued by the Radio Spectrum Policy Group on the Role of Radio Spectrum Policy to help combat climate change. The DSA is pleased to contribute to the discussion on how spectrum policy can help achieve Europe's objective of climate-neutrality with the following observations:

1) In your country, is information being collected on energy consumption of the wireless ECNs? If so, which entity is collecting the information? What is the purpose? Is this based on regulation? If so, please specify the regulation.

- While many public/private surveys and studies have been commissioned in recent years, DSA is not aware of an EU-level initiative related to the data collection of the energy consumption of wireless ECNs. DSA notes that in the context of the EU Digitalisation of Energy Action Plan, the European Commission has announced its intention to take various steps related to monitoring he energy consumption of the ICT sector, including measures to increase transparency regarding the energy consumption of telecommunication services[2].
- Today, according to a recent IDC-Cisco Infobrief, 62% of companies worldwide believe that investments in IT technologies will be extremely important for them to achieve their sustainability goal, while 40% of them will make IT purchases based on the respective vendor's expertise to improve energy efficiency[3].
- DSA supports the RSPG proposal to improve the collection of data and methodologies to assess the impact of electronic communication services (ECS) wireless technologies on climate change. DSA nevertheless kindly requests that the RSPG and its Member States reflect in their recommendations not only cellular technologies, but other non-cellular wireless technologies such as Wi-Fi which constitutes a critical link in the end-to-end broadband connectivity chain. We also invite RSPG to consider analysing the environmental impact of different spectrum management models, in particular licence-exempt spectrum vs. exclusively licensed spectrum.

[1] The Dynamic Spectrum Alliance (DSA) is a global, cross-industry, not for profit organization advocating for laws, regulations, and economic best practices that will lead to more efficient utilization of spectrum and foster innovation and affordable connectivity for all. The DSA advocates for policies that promote unlicensed and dynamic access to spectrum to unleash economic growth and innovation.

[2] European Commission, Digitalisation of Energy Action Plan, Press Release, October 2022, https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6228

[3] IDC Infobrief, sponsored by Cisco, "5 keys to sustainability success", March 2023, link: https://newsroom.cisco.com/c/r/newsroom/en/us/a/y2023/m03/5-keys-to-sustainability-success.html

2) In your country, is the energy efficiency of the wireless ECNs being calculated? If so, which entity is responsible for this? What is the purpose? Is this based on regulation? If so, please specify the regulation.

- France's Agency for Ecological Transition (ADEME) has launched a campaign to encourage French citizens to use Wi-Fi rather than cellular networks. ADEME says that using Wi-Fi reduces CO2 pollution 23-fold[4]. Similarly, mobile operator Orange France says it will remind customers to switch to use Wi-Fi at home during periods of peak energy consumption. "Per Gb of traffic, mobile networks have close to three times the footprint of fixed networks for all the environmental indicators studied," notes the French regulator ARCEP in a report published at the beginning of 2022[5].

3) For the items described in Questions 1) and 2) above, which methodology/ methodologies are being used? Please name any standards that are being used. Is the information available for all wireless ECNs, or only for a part of these? Which data breakdowns are available: e.g., by operator, by service, by frequency band, by technology (e.g., 2G/3G/4G/5G), by region, by site, by network element, etc.? Please mention also the cases when incomplete breakdowns are available.

- DSA would like to comment on other technology standards, such as Wi-Fi. The development of the Wi-Fi 6 802.11ax wireless standard is also called High-Efficiency Wireless (HEW). With this, Wi-Fi 6/6E is offering robust high-efficiency signalling for improved operation. The technology quadruples the average throughput per user, providing a reliable and consistent data stream for every user connected to the same Wi-Fi 6 network, regardless of whether the router is jam-packed with users. Wi-Fi device energy use is further reduced by features like the Target Wake Time (TWT) mechanism, which allows connected devices to arrange when and how often they will wake up to service or send data. This improves the battery life of the client devices by allowing them to sleep for hours and ensures a reduction in power consumption[6].

4) In your analyses related to energy consumption and/or energy efficiency, what are your reflections on the influence of parameters such as frequency band, type of radio access technology, coverage addressing different areas (urban, suburban, rural)?

- As highlighted in our response to the RSPG consultation last year, important factors to examine when considering sustainability of communications technology are the relevant **frequency band(s), the type of radio access technology, the targeted use cases, and the building materials** that will be used in the context of the green and energy transition.

[4] ADEME, "Numérique responsable: et si nous adoptions les bons reflexes", p.5, https://presse.ademe.fr/wp-content/uploads/2022/01/DP_Numerique-responsable-190122.pdf
[5] ARCEP, "Consommation énergétique des réseaux mobiles", 14 January 2022, https://www.arcep.fr/la-regulation/grands-dossiers-thematiques-transverses/lempreinte-environnementale-du-numerique/consommation-energetique-reseaux-mobiles-etude-comparee.html
[6] STL, Meet WiFi 6: The Prospects and Prominence, 24 August 2021, https://www.stl.tech/blog/meet-wifi6-the-prospects-and-prominence/#Benefits_of_WiFi_6

- Cellular technologies such as IMT (3G/4G/5G) were designed to provide wide-area coverage for outdoor and mobile users while technologies such as Wi-Fi were optimized for providing wireless broadband connectivity in indoor environments. Hence, classical outdoor IMT base stations are not well suited for providing connectivity to indoor users.
- A major obstacle, for example, are energy efficient windows which are expected to become the standard in Europe. These windows can attenuate radio waves in the 6 GHz band by 40-60 dB and thermal insulation material used for retrofitting older building stock typically attenuates RF signals above 500 MHz by more than 30 dB, so that signals entering from the outside will experience a very significant building entry loss. Considering this, indoor coverage will be provided in a much more energy-efficient way from inside, via Wi-Fi connectivity, than from outside via 5G connectivity, as the latter requires additional base stations and power to compensate the building attenuation. This is in line with ARCEP's conclusions above pointing to fixed networks being greener that mobile networks. Therefore, the environmental impact of the connectivity solution used to provide end users with gigabit connectivity at a fixed location (i.e., indoors), as envisioned in the Digital Decade Policy Programme 2030, will very much depend on whether it is based on a combination of fibre and Wi-Fi or on 5G.
- This technological choice is linked to the decision on the allocation of the full 6 GHz band to WAS/RLAN or to IMT, as Wi-Fi requires licence-exempt access to the full band. An allocation as a licence-exempt band will therefore contribute to reducing the carbon footprint of delivering the gigabit connectivity targets across the EU.
- An efficient allocation of harmonized spectrum can also reduce emissions by reducing the variety of country-specific hardware and software required to comply with the different regulations. The role of terminal equipment is especially relevant as highlighted by a December 2020 ARCEP report on sustainability, which found that 81% of the digital technology's environmental footprint originates with terminals (only 5% from the network, 14% from the data centres).[7] IMT terminals operating indoors will have to operate at high transmit power levels to maintain a stable link with the outdoor base station, leading to higher energy consumption, shorter recharge cycles as well as increased wear and premature replacement of the batteries.
- In addition, Wi-Fi has seen strong growth for battery-powered applications in recent years, driven by increased adoption of low-power IEEE 802.11ax [also called High-Efficiency Wireless (HEW)] devices. Many of the IT devices consumers use in their homes, at work, or elsewhere are battery-powered. This means that smartphones, laptops, AR/VR and more can run on their battery power for as long as possible. With this, Wi-Fi 6 aspires to offer robust high-efficiency signalling for better operation. The technology used quadruples the average throughput per user, providing a reliable and consistent data stream for every user connected to the same Wi-Fi 6 network, regardless of whether the router is jam-packed with users. Thus, IEEE 802.11ax enables these products to enjoy improved power consumption and efficiency, along with

[7] ARCEP, "Achieving Digital Sustainability," at 12, 15 December 2020, https://en.arcep.fr/uploads/tx_gspublication/achieving-digital-sustainability-report-dec2020.pdf.

enhanced performance and robustness. The new Wi-Fi 6 uses a modified version of the TWT (Target Wake Time) mechanism, which allows connected devices to arrange when and how often they will wake up to service or send data. This improves the battery life of the client devices by allowing them to sleep for hours and ensures a reduction in power consumption[8].

5) Is the energy efficiency of the wireless ECN not only measured / calculated but also subject to regulations in your country? If so, by which entity and for which purpose or objective? If so, please describe the provisions in place, including how these provisions are enforced and controlled (if applicable), and the experiences with these provisions so far.

- N/a.

6) Taking into account the scope of the work of the RSPG above, do you wish to share other thoughts or ideas which could be helpful to the RSPG to identify the role radio spectrum policy can play to help combat climate change and mitigate other adverse environmental impacts?

- As mentioned in our response to Q1, DSA kindly requests RSPG and its Member States to reflect in its recommendations ECS wireless technologies beyond cellular technologies, such as Wi-Fi. We also invite RSPG to consider analysing the environmental impact of different spectrum management models, in particular licence-exempt spectrum vs. exclusively licensed spectrum.

7) What information on energy consumption of the wireless ECNs does your company / the Members of your stakeholders' association collect? Which methodology/ methodologies are being used? Please name any standards that are being used.

Many DSA members do not manufacture radio equipment, which is the main source of energy consumption in the life cycle of a device. ARCEP underlines *"As indicated above, the vast majority of devices' environmental footprint is generated during their production (86% of the GHG emissions tied to devices in 2019 were generated during the production stage)."*

When it comes to networks, according to ARCEP:

- most of the electronic communications operators' direct greenhouse gas emissions are due primarily to networks' electricity consumption,
- electronic communications operators' direct greenhouse gas emissions are due primarily to electricity consumption just on their networks,
- mobile networks consume 10x more energy per bit delivered than fixed networks.

We would like to flag the ongoing work in 3GPP RAN related, such as:

- Energy efficiency of 5G
- Smart energy and infrastructure
- Rel18 Energy and complexity saving
- Network energy savings for NR

[8] STL, Meet WiFi 6: The Prospects and Prominence, 24 August 2021, https://www.stl.tech/blog/meet-wifi6-the-prospects-and-prominence/#Benefits_of_WiFi_6

- Enhanced relays for energy efficiency and extensive coverage

Employing Wi-Fi in the 6 GHz band will require less power, helping to make better use of energy resources. The ITU has forecast that the energy used by mobile networks around the globe will emit 73.0 Mt CO2 equivalent (CO2e) in 2025, compared with 35.2 Mt CO2e for fixed networks. That suggests fixed networks will produce less than half the CO2e of mobile networks, even though they transport more than ten times the amount of data[9].

At the same time, Wi-Fi is becoming more efficient, thanks to new features, such as target wake time and the OFDMA radio interface, which reduce power consumption. Furthermore, Wi-Fi 6 introduced new features to support IoT deployments, such as support for large numbers of simultaneous connections, which can then be used to monitor environmental conditions. With the new features in Wi-Fi 6, more IoT devices will be able to send more information and use less power.

8) Does your company / the Members of your stakeholders' association measure or calculate energy efficiency of wireless ECNs? Which methodology/ methodologies are being used? Please name any standards that are being used.
See response to Q7.

9) For the items described in Questions 7) and 8) above, which data breakdowns are available to your company / association2 : e.g., by operator (if applicable), by service, by frequency band, by technology (e.g., 2G/3G/4G/5G), by region, by site, by network element, etc.? Please mention also the cases for which incomplete breakdowns are available.
See response to Q7.

10) Are you considering collecting any additional information that you could collect with reasonable effort?
See response to Q7.

11) Which actions is your company / the Members of your association taking to improve the energy efficient use of radio spectrum (e.g. switching to new technologies, advertisements to make energy efficient technologies more attractive, sleep mode for base stations, or other actions)?

- In parallel, recent advancements in networks, supported by AI/ML, AR/VR and other technologies, and a focus on sustainability and energy performance have enabled both the fixed and wireless communication industry to deliver increased bandwidth using the same or less power.
- DSA members producing networking and radio equipment are actively working on minimizing not only device energy consumption but the overall carbon footprint

[9] ITU, "Greening Digital Companies: monitoring emissions and climate commitments", 22 June 2022, https://www.itu.int/en/ITU-D/Environment/Documents/Publications/2022/Greening-Digital-Companies-22June2022.pdf

associated with designing, sourcing, operating, decommissioning, and disposing off their products.

- Also switching from legacy technologies to new continuous network modernizations are further improving the overall energy performance of networks. This recommendation is supported by an external study commissioned by BEREC[10], which concludes that regulators should promote the switch-off of legacy technologies, as well as the deployment of more energy efficient technologies (per Gbit) and comply with the principle of technological neutrality and the requirements set out in the European Electronics Communication Code for national regulators to promote Very High-Capacity Networks.
- Finally, the DSA also concurs with BEREC's objective to explore other dimensions of sustainability in terms of economic and social impacts. Due to its affordability and extensive coverage, Wi-Fi continues to be the best technology for inclusive connectivity and closing the digital divide. Many low-income people rely on shared or public Wi-Fi connections (e.g., libraries, public Wi-Fi access points, restaurants). The WiFi4EU initiative has been crucial in closing the digital divide by providing funding for EU municipalities to offer free Wi-Fi connectivity for citizens in public spaces, including parks, squares, libraries, health centres and museums.

12) What were the triggers for these actions (e.g. legal requirement, economic interests, consumer expectations, competitiveness, etc.)?

- With new EU Climate Law objectives for 2050 as well as the current energy transition in Europe, the Industry is preparing for its Net Zero journey and meeting new legal requirements. The Digital Decade 2030 targets also encourage businesses to accelerate their green and digital transition. The market is following with many new requirements in RFIs/RFPs/RFQs and in public tenders. According to a recent IDC-Cisco Infobrief, around 55% of companies worldwide view energy management and decarbonization as their primary area of focus[11]. Civil society is also asking for more transparency.

13) Were there any difficulties when you attempted to introduce or perform these actions? Please specify.

- Uncertainties around sufficient allocation of licence-exempt spectrum in the 6GHz band in the future put at risk deployment of already available, energy efficient technologies such as Wi-Fi6/6E chips or AR/VR, which will be enablers of the green and digital transition.

14) What further actions would enable you to foster (a more) energy efficient spectrum use, if any? Should such an activity be done by national spectrum regulators / ministries / European entities? Please specify and explain.

[10] 'Environmental impact of electronic communications' conducted by WIK and Ramboll https://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/10206-external-sustainability-study-on-environ_0.pdf

[11] IDC Infobrief, sponsored by Cisco, "5 keys to sustainability success", March 2023, link: https://newsroom.cisco.com/c/r/newsroom/en/us/a/y2023/m03/5-keys-to-sustainability-success.html

- DSA invites the RSPG to consider analysing the environmental impact of different spectrum management models, in particular licence-exempt spectrum vs. exclusively licensed spectrum.
- Any action addressed to this sector should consider the critical role that the digitalization of the economy will play in advancing Europe's green transition. A recent report by Ecorys[12] refers for example to the potential positive contribution of AR/VR technologies. A positive net contribution will in any case require that the environmental footprint of digital services does not outweigh the benefits of such technologies in greening other sectors. Given that the green transition of the whole economy is underpinned by the general take up of digital services by citizens, businesses and public services, regulation of sustainability in the digital sector should avoid targeting the growth of the digital services (in terms of traffic or consumption) and rather focus on parameters such as energy efficiency or carbon neutrality.
- Although estimating the net impact of the digital sector might be beyond the remit of spectrum regulators, DSA invites RSPG to reflect in its final Opinion the specific role of wireless ECS in reducing the carbon footprint of other industries. The RSPG's proposal to improve the methodologies to assess the impact of wireless ECS should aim at an improved understanding of both their positive and negative environmental impact on the whole economy. Collaboration with regulators of other sectors to track the progress on sustainability enabled by digital services could help monitor how digital, including wireless ECS, is impacting other sectors.

15) Would some kind of spectrum regulation facilitate your motivation to use radio spectrum in a (more) energy efficient way?

- DSA highlights the importance of having adequate and sufficient harmonized spectrum for the development of wireless services in the EU, including those particularly well positioned to help combat climate change.
- A 2020 ARCEP report highlights that 70-80% of the network emissions are due to the access network and that fibre networks are ten times more effective than mobile networks to deliver data in an energy efficient manner[13].
- In the same vein, a study comparing, amongst other things, the energy efficiency of 5G Fixed Wireless Access (FWA) and pure fibre deployments in Sweden[14], concludes that FWA solutions have significantly higher levels of energy consumption than the pure fibre-based solution. Against this evidence, regulators can positively contribute to reduced emissions by promoting an energy-efficient mix of technologies, with 5G networks where mobility is needed and fibre networks as the first connectivity option otherwise.

[12] Ecorys, XR and its potential for Europe, April 2021, https://xreuropepotential.com/
[13] ARCEP, Achieving Digital Sustainability, December 2020, https://en.arcep.fr/uploads/tx_gspublication/achieving-digital-sustainability-report-dec2020.pdf
[14] Li, Jie; Forzati, Marco. Conference Paper 'Cost, performance and energy consumption of 5G fixed wireless access versus pure fiber-based broadband in Sweden' ITS Online Event, 14-17 June 2020.

- Given that the primary way to connect to fibre networks is via a Wi-Fi connection, a combination of full-fibre and energy-efficient Wi-Fi technologies represents the greenest way to connect indoors (Analysys Mason, January 2021).[15]
- Following the 2021 EC Decision on the 5945-6425 MHz band, the 6425-7125 MHz band should be also opened to WAS/RLAN in a harmonized way in Europe to maximise the benefit from the energy efficiency of fixed/RLAN architecture. Opening the 6425-7125 MHz band to WAS/RLAN in Europe would have additional environmental benefits which we recommend taking into account.

16) Taking into account the scope of the work of the RSPG above, do you wish to share other thoughts or ideas which could be helpful to the RSPG to identify the role radio spectrum policy can play to help combat climate change and mitigate other adverse environmental impacts?

As mentioned in our response to Q4, Wi-Fi improves power consumption and efficiency, along with enhanced performance and robustness and at an affordable cost. The technology responds to the needs and ambitions of the European Union and will better thrive if it has access to the right amount of unlicensed spectrum in the 6GHz band.

According to the Shift Project's Forecast Model 2021, by 2025 fixed Wi-Fi will consume 3x (1,5 today) less electricity than mobile networks in a conservative scenario[16], while delivering orders of magnitude more data:

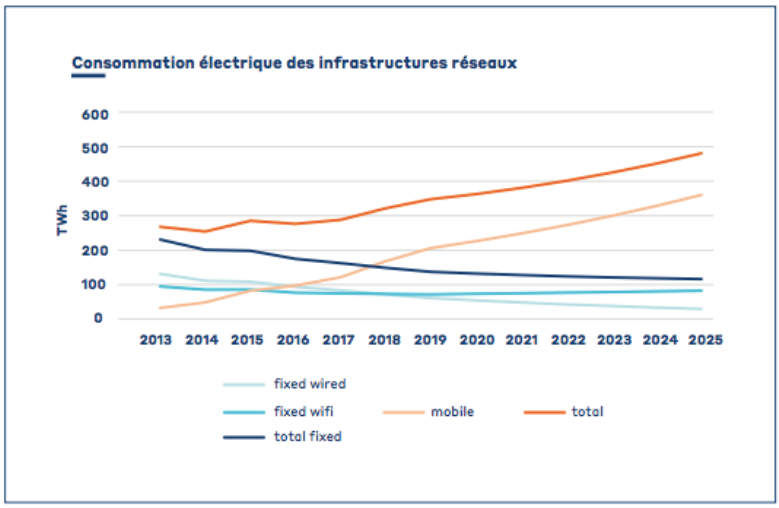

Figure 1 - The Shift Project - Forecast Model 2021 - 2013 to 2025 evolution of electric consumption of networks in the world (conservative scenario)

[15] "Notwithstanding its superior performance, a combination of full-fibre and low-power-mode Wi-Fi 6 represents a more efficient and a greener way to connect wirelessly in the indoor environment than mobile." Rupert Wood, "Full fibre access as strategic infrastructure: strengthening public policy for Europe," Analysys Mason, at 32. (07 January 2021), https://www.analysysmason.com/contentassets/ae94d4d039a144529906c1a8ca58d1ea/analysys_mason_full_fibre_europe_rdfi0.pdf.

[16] https://theshiftproject.org/wp-content/uploads/2021/03/Note-danalyse_Numerique-et-5G_30-mars-2021.pdf (p.25)

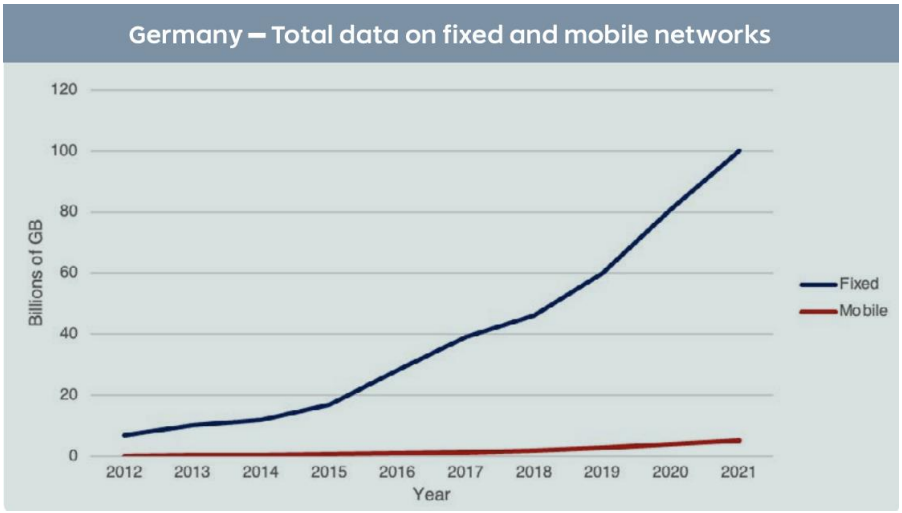

Figure 2 –Germany - Total data on fixed and mobile networks. Source: DSA, How do Europeans connect to the internet?

In addition to the responses above, we would like to highlight our response to the past RSPG consultation on the draft Opinion on the role of radio spectrum policy to help combat climate change available here.

The DSA would like to thank again the RSPG for organizing this consultation and remains available to meaningfully contribute to the ongoing discussions on the role of the digital sector in helping Europe achieve its sustainability goals with RSPG, the relevant EU institutions and other stakeholders.

Respectfully submitted,

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