GTPRN December 2020 Newsletter

Welcome to the GTPRN December 2020 Newsletter

And finally HOPE. We are so excited about the different vaccines' news, and it seems that COVID-19 will finally come to an end, hopefully in the near future. We are also so grateful to our authors and readers for supporting us during the last months with their contributions and views, and we are counting on your support to continue with our volunteering efforts.

We want to introduce new flavors to this issue, and certainly nothing better than the last update on the 6G development from one of the main international experts in this field, Prof. Marja Matinmikko-Blue. With the tremendous speed of 5G development compared to 4G, it seems that 6G may be developed faster than we think, and who is better to explain the concept to us than the main leader of 6G Flagship, World's first 6G Research Program, Prof. Matinmikko-Blue. Please check her article here.

Last month, we introduced one viewpoint of the debate on the pros of licensing against un-licensing, and in this issue, we have an exclusive article for GTPRN by Prof. Martha Suarez, President of Dynamic Spectrum Alliance (DSA), which highlights the recent development of the latest generation of Wi-Fi, known as Wi-Fi 6E, and the merits of deploying Wi-Fi in the 6 GHz instead of IMT. Prof. Suarez has certainly introduced a new spirit within the unlicensed spectrum community, and I personally believe that DSA is lucky to have her. Please check her article here.

Regarding online events, please check the following list for different telecom policy related topics webinars:

- TPRC49 will be held on 23rd and 24th of September 2021, and call for proposals will be released at the end of January. Abstracts are due on 15th of March, 2021.
- Silicon Flatirons Center event on "Trust and Trustworthiness in the Tech Sector" – on 9th -12th February 2021. Event details are here.

- A video recording of the ITS Webinar on AI International Impact on Economy and Society is [here](#).

- A reminder that early-bird registration will end on 31st of December 2020 for the PTC'21 conference that will be held online from 17th to 20th January 2021 due to the COVID-19 circumstances. You may register for the event here.

- Check the ITS Webinar on Strategic Autonomy - the European Perspective on 27th January, 2021, 16:00 - 17:30 CET. Free registration is here.

- PolicyTracker, will hold a webinar on "How can we counter 5G EMF health fears?" on Wednesday 3rd February 2021 at 3 pm GMT/4 pm CET/10 am EST. More information can be found here.

With respect to telecom policy publications, please find below these latest releases and CFPs:

- ITU invites interested authors to submit papers for consideration for the 2021 edition of the publication "Digital Skills Insights". Details of the call for papers can be found [here](#).

- This is a [reminder](#) for CFP for a special issue of Telecommunications Policy journal on 'Innovation in 5G Technology: leadership, competition and policy issues'.

- IEEE invites technical paper submissions and proposals for workshops, tutorials, special sessions and Industry Forums for the 7th IEEE World Forum on the Internet of Things being held in New Orleans, Louisiana USA June 20th – 24th, 2021.

The TPRC48 will be held online from 17 to 19 February 2021 due to the COVID-19 circumstances. Registration fees have been dramatically decreased for the conference to encourage participation, and all live content will be recorded and subsequently available at any point during the conference to registered attendees. TPRC48 shall accommodate an excellent set of papers, so make sure to register

here before 15th of January 2021 to benefit from the early-bird registration.

Make sure also to check and to submit to the 23rd ITS Biennial Conference "Digital societies and industrial transformations: Policies, markets, and technologies in a post-Covid world" on the 20th – 23rd June 2021 in Gothenburg, Sweden. The conference shall discuss several issues including the impact of Covid-19 – on telecommunications networks, different sectors, and users. You can submit your abstract here.

Last but not least, there is an excellent opportunity at the Department of Technology Management and Economics at Chalmers University of Technology for a PhD candidate in Science, Technology and Society (STS). More information is here.

Finally, please share with us and with the GTPRN community your articles, views, news, announcements. If you have a specific topic that you want to share an update or opinion on in one to three pages, please do not hesitate to share it with us via news@gtprn.org

Kindly also help us by spreading the word about the GTPRN community and forward this newsletter to your colleagues or students. You are more than welcome to join our Facebook or LinkedIn Groups, or to subscribe directly to our website www.gtprn.org where you have the chance to comment on each article or post.

Merry Christmas, take care, stay safe and well.

Mohamed El-Moghazi

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Towards sustainable 6G

Marja Matinmikko-Blue, Dr.Sc. (Tech), Ph.D., Research Coordinator of 6G Flagship
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6G Flagship – World's first 6G Research Programme

6G research started in 2018 when Finland launched the world's first 6G research programme called 6G Flagship[1]. The 8-year long research effort appointed by the Academy of Finland and led by the University of Oulu envisions a future society towards 2030, which is data-driven and enabled by near instant, unlimited wireless connectivity. The research in 6G Flagship is carried out in four interrelated strategic research areas: wireless connectivity, device and circuit technologies, distributed computing, and applications and services. The three main goals of 6G Flagship are 1) to support industry in finalization of the 5G standard; 2) to develop the essential technology components needed for 6G; and 3) to speed up the digitalization of society via targeted application areas. During the first two and a half years, a total of 1,100 peer-reviewed articles have been published by the 6G Flagship researchers. For an overview of 6G Flagship activities, see the second issue of 6G Waves magazine[2] prepared by the 6G Flagship.

Under the first goal, the 6G Flagship has supported 5G-enabled economic growth in industry through collaboration with more than 300 companies including joint projects, shared human resources, joint standardization and regulation efforts, and the commercialization of research results. The open 5G Test Network (5GTN) has attracted more than 150 companies to test 5G prototype devices, and to explore higher frequency bands, cognitive management functionalities, and system testing tools for new solutions.

Under the second goal, 6G Flagship is building an ecosystem and discussion forums to build joint 6G vision and to develop the most promising enablers for 6G with its global network of more than 1,000 collaborators. 6G Flagship has established an annual event, the 6G Wireless Summit 6G. It has also prepared twelve 6G White Papers as a collaborative effort between experts. Under the third goal, 6G Flagship has gained regulatory acceptance for disruptive local 5G operator models; promoted 6G for European and global research agendas; and

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[1] 6G Flagship www.6gflagship.com

[2] H. Saarela, V. Wittenberg & M. Matinmikko-Blue (eds.) 6G Waves magazine, no 2. 2020. http://jultika.oulu.fi/files/isbn9789526227641.pdf

strengthened global support for using UN SDGs as a basis for 6G development. The program has supported regulation and legislation based on the requirements rising from research especially in the areas of ownership and use of radio spectrum, communications infrastructure, and data. Already now, the Flagship program's results are visible in decision making at national, European and international levels.

Global 6G research vision through 6G White Papers

6G Flagship has invited the global community for joint vision building by organizing annual 6G Summits and preparation of 6G White Papers. A group of 70 invited international experts met at the first 6G Wireless Summit in 2019 and developed the world's first 6G White Paper[3] that was published by the 6G Flagship in September 2019, summarizing the 6G vision statement into Ubiquitous Wireless Intelligence. The experts reached a consensus that 6G research and developed should be driven by United Nations' Sustainable Development Goals (UN SDGs). The white paper highlights that the integration of sensing, imaging and highly accurate positioning capabilities with the communication service opens a myriad of new applications in 6G. It emphasized the increasing role of indoor networks that will drive the "local operator" paradigm. Regarding the performance of 6G networks, many of the key performance indicators (KPIs) used for 5G continue to be valid also for 6G. However, the KPIs must be critically reviewed and new KPIs must be seriously considered.

A new set of 6G white papers[4] prepared by 250 global experts and published by 6G Flagship in 2020 presents more detailed analysis of selected themes that came up in the preparation of the first white paper. The work was done in expert groups that each prepared a white paper, including linkage to UN SDGs, business of 6G, trials for verticals, remote area connectivity, networking, machine learning, edge intelligence, trust, security and privacy, broadband connectivity, machine type communications and localization and sensing. Technology, sustainability and business are recurring themes in the new white papers and many topics fall under all three - yet the emphasis is different. The business environment will undergo a drastic change when digitalization is gradually introduced to all aspects of society, leading to a new business ecosystem for 6G.

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[3] M. Latva-aho & K. Leppänen (ed.) Key drivers and research challenges for 6G ubiquitous wireless intelligence. University of Oulu. 2019. http://jultika.oulu.fi/files/isbn9789526223544.pdf

[4] 6G White Papers 2020, see https://www.6gchannel.com/6g-white-papers/

UN SDGs and 6G – where is the connection?

The White Paper on 6G Drivers and the UN SDG[5]s builds on the current relation between ICT and the UN SDGs and creates a strong linking between the upcoming 6G systems and the UN SDGs – both targeting year 2030. The expert group identified global megatrends, which will drive 6G research and shape the world. The group defines a three-fold role for 6G as 1) provider of services to help reaching the UN SDGs, 2) enabler of measuring tools for data collection to help with the reporting of indicators, and 3) reinforcer of a new ecosystem to be developed in line with the UN SDGs. Existing indicators in the UN SDG framework served as a point of departure in the development of the novel view on the future communication system, where various stakeholders have an active role.

The white paper proposes that 6G systems could gather a variety of data to report on the achievement of the UN SDGs on a highly local granularity level which today is a challenge that nations face, noting that counter effects are also expected and therefore it is crucial to look into what data actually should be collected and reported and how. The group identified a number of challenges from political, economic, societal, technological, legal and environmental perspectives.

The new 6G ecosystem is expected to be built around a number of new stakeholders and principles. Pure business-driven operations will be complemented with new societal models including community-driven networks which will emerge depending on the regulatory environment. Another big transformation will come from the vertical industries and their public sector counterparts to whom the achievement of the UN SDGs will place significant economic constraints and they will need to take everything the future technologies can offer to improve systems and processes. This requires an early engagement in the process of 6G development instead of waiting for the telecommunication industry to define what 6G can bring for them.

The White Paper on 6G Drivers and the UN SDGs also introduces a preliminary action plan for engaging different stakeholders to support the achievement of the UN SDGs with the help of ICT. The work recognizes that the role of ICT in meeting is critical in meeting the UN SDGs and It is not enough to treat them separately. The UN SDG framework will also need to evolve along with the technology development. The white paper emphasizes that the role of ICT should be seen broadly, not only through ICT related indicators in the UN SDG framework, which are currently only seven. ICT's role in helping to achieve all

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[5] M. Matinmikko-Blue et al. (eds.) White Paper on 6G drivers and the UN SDGs. University of Oulu. 2020. http://jultika.oulu.fi/files/isbn9789526226699.pdf

17 SDGs is significant and can be seen through investigating on how the use of new technology can contribute to the existing indicators of the UN SDG framework beyond the ICT related indicators.

The action plan identifies specific roles for stakeholder groups in the joint development and evaluation effort. Governments play a key role in contributing to coverage and low cost of service for everyone through the creation of the regulatory framework and incentives to invest and operate the systems. Often more flexibility is needed to allow low-cost solutions in challenging areas that are not of business interest to operators. For the mobile communication sector, 6G is not only about developing yet another generation, but a true opportunity to contribute to sustainability at large. The role of the research community is important in facilitating stakeholder interact

Marja Matinmikko-Blue
Senior Research Fellow, Adjunct Professor in Spectrum
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Marja Matinmikko-Blue is 6G Flagship Research Coordinator and Senior Research Fellow at Centre for Wireless Communication (CWC), University of Oulu where she holds an Adjunct Professor position in spectrum management. Prior to joining the University of Oulu in 2016, she had worked at VTT Technical Research Centre of Finland Ltd. for 15 years. She holds a Dr.Sc. degree in telecommunications engineering on cognitive radio system techniques and a Ph.D. degree in management sciences on stakeholder analysis for spectrum management from University of Oulu in 2012 and 2018. She conducts multi-disciplinary research on technical, business and regulatory aspects of mobile communications.

She received the Young Scientist of the Year award in Finland in 2013 for her close collaboration between industry, academia and regulators on spectrum matters. She has coordinated several national research project consortia that have successfully demonstrated the world's first licensed shared access (LSA) spectrum sharing trials and introduced a new local 5G operator concept based on local licensing that has now become a reality in several countries. She has

published 150+ scientific publications and prepared 150+ contributions to regulatory bodies on spectrum management in national, European (CEPT) and international (ITU-R) levels. Most recently she coordinated the writing of twelve new 6G White Papers in 6G Flagship and led the group that prepared a white paper on the connection between 6G and the United Nations Sustainable Development Goals (UN SDGs).

The crucial decision of enabling better and affordable connectivity through Wi-Fi and spectrum sharing

Martha Suarez
President, Dynamic Spectrum Alliance

This year, it's more obvious than ever that internet access is no longer the luxury item it may have been in years gone by, but a necessity. Throughout 2020 and the Covid-19 pandemic, Wi-fi access has allowed us to stay connected in a number of previously unimaginable ways. We have been able to see and talk to loved ones, continue to work when our offices are closed, educate our children although they can't be in classrooms, and perhaps most importantly stay occupied in numerous virtual conferences and entertained when we've been told to stay at home. Enhancing digital technology and global proliferation of Wi-Fi access is important for both established and developing economies. The flexibility and benefits Wi-Fi brings to digital economies have proven to provide essential benefits during the COVID-19 pandemic.[6]

But as the struggles of this year eventually become a distant memory, the vitality of the internet will not. The expectations of consumers are increasing; we want fast connectivity, low latency and connection on more devices than ever and at the same time, we also care about affordability, especially after a year that has very much affected the economy in many latitudes. What's more, as technology continues to develop, we will use the internet for more of our every-day needs, like smart homes and cars, upping the demand for broadband further still. Additionally, in the case of rural and underserved areas, Wi-Fi has also become the first option for many people to access Internet and broadband access, at public hotspots when they are not able to afford a connection at their home or through a particular connection provided by Wireless Internet Service Providers.

According to Cisco, more than half of the Internet connections start or end by a Wi-Fi connection. However, Wi-Fi networks congestion at the access point level is becoming an issue because access to license-exempt mid-band spectrum creates an artificial spectrum shortage: since the World Radiocommunication Conference in 2003 no new mid-band spectrum has been made available for Wi-Fi despite the exponential growth in the data traffic.[7] Furthermore, current Wi-Fi spectrum doesn't offer sufficiently wide channels for newer applications and services. Wi-Fi 6 will enable new use cases for industrial IoT, smart homes and

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[6] Covid-19 and the economic value of Wi-Fi. Katz, Jung and Callorda, December 2020.
[7] How to realise the full potential of 6 GHz spectrum. Whitepaper. October 2020 (link)

support for high-density deployments, to name a few, but access to wider channels is needed to support these new use cases.[8]

License-exempt access to the 6 GHz band is required to meet this unprecedented demand and enable innovative use cases. With it, comes the opportunity for more effective spectrum use allowing support for new applications and laying the foundations for innovation.

This article will show the importance of Wi-Fi in the current situation as an efficient technology to provide broadband connectivity. It will argue that regulators and spectrum authorities are facing a crucial opportunity to enable better connectivity dedicating more spectrum for Wi-Fi. Finally, it will present some recommendations on how to realise the full potential of the new generation of Wi-Fi, known as Wi-Fi 6E.

Licensed vs license-exempt spectrum access

It seems incredible to hear voices stating that license-exempt access technologies like WiFi are not innovative technologies (It is!, but more about that later). Those same voices seem interested in confusing readers indicating that the Dynamic Spectrum Alliance would like "to leave the impression that 3GPP based technologies are passé"[9], nothing further from the reality.

The DSA promotes a balanced regulatory approach between licensed, license-exempt, and lightly licensed, to enable making unused spectrum available for broadband. An unbalanced approach may create artificial scarcity, which rises the cost of broadband access. The world can and should move away from a view of just licensed or license-exempt spectrum — coordinated shared spectrum and the cost and benefits should be considered in spectrum planning. The DSA is technology neutral and supports all shared spectrum technologies that promote co-existence. An example of it has been our active advocacy for Citizens Broadband Radio Service (CBRS), a 3GPP technology in the 3.5 GHz band for LTE in the United States[10].

On the other hand, it is a fact that there are different and independent standardization organizations and that as well as 3GPP technologies, are developed to evolve over generations and provide a predictable migration path to address growing consumer requirements over time. They also evolve over generations and provide paths for updates. In the case of Wi-Fi, that evolution

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[8] See https://wballiance.com/wp-content/uploads/2019/09/WBA-AnnualIndustry-Report-2020.pdf

[9] Rural Connectivity: Some challenges and opportunities. Shiv K. Bakhshi, Ph.D. and Sendil Devar, Ph.D. GTPRN. November 2020.

[10] See https://www.3gpp.org/DynaReport/GanttChart-Level-2.htm#bm720195

has led to Wi-Fi 6 standardization and that is why Wi-Fi technologies benefit of economies of scale and are currently being used by billions and are expected to continuing growing. To weigh or qualify a standardization effort as superior to others is to ignore how global technology adoption works.

About 3GPP standardization, it is also important to mention that it is not only focused on licensed spectrum access and part of the standardization efforts have been on recognizing the possibilities of license-exempt access. So, at the end, the discussion shouldn't be between licensed vs license-exempt spectrum access.

Current spectrum frameworks need to recognize that both access schemes are complements. As it was recently stated by the FCC Chairman Ajit Pai: "Some suggest that Wi-Fi and cellular spectrum are rivals. But I believe freeing so much spectrum for unlicensed use will advance U.S. leadership in 5G technologies. For instance, Cisco projects that 59% of mobile data traffic will be offloaded to Wi-Fi by 2022. And cellular operators can improve their 5G mobile broadband services by using the 6 GHz band; 3GPP Release 16 will include a 5G New Radio specification for unlicensed spectrum, called 5G NR-U. So, to me, cellular and Wi-Fi spectrum are powerful complements, not rivals."[11]

Wi-Fi 6E technology performance and evolution

A new Wi-Fi standard, IEEE 802.11ax, also known as Wi-Fi 6, is enabling compatible devices to benefit from higher data rates, greater responsiveness, increased capacity, better performance in environments with many connected devices and improved power efficiency, as well as other improvements.
By implementing Orthogonal Frequency-Division Multiple Access (OFDMA), the transmission of multiple signals at one time is allowed, by splitting them and sending them over different frequencies. Alongside the upgrade that Wi-Fi 6 will bring to Multi-User, Multiple Input and Multiple Output (MU-MIMO) technology, there is an increase in the number of communication routes and the amount of data that can be transmitted.

With stronger connections, wider reach and lower latency, broadband usage across homes, businesses and leisure settings will be transformed. Tangible benefits for the end-user include the ability to use multiple devices without disruption due to speeds 30% faster than previously experienced, increased efficiency of battery life and better security on those devices.

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[11] DOC-368614A1. Remarks of FCC chairman Ajit Pai to the International Telecommunication Union webinar "Radio spectrum for imt-2020 and beyond: fostering commercial and innovative use" December 8, 2020

For effective use, three operating classes of the 6 GHz band have been identified:

- Very Low Power (VLP): devices which would be permitted to operate at very low power levels for indoor or outdoor use. They provide low latency and very high throughput over short distances. VLP portable usages are for example mobile AR/VR, UHD video streaming, high speed tethering and in-vehicle entertainment.
- Low Power Indoor (LPI): such as an Access Point or client device, which would be permitted to operate for indoor use only. LPI use cases include residential Multi-AP/mesh networks, multiple dwelling unit (MDU), single-AP networks, high-density enterprise networks, indoor public venues and industrial IoT.
- Standard Power (SP): license-exempt devices operating at 36 dBm EIRP that are only permitted access to spectrum under the control of an Automated Frequency Coordination (AFC) system, which would establish exclusion zones where license-exempt devices could not operate. High throughput capabilities for outdoors and indoors. Relevant for rural connectivity.

Every use case provides benefits and regulators can decide on a case by case which operating classes they enable.

Wi-Fi 6 is already standardized by the Wi-Fi Alliance since 2019 and new devices, including Wi-Fi 6E routers, have been announced and we have recently seen the first Wi-Fi 6 chip certified by the FCC.[12]

Research firm IDC has forecast that more than 316 million Wi-Fi 6E devices will enter the market in 2021 and shipments will rise rapidly over the next three years (see Figure).

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[12] *See* FCC, Grant of equipment authorization QDS-BRCM1095 ([link](#))

SHIPMENTS OF WI-FI 6E PRODUCTS WILL RISE RAPIDLY OVER THE NEXT FIVE YEARS

Source: IDC
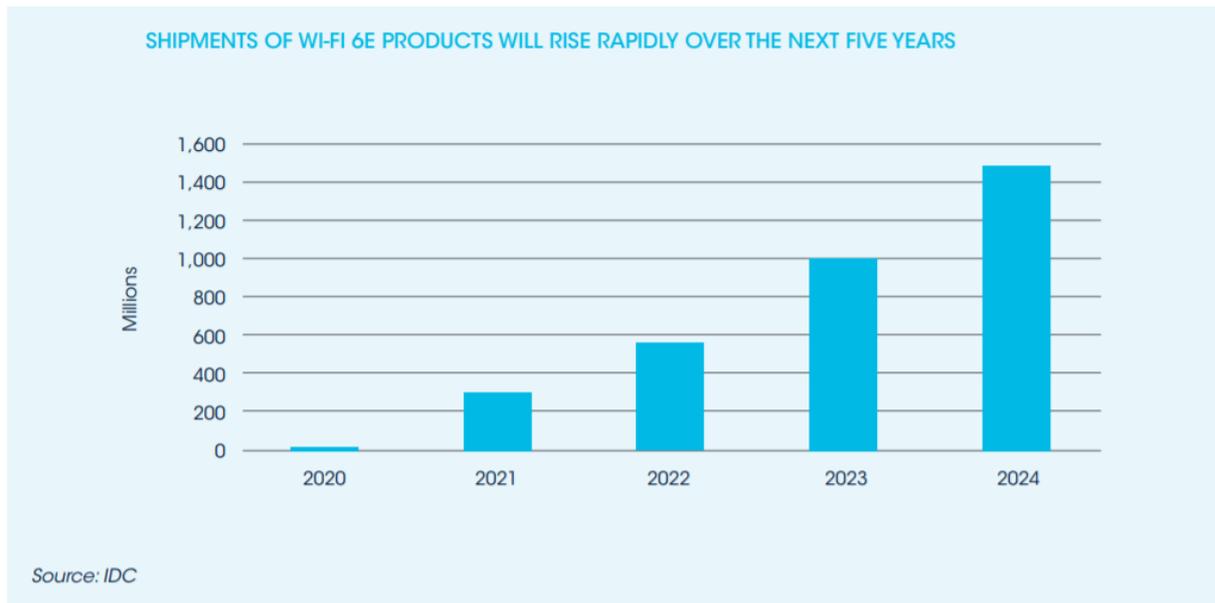
Wi-Fi 6E can coexist with incumbent services in the 6 GHz band.

It is important to note that the 6 GHz band is already in use by a range of services, like fixed satellite services, fixed services and some mobile applications, for example electronic news gathering. License-exempt access will not only open the door to innovation by offering extra capacity but protect those that already use the band. There will not be requirements for spectrum clearance processes, that might be complex and expensive. It is really an efficient use of the spectrum. Protecting incumbents and at the same time enabling innovation.

License-exempt access is a decision that regulators can make on a national basis and is accepted by the International Telecommunication Union (ITU). During the DSA's Global Summit this November, Mr. Mario Maniewicz, Director of the Radiocommunication Bureau at the ITU, outlined the ITU's response to the effects faced by the unconnected in a post COVID-19 world, addressing the different technologies and initiatives that are best suited for providing connectivity during these difficult times; ITU-R is open to unlicensed access, enabling billions of people to use Wi-Fi networks and enjoy connectivity at home, at work and in public spaces.[13]

Low Power Indoor (LPI) and Very Low Power Portable (VLP) WAS/RLANs, such as those using Wi-Fi 6E, can coexist well with current incumbent operations

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[13] See http://dynamicspectrumalliance.org/dsa-thanks-maniewicz-presentation/

and meet the required use cases as demonstrated in the CEPT studies in the 5925-6425 MHz frequency range[14].

Like in Europe, the FCC in the United States concluded that LPI devices can coexist with incumbent services in the band without further mitigation measures. The studies in the United States were conducted in the complete 6 GHz band (5925-7125 MHz). In addition, the FCC enabled Standard Power devices, using an AFC system in order to manage coexistence with incumbent services in the 5.925-6.425 GHz and 6.525-6.875 GHz sub-bands. This system will coordinate outdoor deployments to ensure no interference will be inflected on the tens of thousands of point-to-point microwave links and other incumbents. Finally, the FCC is currently proposing enabling VLP operations through a further notice of proposed rulemaking.[15]

The FCC claims that "Wi-Fi 6 will be over two-and-a-half times faster than the current standard and will offer better performance for American consumers. Opening the 6 GHz band for unlicensed use will also increase the amount of spectrum available for Wi-Fi by nearly a factor of five and help improve rural connectivity."

In ITU region 1, discussions are taking place about the future of the upper part of the 6 GHz band (6425 - 7025 MHz) because some countries are considering it for the use of International Mobile Telecommunications (IMT). This consideration is part of the World Radiocommunication Conference 2023 (WRC-23) agenda, item 1.2. There is no certainty around this possibility yet, but by the time of the conference we will know if it is technically feasible. Studies about the upper part of the band at WRC-23 cover only Region 1, so there will be no global harmonization for IMT anyway at the end of the conference, except possibly for the 7025-7125 MHz segment, depending on the studies and the interest of administrations.

In some country specific cases, these studies are particularly supported because they have restrictions to implement IMT solutions in the 3 GHz band. These cases are, however, sporadic and particular. Furthermore, if the 6 GHz band is considered as a candidate for IMT usages, administrations should be aware that mobile rural coverage would need higher power outdoor deployments, much higher than the power levels envisaged for SP license-exempt usages. For this reason, there is a risk that IMT outdoor deployments could interfere with fixed

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[14] *See* Sharing and compatibility studies related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the frequency band 5925-6425 MHz (link) and Harmonised technical parameters for WAS/RLANs operating on a coexistence basis with appropriate mitigation techniques and/or operational compatibility/coexistence conditions, operating on the basis of a general authorisation (link)

[15] See https://docs.fcc.gov/public/attachments/FCC-20-51A1.pdf

and fixed satellite links currently operating in the band –and may require relocation of existing operations which is not required with a license-exempt solution. It is important to note that those existing applications in the band are already crucial for connectivity. Studies within the ITU-R are just starting, and administrations should remain open minded when undertaking coexistence and sharing studies based on justifiable technical characteristics and realistic and agreed propagation characteristics.

Wi-Fi is a great example of how global harmonization benefits economies of scale and final users. Plans for the license-exempt opening of the 6 GHz band are becoming ever-more prevalent, with final regulations adopted by the United Kingdom, the United States of America, the Republic of Korea and Chile. And that's not all: Germany is planning to open the band in 2021 and the European Commission Decision is likely to mandate by September 2021 Member States shall designate and make available 5945-6425 MHz for the implementation of WAS/RLANs. Wi-Fi 6E consultations have taken or are also taking place in Brazil, Canada, Mexico, Costa Rica, Honduras, Peru, Argentina, Taiwan and Saudi Arabia.

While worldwide momentum for the license-exempt access to the 6 GHz band builds, the potential to meet unprecedented broadband demand is hopeful, and the future for innovation is bright.

Wi-Fi is a cost-efficient solution and suitable for affordable access

As a license-exempt technology offering very low barriers to entry, Wi-Fi serves as a platform for the creation of innovative business models that underpin unique services, while expanding access to communication services for mobile, fixed, and satellite networks through Wi-Fi hotspots.[16]

Spectrum sharing capabilities of Wi-Fi technologies avoid time consuming, complicated and expensive clearance processes that are often required before any commercial usage of a frequency band by exclusive licensed systems.

Wi-Fi is a highly cost-effective wireless access technology due to ease of installation and user control over the network. According to Intel, the cost of licensing the necessary intellectual property for cellular 5G alone is 3x that of a Wi-Fi chipset, and the entire 5G cellular modem cost is 50x the cost of a Wi-Fi

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[16] How to realise the full potential of 6 GHz spectrum. Whitepaper. October, 2020 (link)

chipset.[17] Support for a cellular connection can add as much as US $130 to the retail price of a tablet device.

What's more, in regions where connectivity is sparse, Wi-fi is still vital for development, technological advancement and improving the livelihoods of citizens. To allow license-free use of the 6 GHz band therefore enabling Wi-Fi 6E, ensures accessibility to this technology without limiting its potential.

Given that Wi-Fi service providers do not need to participate in auctions to license the spectrum, the technology is a very cost-effective form of connectivity. It could be argued that for network operators seeking to provide rural connectivity, there *is no additional spectrum cost* considering they would have already paid for the spectrum when they acquired a nationwide license, or that there is not any spectrum scarcity in rural areas. Indeed, that is true, the traditional model of exclusive use of spectrum over large geographical areas for extended terms provides little incentive for licensees to make their spectrum available for smaller, rural or competitive use cases. In such circumstances, licensees may not want to take on the transaction costs required to partition, disaggregate or sublease their license to a third party. More fundamentally, licensees may want to preserve optionality in the future to build out to less economically attractive areas, or even be motivated to stifle competition. The result is underutilization of spectrum and warehousing, often at the expense of the underserved and rural communities. Adoption of use-it-or-share-it rules would encourage licensees to put their spectrum to use more quickly, or absent that, make unused spectrum available for opportunistic uses or lessees on the secondary market[18].

But coming back to the discussion about Wi-Fi, thanks in part to spectrum harmonisation, the global Wi-Fi ecosystem benefits from enormous economies of scale, enabling manufacturers to produce very cost-effective products.

We have seen important public programs and initiatives to increase Wi-Fi hotspots like it is the case of the WiFi4EU[19] in Europe, the WiFi4EU initiative aims to provide high-quality Internet access to citizens and visitors across the EU via free of charge Wi-Fi hotspots in public spaces such as parks, squares, administrations, libraries, and health centres. It has revealed a strong and local demand for the expansion of Wi-Fi services in order to foster the local e-commerce economy, support tourism, and increase the availability of local public services to citizens.

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[17] Source: Eric McLaughlin, General Manager Wireless Solutions Group, Intel during the WBA Congress in Frankfurt in September/October 2019.

[18] See DSA Comments to FCC on Partitioning Disaggregation and Leasing of Spectrum, June, 2019.

[19] See https://ec.europa.eu/digital-single-market/en/wifi4eu-free-wi-fi-europeans

But this type of initiatives occurs not only in Europe or in urban areas. If we refer to rural connectivity, cost-efficiency is best achieved by benefiting of scale inherent in globally adopted Wi-Fi standards, which mean lower cost of coverage for low-population density areas and lower cost of terminals.

The ITU-D Study Group on Broadband development and connectivity solutions for rural and remote areas, in its Annual deliverable 2019-2020 has recognized that "Wi-Fi hot spots and local area networks, which can be installed at rural points of community activities, including shopping centres and university campuses, can serve a variety of users. These are also suitable for homes, where all family members can access Wi-Fi connectivity. Wi-Fi technologies are very effective if the backbone landing is not far from the locality and can be used to create a mesh network".[20] According to the report, in India[21], several rural areas have been connected using Wi-Fi, as a last-mile connectivity solution. In Zimbabwe[22] the community information centres constructed by the universal services fund of the country use Wi-Fi technology. In Latin America, more than 19 universal service projects in the countries of the Pacific Alliance rely on Wi-Fi to deliver affordable broadband to rural and underserved[23].

Regulators and spectrum authorities are guided by public policy goals focused on providing broadband access to all their citizens, leaving no one behind. They recognize spectrum is the income for wireless access and always try to make the most efficient use of it. In this context, spectrum sharing technologies like Wi-Fi 6E, that make a more efficient use of the spectrum, while protecting incumbents and increasing affordable connectivity are being considered by regulators and spectrum authorities worldwide.

This article has referred to the importance of Wi-Fi for affordable broadband connectivity. It described why providing additional spectrum access in the 6 GHz band (5925 – 7125 MHz) to support the deployment of Wi-Fi 6E, will offer consumers one of the most anticipated advancements in affordable broadband connectivity to date. It is time to act now.

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[20] Annual deliverable: "Broadband development and connectivity solutions for rural and remote areas". Question 5/1 Telecommunications/ICTs for rural and remote areas. ITU-D (link).

[21] Presentation by Mohit Bansal at the workshop on broadband development in rural areas hosted by the Question 5/1 Rapporteur Group,25 September 2019 (link).

[22] Presentation by Batsirayi Mukumba at the workshop on broadband development in rural areas hosted by the Question 5/1 Rapporteur Group, 25 September 2019 (link).

[23] Sources: IFT-Mexico, MINTIC–Colombia, MTC-Peru and SUBTEL-Chile, universal service projects planned by 2020.

Martha Suarez
President, Dynamic Spectrum Alliance

Martha Suarez was born in Bucaramanga, Colombia. She received her degree as Electronics Engineer from the Universidad Industrial de Santander in 2004. During her undergraduate studies she participated in an exchange program with the Ecole Superieure Chimie Physique Electronique de Lyon, France in 2001. She received her master degree in high frequency communication systems from the University of Marne-la-Vallee, France in 2006 and her Ph.D. degree from the University Paris-Est in 2009. She joined the department of Telecommunications and Signal Processing at the École Supérieure d'Ingénieurs en Électronique et Électrotechnique de Paris ESIEE and the Esycom Research Center where she worked on wireless transmitter architectures.

In 2011 she was awarded with a Marie Curie Fellowship and worked at the Instytut Technologii Elektronowej ITE in Poland for the Partnership for Cognitive Radio Par4CR European Project. Her research interests were in the areas of wireless system architectures and the design of high performance Radio Frequency RF transceivers. Since 2013 she joined the National Spectrum Agency in Colombia, ANE, where she worked as Senior Adviser to the General Director and supported international activities of the Agency. Afterwards, in December

2015, she became the General Director of ANE and continued promoting the efficient use of the Spectrum and the mobile broadband connectivity in Colombia.

Since the 1st of May 2019, Martha Suarez is the President of the Dynamic Spectrum Alliance DSA, a global organization advocating for laws and regulations that will lead to more efficient and effective spectrum utilization, which is essential to addressing key worldwide social and economic challenges.