GTPRN NEWSLETTER

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Global Telecoms Policy Research Network

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NEWSLETTER

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WELCOME TO THE GTPRN JANUARY 2023 NEWSLETTER

AND WE ARE BACK ☺

This issue is a review of the important updates from 2022, a difficult year for some of us, and we wish 2023 would be a year of peace, prosperity, and good health for all of us.

Our editors have been in consultation the last months to reach the optimum format for our readers and your responses to our survey have been quite beneficial in this regard.

As a result, we have changed the newsletter format and try to accommodate other telecom policy interests recognizing that perhaps our focus has been limited to topics such as wireless technologies and satellite industry and spectrum management. We truly hope that you will find this issue useful, and we remind ourselves that we volunteer for the benefit of the global telecom policy research community.

Kindly also help us by spreading the word about the GTPRN community and forward this newsletter to your colleagues or students. We have now 170 scholars and practitioners who share the interest in telecom policy, and we can only grow with your help and support. You are more than welcome to join our Facebook or LinkedIn Groups, follow us on twitter @GlobalGtprn, or to subscribe directly to our website www.gtprn.org where you have the chance to comment on each article or post.

INSIDE THIS ISSUE

TOP ARTICLES

Our first exclusive article is by Prof. Arturas Medeisis, lead scientist at Cellular Expert company and adjunct Professor at the VILNIUS TECH University, on database-driven shared spectrum access. In this article, he addressed the reasons for the gap between innovative concepts in spectrum management and existing traditional operations. You can check his article at the GTPRN website or by the end of this newsletter.

Our second article is by Mr. Khalid Al Awadhi, Chairman of the Conference Preparatory Meeting (CPM19) for the World Radiocommunication Conference (WRC-19) and the head of the UAE delegation when it comes to Space Services, and it is entitled "Measuring User Acceptance of Satellite Broadband in the UAE". The issue has become increasingly important due to the advancement in satellite technologies and the integrations towards cellular mobile. You can check his article at the GTPRN website or by the end of this newsletter.

Our third exclusive article is by Prof. Giovanni Geraci, the Head of Telecommunications Engineering at Univ. Pompeu Fabra in Barcelona, with the title "Integrating Terrestrial and Non-terrestrial Networks: 3D Opportunities and Challenges". The article is related to the increasingly attention to NTN and how it can contribute to the concept of 3D wireless networks. You can check his article at the GTPRN website or by the end of this newsletter

Last but not least, our fourth author, LTC (Ret) G A Redding, addresses a non-traditional topic that has been overlocked in the literature in his article "American Forces Radio and Television Service (AFRTS) Initiates Worldwide Satellite Delivery". Mr. Redding has over 50 years' experience in public affairs and broadcasting, in and outside the government of the United States, and was inducted to the Defense Information School Hall of Fame in 2021. You can check his article at the GTPRN website or by the end of this newsletter.

Make sure also to check latest article by Prof. William Webb "The end of an era of mobile data growth is in sight" which confirms previous predication in his book "The 5G myth". Please check his article here.

TELECOM POLICY NEWS

GENERAL NEWS

It is worth having a special feature in this GTPRN issue to cover the activities of PLAMADISO Talks during 2022 which covers different topics ranging from digital platform, the role of data, clouds to Blockchain, market power and antitrust in 22 series. The PLAMADISO Talks is an initiative led by Dr. Volker Stocker, Head of Research Group/Postdoctoral Researcher at the Weizenbaum Institute for the Networked Society (The German Internet Institute)/ Technische Universität Berlin. Please make sure to follow these fascinating talks on their website, and on Twitter (@JWI_Digi_Econ). The previous talks can be found on their YouTube channel. Their latest event has been by Brett Frischmann 'Friction-In-Design Regulation as 21st Century Time, Place and Manner Restriction' on 12th of January and by Maximilian Schäfer 'Algorithms in the Wild: Evidence from an Online Marketplace' on 18th of January.

Another important update from 2022 is regarding the impact that the Silicon Flatirons scholars on the global spectrum regulations. In particular, the FCC started a proceeding that will explore ways to promote the efficient use of spectrum through improved receiver interference immunity performance. The FCC announcement is based on the seminal contributions of two pioneers when it comes to spectrum policy, Prof. Dale Hatfield and Dr. Pierre De Vries. We have very excited by the news that reflects the positive influence that the academia has on policy and regulations.

For those who are interested in spectrum management, the UK Future Spectrum Policy Forum (SPF) has recently hosted its first annual summit on future spectrum policy with the launch of three UK SPF-commissioned reports – 'Market Mechanisms Review', 'Future Utilisation of the UHF Band' and 'Examination of existing services in 7- 24 GHz range'. These studies can be downloaded here.

PolicyTracker, the leading spectrum management consultation entity, has announced the release of their Spectrum Policy 101 podcast where they interview major scholars in the field including Professor Gerard Pogorel, Professor Martin Cave, Professor Thomas Hazlett, and Professor William Webb. You can check the available podcasts at the following link.

Another important spectrum related event was virtually held in November 2022 by ITS on 'Driving Digital Transformation: International Comparisons of Spectrum Policy' and the video recording can be accessed here

The CFP for ITS Europe 2023 is out now on and deadline has been extended to 20 January 2023. Details of the Call for Papers and abstract submission can be found on the ITS Europe website - https://itseurope.org/2023/. The conference will be held in Madrid, Spain in the period of 19th – 20th June 2023.

Three important CFPs are available now for three special issues of Telecommunications Policy as follows:

- The Impact of Modern Broadband Networks on Energy Consumption and CO2 Emissions [Paper submission deadline March 30, 2023 and scheduled publication date October 2023]
- The Economic, Social and Political Impact of Blockchain [Paper submission deadline April 30, 2023 and scheduled publication date Q4 2023 / Q1 2024]
- A Tribute to Dale W. Jorgenson: A Special Issue of the Journal of Telecommunications Policy Focused on the Digital Economy [Paper submission deadline June 30, 2023 and scheduled publication date Q1 2024].

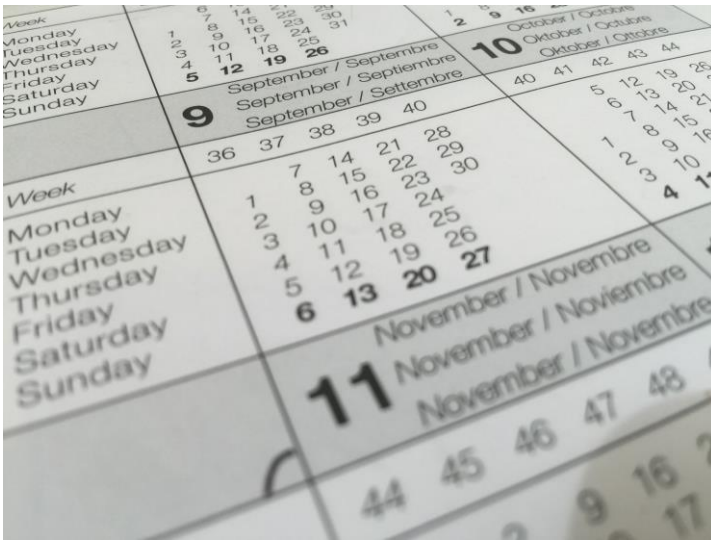
One of the main highlights of 2022 was the ITU Plenipotentiary Conference (PP-22) that was held between 26 September and 14 October with the participation of 183 of ITU's 193 Member States, as well as international and regional organizations, academia, and private-sector representatives. The final act of the conference included important resolutions on AI, outer space, digital transformation, IoT, and frequency assignments by military radio

installations for national defense services. The final act is available here.

Another ITU important event was the ITU Workshop on the future development of mobile communication systems beyond IMT-2020, targeting year 2030 and beyond along with some of the best experts in the mobile industry. Presentations of the workshop can be downloaded here along with this important ITU report on IMT-2030 entitled "Future technology trends of terrestrial International Mobile Telecommunications systems towards 2030 and beyond" for a peek into what 6G would look like.

One of the main ITU conferences during 2022 was the International Forum on Connecting the World from the Skies that took place from 8 – 10 November 2022, in Riyadh, and hosted by The ITU and the Communications, Space & Technology Commission (CST) of Saudi Arabia. This forum addressed airborne and space-borne communication networks from technology, space and science policy perspectives. These include GSO and HEO satellites, MEO and LEO satellite constellations, as well as High Altitude Platforms (HAPs), Low Altitude Platforms (LAPs), and air-to-ground (A2G) networks. You can check the forums sessions through the following link.

UPCOMING EVENTS



You don't want to miss the next ITS webinar "Internet Fragmentation, Reconsidered" by Andrew Sullivan, President and CEO of the Internet Society. This online event will be held on February 6, 2023 starting at 10:00 am EDT / 4:00 pm CET / 11:00 pm JST / 11:00 pm KST. The event will be host by the Ivy Business School, University of Western Ontario and TELUS Communications. More details can be found here.

A Workshop on 'Communication Policy in the Time of Pandemics' to be held in Toronto, Canada on May 29, 2023 and organized by the Institute for Information Policy (IIP) at Penn State University in collaboration with the Global Communication Governance Lab at Toronto Metropolitan University (TMU) and the York University/TMU Joint Graduate Program in Communication and Culture. The submission deadline for papers or abstracts is January 16, 2023, and Proposals and papers should be sent by e-mail to the Workshop Organizers at pennstateIIP@psu.edu.

An important conference by the Silicon Flatirons Center and the University of Colorado Law 'The Internet's Midlife Crisis' will be convened on Sunday, February 5–Monday, February 6, 2023 in the Wittemyer Courtroom, located in the Wolf Law Building at the University of Colorado Boulder. Details on the agenda and registration are available here.

The Journal of Telecommunications and the Digital Economy is seeking submissions for a special issue on Women's Participation in the Digital Economy and Digital Society. The date for manuscript submissions has been extended to **14 February 2023**. Accepted papers will still be published in the June 2023 issue of the *Journal*. More details can be found here.

TELECOM POLICY VACANCIES

There are several related telecom policy vacancies as follows:

• The Weizenbaum Institute for the Networked Society (The German Internet Institute)/Technische Universität Berlin is

seeking applicants for PhD candidate. More details can be found here.

• The Center for Advanced Research in Global Communication (CARGC) at the Annenberg School for Communication at the University of Pennsylvania invites applications for a "CARGC Postdoctoral Fellowship." This is a one-year position renewable for a second year based on successful performance. Deadline is on 1st of February 2023.

• The Institute for Advanced Study in the Global South at Northwestern University in Qatar (#IAS_NUQ) is seeking outstanding candidates for two postdoctoral fellowships focused on (1) research and program development on Arab Media and on (2) Digital Media in the Global South. More details can be found here. Deadline is on 1st of February 2023.

The Economic and Social Research Institute (ESRI) in Dublin, Ireland, is seeking to fill a vacant 3-year position for a

Postdoctoral Research Fellow in Electronic Communications. More details can be found here

There are also several exciting opportunities at the ITU for junior and middle levels as well. Feel free to check them here.

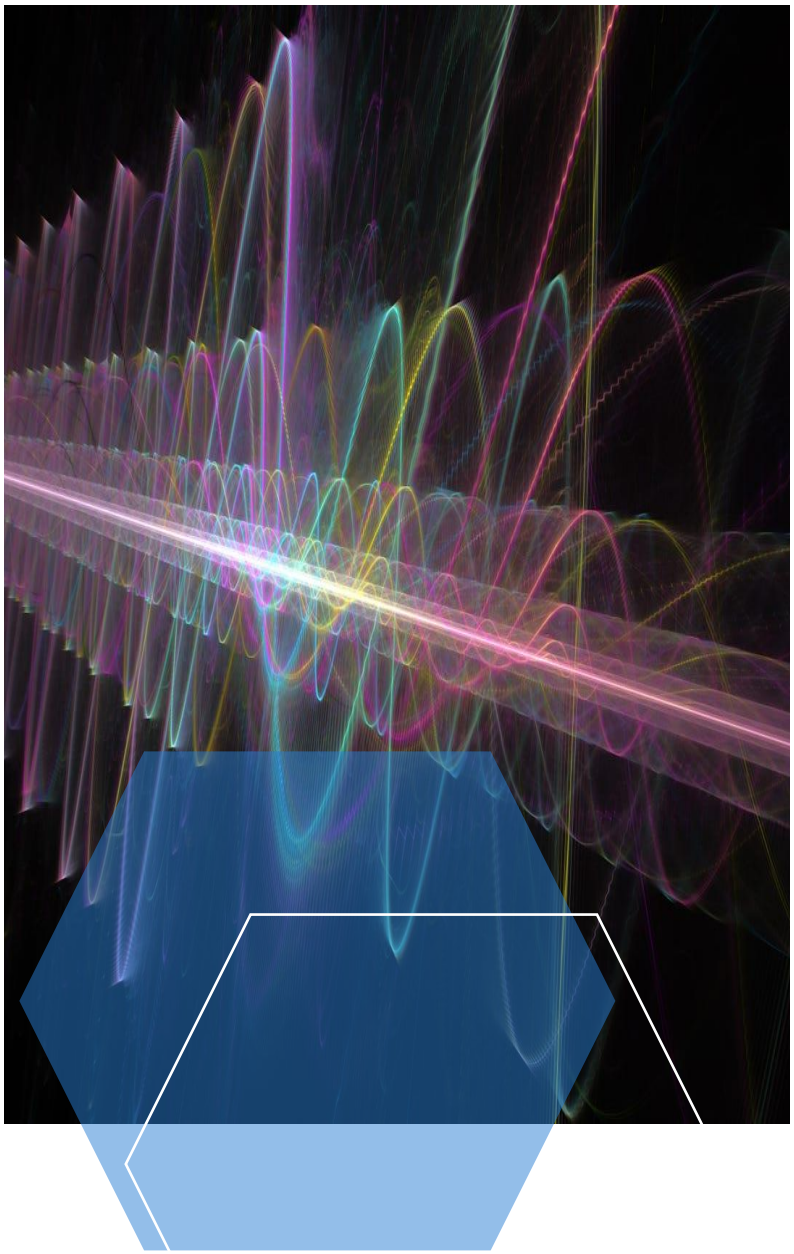
MAIN PUBLICATIONS

Below are the main publications on telecom policy in the last months:

- May 2022 (Volume 70) of Telematics and Informatics
- July 2022 (volume 46/6) of Telecommunications Policy
- July 2022 (Volume 71) of Telematics and Informatics
- September 2022 (Volume 46/8) of Telecommunications Policy
- October 2022 (volume 46/9) of Telecommunications Policy
- November 2022 issue (Volume 74) of Telematics and Informatics
- November 2022 (volume 46/10) of Telecommunications Policy
- December 2022 of Journal of Information Policy 'Special project: 50th anniversary of TPRC'.
- December 2022 issue (Volume 75) of Telematics and Informatics
- January 2023 issue (Volume 76) of Telematics and Informatics
- January 2023 of Telecom Review which focuses on PTC activities.

SHARE WITH US

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



IN NEED OF NEW WINDOWS OF OPPORTUNITY FOR DATABASE-DRIVEN SHARED SPECTRUM ACCESS

BY ARTURAS MEDEISIS

THE ISSUE

For an activity that enables such hotbeds of high-tech innovation as wireless broadband or satellite Earth exploration, the spectrum management itself remains strangely low-tech and largely entangled in century old ways of doing business. Granted, some practices have changed over last couple decades, such as auctions becoming near dominant mechanism for assigning commercial spectrum, or licenses allowing technological evolution within the given service, such as Land Mobile. Yet the spectrum access and use remain overall a strictly regulated process under close NRA control. It still involves extensive international studies and consensus building negotiations to decide on changing the utilisation of a particular band or allowing spectrum access for new technologies and applications. All this worked for many years and there is no reason, why this would not work for years to come. But clearly this way of doing business is not well suited for modern innovation and experimentation with new spectrum access techniques and new wireless business models.

Around a decade ago, there was some sense of high-tech innovation arriving to take spectrum management into the XXI century, with all the buzz of Cognitive Radio, “white spaces”, real-time dynamic auctions and so on and so forth. But the buzz has now all but faded and the only visible remaining practical example of all that hectic innovation efforts is the 3.5 GHz CBRS solution in the US. So why that innovation wave has produced so few sustainable results that really affect the way we manage spectrum? In large part this might be attributed to overhyped expectations meeting the harsh reality of fragmented markets and fledgling demand, which discredited the entire concept of Dynamic Spectrum Access (DSA) in early phase, resulting in

regulators abandoning further support and rolling back on implementation efforts.

LESSONS OF STALLED INNOVATION EFFORTS

A case in point could be the "TV White Spaces" concept in UHF bands, where the principal solution had been in hands reach, and was indeed already being implemented in a few pioneering countries. But the early Geolocation Database technology was still rudimentary, the markets' focus was on evolving LTE at the time and the demand for TVWS did not materialize quickly enough to keep the momentum.

A similar story happened in Europe with Licensed Shared Access (LSA) initiative, which meant to allow mobile networks to tap into little used governmental spectrum in 2.3 GHz and possibly other bands. Around 2012-2014 there was a big push and broad support from regulatory establishment for that idea, a lot of hopes had been pinned on having ETSI standards developed, but once they were developed by 2017, it did not help to move the LSA from concept to implementation. It may be said that LSA emerged as a top-down concept recommended (as opposed to enforced) on European level by RSPG and CEPT. It remains unclear how much support there really was from industry and Mobile Network Operators (MNO), who initially indicated their tacit support, seeing LSA as means to obtain access to new trenches of mobile spectrum. But once the prospect of new exclusive 5G spectrum in 700 MHz and 3.5 GHz bands in Europe have materialized, followed by reasonably prompt issue licenses, the support for implementing LSA quickly dwindled across the board. It thus appears that having declared nominal readiness and tacit support for LSA, everyone – the industry and NRAs alike, were simply waiting for some champion first mover to demonstrate a successful deployment, be it a country or a strong European multi-national MNO. When this failed to happen, the LSA policy became broadly perceived as a failure. At that point it became very hard to revive it unilaterally in any one country, since establishing the complete ecosystem needed to achieve positive momentum and economies of scale became impossible for any single stakeholder.

WHY WE NEED MORE DSA OPPORTUNITIES

But with a view on growing success of CBRS innovation taking hold in the US market, it may be good time to re-consider the prospects of database-driven DSA solutions. The early implementations might have simply arrived too early, without mature connectivity and database technologies in place, and without properly aligned interests and coordinated efforts by all involved as well as potentially interested stakeholders.

The benefits of database-driven shared spectrum access are many. First of all, administratively, they may be seen simply as an automation of frequency assignment process. So as such their implementation does not require any changes to ITU Radio Regulations, national telecom laws or National Tables of Frequency Allocations. Very often, they might be enacted through secondary legislation such as NRA-issued rules for spectrum access and registration of transceivers. This means, that in principle, say, land mobile systems could have access by means of DSA to any band that is allocated to Land Mobile service in the ITU RR (and NTFAs), which are quite many. NRAs would just need to establish some meaningful interference-control conditions as part of DSA framework, and while that is not a trivial task, the previous developments and test runs with TVWS, CBRS, and LSA have all demonstrated that that should not be a problem in itself.

Secondly, the DSA platforms would be well poised to answer the growing demand for highly localised industrial/private mobile systems. They become increasingly popular as of recently, based on LTE and now 5G NR technological solutions as providing more robust solutions than Wi-Fi for industrial applications. For instance, Nokia has published estimates that worldwide there exist some 15 million venues/locations that may benefit of having a private local LTE/5G network or system (think of evolved "hot spot" access point). If each of those would get even a single micro base station/access point, all together that would rival the combined global number of MNO cell sites in terms of volume of radio hardware.

Similar recent predictions from Federated Wireless show that in the US alone, private cellular solutions using the CBRS may be worth some $3 billion in the next few years. While that figure, as many such forecasts, by itself is not meant to end up being anywhere near precise, the point is that the current market expectations are very high.But having just one working solution like CBRS is not enough, not only because it is limited to one market, but also because it addresses just one band. We need to have multiple working DSA platforms in different bands as testing grounds to allow for

spectrum access innovation to develop and flourish, in order to derive new knowledge and understanding of evolving sharing scenarios for 5G systems and beyond. And just like with CBRS, multiple DSA platforms, in different bands and markets, would allow a true testing of business models that may evolve thanks to managed shared spectrum access, as opposed to unmanaged best-effort shared spectrum access in "spectrum commons".

Eventually and somewhat ironically, the DSA systems could even resurrect the notion of proverbial "Command and Control" regime as perhaps the most optimal way to manage spectrum. This might be indeed true, provided that those C&C decisions are taken not subjectively and arbitrarily by humans, but by centralised national databases in highly dynamic fashion, based on some clear technical criterions. The recent developments in nearly universal and cheap Internet connectivity, real time geo-location and mapping, coupled with proliferating cloud-based computing and database solutions, all make implementing such machine assisted spectrum access a viable reality.

Ultimately, different DSA systems, serving different bands and systems/users, could be combined into nation-wide Radio Environment Maps. Those would be useful both for spectrum users to guide their spectrum access decisions (locally and dynamically) and to NRAs to guide their understanding of what really happens in spectrum and any necessary interference resolution activities.

WHAT NEEDS TO BE DONE

The regulators have an important role to play in bringing forth such DSA platform innovations into modern spectrum management practices. The governments are critical in stimulating innovation and technological development through policy. This is especially so in the context of spectrum management, which relies on coordinated actions of many players on international and national layers. By organising broad co-evolutionary development efforts, the policymakers could provide meaningful leadership and guidance, bringing about the consolidation and networking effects.

Previous research on innovation in the mobile industry had highlighted the remarkable interdependency and operational bonds of dominant players that results in forming of "strong networks". This, in turn, results in the effect of "lock-in" to specific technological solutions and administrative as well as market relationships. In this light, the introduction of new spectrum access technology such as DSA would pose enormous challenges to implement a completely new technological paradigm of dynamic/opportunistic spectrum access, based on utilisation of novel spectrum geolocation databases. This would require significant reconfiguration of business relationships, which is never a straightforward process, and therefore needs some policy guidance.

In particular, the deeper look at the circumstance of stalling of LSA innovation in Europe, suggests the following possible areas for developing supportive and remedial policy actions:

- Recognising and addressing the 'strong networking' effects to break any current technological and business lock-ins: this could be done by expanding the design architecture and operational business scenarios of DSA frameworks to include non-MNO players, such as micro-operators and private enterprise mobile networks;
- Propping DSA platforms to survive and evolve during the unavoidable initial hesitancy of the market players: this could be done by mandating DSA platforms as an obligatory solution for access to chosen spectrum band(s);
- Developing new 'soft institutional norms' to further facilitate development of new players and emergence of new business models: this could be done by providing administrative incentives for new micro-operators such as zero pricing for access to spectrum managed by the DSA platform, providing targeted R&D funding to support market uptake and development of new business models:
- It may be further suggested that NRAs need to take the central role (themselves or through appointed independent third party) of operating the DSA platforms in their countries as a trusted orchestrator. This would help building a system of trust from the get-go and laying solid foundations for new spectrum access paradigm.

These actionable items fall squarely into the traditional remit of the NRAs and some further coordinated guidance and harmonisation measures from regional organisations involved in spectrum management would be helpful and relevant as well.

By providing such support and opportunities to evolve for still fledgling DSA systems and similar shared spectrum access concepts and platforms, the regulators would build solid foundations for continued innovation in spectrum management.

This would further invigorate the wireless communication markets, allow implementing and testing new technological solutions as well as new business models. Needless to say, that at the end we all – a growing global multitude of avid wireless consumers, would benefit.

Arturas Medeisis
Vilnius Tech University, Lithuania

Arturas Medeisis holds PhD from Kaunas University of Technology, Lithuania. He has 27 years of experience in the field of radio spectrum management and development of radiocommunication networks and services. Throughout his career Arturas worked in various positions in national as well as international organizations – European Radiocommunications Office of CEPT and the Telecommunications Development Bureau of ITU, combined with industry and academia engagements. Presently he works as lead scientist at Cellular Expert company, which develops various cellular systems modelling software tools and provides associated professional services. Arturas also holds a position of Adjunct Professor at the VILNIUS TECH university, where he is teaching telecommunication technologies.

MEASURING USER ACCEPTANCE OF SATELLITE BROADBAND IN THE UAE[1]

BY KHALID AL AWADHI

There has been global recognition of ICT's contribution to human progress. ICT is identified as an essential component in all of the 17 Sustainable Development Goals (SDGs) as outlined by the United Nations (UN) (ITU 2021; Lythreatis, El-Kassar & Singh 2022). Despite this, almost half of the people around the world do not have Internet access (Henri 2020, p. 2), leading to the so-called "digital divide". The challenge of the digital divide has different levels (Lythreatis, El-Kassar & Singh 2022). As it could refer to the absence of connectivity, it could also refer to poor Quality of Service (QoS) (Montenegro & Araral 2020).

The United Arab Emirates (UAE) enjoys globally recognized excellent internet connectivity, and the UAE's mobile internet is rated one of the best in the world (Alshurideh et al. 2019; Kurdi et al. 2020; Ookla 2021). Nevertheless, there are still some underserved markets in the UAE that require better connectivity solutions (Alshurideh, Al Kurdi & Salloum 2019; Al-Hamad et al. 2021). Looking at the current connectivity options in the UAE, it is recognized that connectivity through satellites is generally not widespread, as connectivity through the current geostationary (GSO) satellites has many disadvantages over standard terrestrial connectivity (Lin et al., 2021; Nuseir et al., 2021). Nowadays, we are witnessing significant growth in non-geostationary (NGSO) satellite communications, with capabilities comparable to terrestrial connectivity resulting from sophisticated technological developments.

Looking at the expected significant role of connectivity in rolling out use cases of the fourth industrial revolution (4IR), global initiatives started to evolve to provide broadband connectivity through NGSO satellites (Del Portillo, Cameron & Crawley 2019).

This study aims at assessing the acceptance of consumers in the UAE of satellite broadband. Since the advancement in satellite technologies has brought satellite services much closer to the usual services provided by terrestrial service providers, it became inevitable that satellite broadband is to be considered to provide appropriate communication services in underserved markets in the UAE.

To conduct our assessment, we used the Technology Acceptance Model (TAM) as the theoretical basis of our work.

[1] A full version of this article has been published in the International Journal of Data and Network Science 6 (2022). 1459–1470

We considered the effect of the primary two independent variables in the model, perceived usefulness (PU) and perceived ease of use (PEU). In addition, we included innovativeness (INN) as a variable based on the literature review and satisfaction with current services (SAT) as another variable based on existing knowledge about the UAE market. Hypotheses were established regarding the effect of the four factors on consumer behavior (BI) towards using satellite broadband. Also, a hypothesis was established regarding the effect of PEU on PU. The hypotheses of the study were as follows, and the conceptual model in this study can be seen in Figure (1).

- H1: Perceived Usefulness will positively influence the UAE population's intention to use satellite broadband
- H2: Perceived Ease of Use will positively influence the UAE population's intention to use satellite broadband
- H3: Perceived Ease of Use will positively influence UAE population's Perceived Usefulness of satellite broadband
- H4: Innovativeness will positively influence the UAE population's intention to use satellite broadband
- H5: Satisfaction with current services will negatively influence the UAE population's intention to use satellite broadband

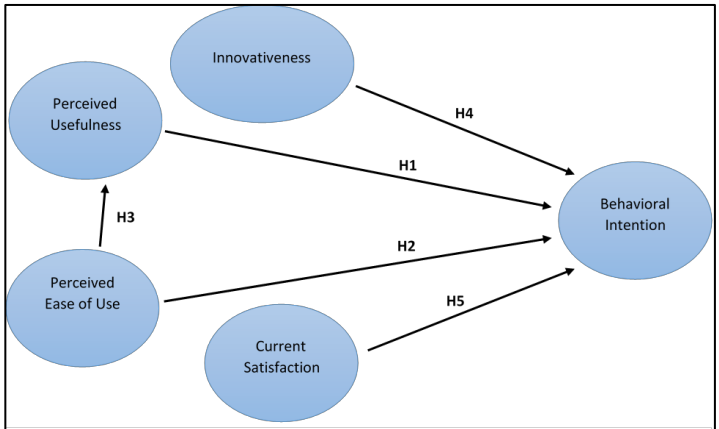


Figure 1: Conceptual Model

The developed questionnaire included 24 questions related to the model's constructs, the current service providers, and respondents' demographics. 146 respondents completed the survey questionnaire.

Accordingly, we constructed the model and tested it using the appropriate tools. All the hypotheses were supported by the conducted test, except the effect of SAT on BI. It was found that the model is acceptable for the assessment of UAE consumer's acceptance of satellite broadband. From the analysis of survey results and model tests, we could draw recommendations on how to support a smooth introduction of NGSO satellite broadband into the UAE market.

It is recommended that before introducing the services into the UAE market, tailored advertising campaigns should be conducted. In order to demonstrate the usefulness, the campaigns could, for example, focus on how the NGSO broadband services can be used wherever the user is in the UAE, even in remote and rural areas. They could also demonstrate the sufficient connectivity speed and reliability of the service. Also, to demonstrate the ease of use, the campaigns could, for example, focus on how easy it is to set up and install the required user terminals to establish the service. Finally, to demonstrate innovativeness, the campaigns could, as an example, shed more light on the space sector and its importance to the UAE. A good strategy could be to link the NGSO satellite broadband service to the major achievements made in the UAE in the space sector. Also, the campaigns could show the fact that NGSO satellite broadband is considered the latest technological advancement in satellite connectivity.

An attempt was also made to analyze the difference in BI for different genders and age groups. The result of such analysis would assist in identifying the target audience of any advertising campaigns for the new services. The results showed that gender and age group do not significantly affect people's intention to use the new services. Therefore, it is recommended that any advertising campaign should be general to the UAE population and should not be only targeted to specific gender or age group.

It is recognized that the current services and performance of existing service providers in the UAE have been previously criticized (Salama 2020). However, this study showed that our hypothesis for the relation between satisfaction with current services and the UAE population's intention to use satellite broadband is not supported. Therefore, it is expected that attempts to improve satisfaction with existing services will not affect introducing the new services.

Finally, it is recommended that future research expand the acceptance model by looking at other variables that could affect people's intention to use the service. Also, future research could be done after introducing the service into the UAE market to introduce the actual system use into the model and conduct a chronological study to link it with the existing model.

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He is involved with the work of the International Telecommunications Union, participating at various study group meetings and all the World Radio Conferences since 2007. He became the Chairman of the UAE National Committee for World Radiocommunication Conferences since 2015. He is a member of the Arab Spectrum Management Group (ASMG), heading the UAE delegation and holding various chairmanship positions related to Space Services.

He was the Chapter Rapporteur for Chapter 5 "Satellite Regulatory Issues" of WRC-15, and then the Chairman of Committee 5 during WRC-15. Khalid was the Chairman of the Conference Preparatory Meeting (CPM19) for the World Radiocommunication Conference (WRC-19). He is currently continuing a Professional DBA program at the British University in Dubai.

INTEGRATING TERRESTRIAL AND NON-TERRESTRIAL NETWORKS: 3D OPPORTUNITIES AND CHALLENGES

BY GIOVANNI GERACI

THE ISSUE

A mobile connection is our window to the world. The current social, economic, and political drive to reach global wireless coverage and digital inclusion acknowledges connectivity as vital for accessing fair education, medical care, and business opportunities in a post-pandemic society. Sadly, more than a third of the population on Earth remains unconnected. Indeed, rolling out optical fibers and radio transmitters to every nook and cranny of the globe is not economically viable, and reaching the billions who live in rural or less privileged areas has remained a chimera for decades. The long-overdue democratization of wireless communications will require a wholly new design paradigm to realize ubiquitous and sustained connectivity in an affordable manner.

Meanwhile, in more urbanized and populated areas, even 5G may eventually fall short of satiating our appetite for mobile internet and new user experiences.

Life in the 2030s and beyond will look quite different from today's: hordes of network-connected UAVs[2] will navigate 3D aerial highways—be it for public safety or to deliver groceries to our doorstep—and flying taxis will reshape how we commute and, in turn, where we live and work. The bold ambition of reaching for the sky will take the data transfer capacity, latency, and reliability needs for the underpinning network to an extreme, requiring dedicated radio resources and infrastructure for aerial services.

In a quest for anything, anytime, anywhere connectivity—even up in the air—next-generation mobile networks may need to break the boundary of the current ground-focused paradigm and fully embrace aerial and spaceborne communications.

[1] Short for *uncrewed aerial vehicles*, commonly known as *drones*.

To this end, the wireless community has already rolled up its sleeves in (re)search for technology enhancements towards a fully integrated terrestrial plus non-terrestrial network (NTN) able to satisfy both ground and aerial requirements.

At first glance, terrestrial networks could be re-engineered and optimized to support aerial users or complemented by NTN infrastructure such as low Earth orbit (LEO) satellite constellations or aerial base stations to further improve performance. Cost-related factors may advocate for a progressive roadmap.

The opportunities unlocked by integrating terrestrial and NTN capabilities could lead to a vast number of new applications and services, including critical communications, massive IoT, and aerial communications. Indeed, beyond standalone cellular networks, primarily designed for 2D usage, an integrated ground-air-space network could support reliable data and control links to multiple UAVs, electrical vertical take-off and landing vehicles, and aircrafts. These services would be guaranteed in specific 3D areas—aerial corridors or waypoint trajectories—where end-devices will be allowed to fly at different heights. The potential of UAVs may only truly be unleashed once the network capabilities and regulations allow for autonomous operation beyond visual line-of-sight. To this end, either augmenting a ground deployment with co-channel uptilted base stations or complementing it with a LEO constellation are both promising avenues for supporting aerial communications, under the right design choices: the former entails advanced interference mitigation capabilities, the latter hinges on a sufficiently dense constellation—to guarantee near-zenith coverage—and a carefully designed beam reuse.

Standardization work on non-terrestrial communications in 3GPP dates back to 2017. This effort can be classified nowadays into two main areas, namely NTN enhancements and terrestrial network support for UAVs. The former aims at defining a global standard for future spaceborne communications, fostering an explosive growth in the satellite industry. Activities within the latter serve the twofold purpose of ensuring that mobile standards meet the connectivity needs for safe UAV operations, and that other users of the network do not experience a loss of service due to their proximity to UAVs. Looking ahead, 3GPP Rel-18 will enhance 5G NR NTN operation by improving coverage for handheld terminals, studying deployments above 10 GHz, addressing mobility and service continuity between terrestrial-NTN as well as across different NTNs, and investigating regulatory requirements for network-verified user location. As 5G use-cases evolve, Rel-18 will also introduce 5G NR support for devices onboard aerial vehicles, studying additional triggers for conditional handover, base station uptilting, and signaling to indicate UAV beamforming capabilities, among others.

However, the availability of terrestrial plus NTN segments is just a prerequisite for realizing a 3D wireless network. Jointly and optimally designing and operating all platforms and nodes requires further disruptive and interdisciplinary research. One chief challenge in realizing an integrated ground-air-space network arises from its extreme heterogeneity, reflected at different levels, including radio propagation features, node and device capabilities, and ownership and operations. Such heterogeneity makes realizing a 3D network a remarkable endeavor and suggests much-needed work to enhance radio access, mobility and multi-connectivity, and network management and orchestration. We hope this overview article will foster new research and breakthroughs, bringing the wireless community one step closer to the era of ground-air-space communications.

Full article: G. Geraci, D. López-Pérez, M. Benzaghta, and S. Chatzinotas, “Integrating Terrestrial and Non-terrestrial Networks: 3D Opportunities and Challenges”, *IEEE Communications Magazine*, 2023.

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Giovanni Geraci is an Assistant Professor and the Head of Telecommunications Engineering at Univ. Pompeu Fabra in Barcelona. He was previously with Nokia Bell Labs, holds a dozen patents on wireless technologies, and is a co-Editor of the book “UAV Communications for 5G and Beyond” by Wiley–IEEE. He serves as Distinguished Lecturer for the IEEE Communications Society and the IEEE Vehicular Technology Society, and he received the 2018 IEEE ComSoc EMEA Outstanding Young Researcher Award as well as Best Paper Awards at IEEE PIMRC’19 and IEEE Globecom’22. Giovanni likes coffee, surprises, and living by the sea. Born and raised in Sicily, he has lived across six continents for work/love/adventure and considers himself one of the luckiest people in the world.

AMERICAN FORCES RADIO AND TELEVISION SERVICE (AFRTS) INITIATES WORLDWIDE SATELLITE DELIVERY

BY LTC (RET) G A REDDING

AFRTS programs were, and still are, considered a Quality-of-Life issue impacting servicemember morale and welfare, including family members, especially in remote areas or "hardship" tours. Providing news, entertainment, and sports programming has always been an AFRTS prime mission – a touch of home. Satellite delivery ultimately was able to provide real time programming in lieu of shipping thousands of VHS cassettes overseas and taking weeks if not months to complete a circuit. After an outlet aired a program it would send the videotape to another station by mail, and finally back to AFRTS Los Angeles for reprocessing. With satellite delivery all that went away.

In October 1978, coverage of Superbowl XIII for American Armed Forces OCONUS locations became an issue. Armed Forces Radio and Television Service (AFRTS) Director, Robert Cranston, received an ominous call from his Sports Director, George Balamaci. AT&T had just notified Balamaci that satellite transponder time for the Superbowl XIII had been reserved by an undisclosed party and not available for AFRTS. At that time AT&T held the appropriate/exclusive contracts with the Defense Department. For sports and other special events AFRTS would secure commercial satellite broadcast services on an as needed or ad hoc basis. For example, as little as 15 minutes of satellite reserve time could be secured from AT&T with a personal or business credit card. Businesses or entities with reserved time would then offer to release the satellite transponder space segment to AFRTS for appropriate financial compensation – a.k.a scalping. With this, and increasing satellite use, AFRTS leadership decided to move to full-time satellite distribution.

Future Systems, Inc. (FSI), Gaithersburg, MD, was contracted by AFRTS to evaluate engineering and cost requirements for designing a "worldwide satellite TV distribution statement of work (SOW)".

Defensible budget justifications for establishing and funding the proposed AFRTS Satellite Network (SATNET) were required to support programming issues like the Super Bowl and increase the AFIS budget from $18M to over $38M and $98M in the outyears, including staffing requirements.

The HAC was interested in why AFRTS didn't use existing (underutilized) military satellite facilities. Our response was simple

enough. Should something happen in a tactical environment where additional capacity was needed, AFRTS with a "00" priority would be kicked off the transponder, along with all other military networks. Losing AFRTS broadcasts "might be understood" by its authorized audience, but unofficially AFRTS had an overseas shadow audience that included millions of viewers. That international shadow audience would be very concerned should AFRTS programming for U.S. Forces go unexpectedly dark. That argument / position satisfied the HAC and we proceeded.

Implementing the AFRTS SATNET meant consolidating resources. All personnel and administrative activities pursuant to the AFRTS-Washington closure and the AFRTS-Los Angeles' consolidation into new facilities (e.g., the new AFRTS-Broadcast Center) were executed per the satellite proposal. Implementing the AFRTS SATNET meant consolidating resources. All personnel and administrative activities pursuant to the AFRTS-Washington closure and the AFRTS-Los Angeles' consolidation into new facilities (e.g., the new AFRTS-Broadcast Center) were executed per the satellite proposal. This involved reclassifying and staffing over 170 positions, both military and civilian. I was directed to:

- Ascertaining incremental costs for support of AFRT outlets, per station, circuit, and type of programming.
- Validating data required to making continuing program commitments with respect to decremented, basic, and enhanced funding authorizations.
- Consolidating the AFRTS organization at Los Angeles based on manpower (work) requirements, potential realignment based on new missions associated with the AFRTS SATNET, and the AFRTS Operations Plan 1-79.
- Reviewing all procedures for contracting, procurement and budget submissions: program and equipment costs, personnel, training and travel costs, and maintenance and administrative costs.

Once new staffing plans were published incumbents at AFRTS-Washington were offered positions at the new satellite-enabled AFRTS-Broadcast Center (BC) facilities in Sun Valley, California. None accepted.

With full-time satellite availability looming, the challenge was to secure programming. AFIS approached the newly launched, June 1980, Cable News Network (CNN) to work out a formal relationship. CNN had programs, and a CONUS satellite network. AFRTS would be standing up a worldwide network but needed program. Synergy! Meetings to sort out a mutually beneficial deal were conducted between AFRTS and CNN. As a result, AFRTS overseas downlinks would be fed CNN programming from AFRTS-BC. That signal would be retransmitted (flipped) by U.S. Electrodynamics, Inc. through its antenna farms on the West and East coasts of the United States.

Note: It was believed that AFRTS signals, pirated and retransmitted, into local economies such as hotels provided CNN HQs with enough justification to confirm an overseas audience. This was born out. CNN International was launched at a later date. The history on CNN's website does not mention this AFRTS and CNN collaboration. A "low key" memorandum of agreement was negotiated through AFRTS-LA. As AFRTS SATNET programing expanded, there were increased opportunities to provide sports programs live. News programs from the major networks – CBS, NBC, and ABC – were also transmitted under the condition that they would be broadcast in their entirety (even if some of the segments might not favor U.S. interests).

Impact - BIG DEAL! - The AFRTS SATNET was the first global/international Superstation implementation, a feat that had never before been accomplished. This was also the first time any organization, government or commercial, had asked for full time access to satellite transponders for news and entertainment programming.

G A Redding, LTC, US Army, Retired
Combat Photographer
Public Information Officer
Visual Information Pioneer

Mr. Redding has over 50 years' experience in public affairs and broadcasting, in and outside the government of the United States. In 1985 he joined the Secretary of Defense's Audiovisual Policy Office, developing policy to manage DoD audiovisual resources, including multimedia technologies; videodisc-based training systems, CD-ROM applications, and teleconferencing networks.

Upon retiring from the U.S. Army, he joined the Advanced Distributed Learning (ADL) Initiative as a core team member. In that capacity he evaluated instructional technologies – policies, products, services, devices, and networks – as they apply to multiple education and training environments. The ADL Initiative encompasses content issues, economic models, technical architectures, and research priorities including Pre-K - 12, technical schools, colleges and universities, job skills training, professional development, and life-long learning. He holds a Bachelors degree in Mass Communications from the University of Denver, a Masters degree in Business Administration from Indiana State University, and a Masters degree in Broadcasting from Butler University. He was inducted to the Defense Information School Hall of Fame in 2021.

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