The Evolution of Telecom Business, Economy, Policies and Regulations


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From the late 1970s onward, the global telecommunication industry has gone through several waves of regulatory and technological changes. Today, the very definition of telecommunication has changed. First, the traffic is no longer confined to voice and/or limited data services. Second, the boundary line between telecommunication and information sectors is increasingly blurred. Third, the parties that offer products and services for consumers, businesses and industrial users operate under different regulatory regimes, ranging from strict regulations to no regulations at all. Fourth, the merging of the physical and virtual worlds through immersive technologies opens new social, cultural and business dimensions. Finally, the post-covid environment has opened unprecedented avenues for virtual workplaces (E-work).

This overall transformation is affecting the experience of users, whether individually or collectively, in unprecedented ways. In this environment, network operators, component/system suppliers, but also regulators, business analysts and social scientists and sometimes even philosophers are striving to understand and make sense of the evolution of models and policies related to the evolving telecommunication ecosystem.

Traditionally, the focus of papers published in the *IEEE Communications Magazine* has been mostly on the technical aspects, even though technologies and designs cannot be separated from societal, economic, and regulatory factors. Telecommunication specialists tend to relegate these latter factors to other disciplines and, as a result, they end up operating in a business and legal environment that that they have not defined.

The purpose of this FT is to expand the horizon of telecommunication engineers and technologists to include the non-technological aspects of their industry. Twelve papers were selected with the help of the reviewers listed at the end of this introduction. The papers cover the following areas: economics of telecommunication services, spectrum management and infrastructure sharing, business models and regulation.

The section on the economics of telecommunication services includes four articles, arranged from the specific to the general. "Pricing eSIM Services: Ecosystem, Challenges, and Opportunities," is by Ramneek, Patrick Hosein and Sangheo Pack, from Korea University and the University of the West Indies at St Augustine, respectively. The authors consider the effects of eSIM, which allows easy switching of wireless service providers. This would allow service providers to offer personalized pricing with plans tailored to individual profiles based on specific needs and usage.

The second article is "5G-Kube: Complex Telco Core Infrastructure Deployment Made Low-Cost" written by Domenico Scotece, Domenico, Asma Noor, Luca Foschini, and Antonio Corradi, all from the Universita degli Studi di Bologna (Bologna University), Italy. The authors propose a new management architecture for the 5G core network based on Kubernetes and present preliminary results on the management and deployment of the associated services.

The third and fourth articles in this section are historical reviews. "Less Revolution, More Evolution: Competitive Markets, Copper-Based Broadband Tech, and Lessons for the Future," is written by Advait Deshpande and Allan Jones, from The Open University, UK. The authors explain why copper-based broadband was chosen for Internet connectivity in the United Kingdom (UK). On the other side of the Atlantic, Martin Weiss and Ilia Murtazashvilli, from the University of Pittsburgh, USA, review the history of bandwidth markets in the United States (US) in their article "Risk Management and Historical Bandwidth Markets in US Telecommunications." They suggest ways to combine market mechanisms, regulations and decentralized solutions to satisfy the increased need for wireless bandwidth.

Spectrum management and infrastructure sharing help make the most of the available wireless capacity, particularly in rural and remote areas. The section on spectrum management and infrastructure sharing comprises three contributions. The title of the first article is "Infrastructure Sharing Strategies for Wireless Broadband" and is co-authored by Shruthi Koratagere Anantha Kumar, from the University of Strathclyde, UK, and Edward Oughton, from George Mason University, USA. The key finding is that network sharing increases the Net Present Value (NPV) by anywhere between 20 and 90 percent over the case when there is no sharing.

Zoheb Hassan, Erika Heeren-Moon, Javad Sabzehali, Vijay Shah, Carl Dietrich, Jeffrey Reed, and Eric Burger are the authors of "Spectrum Sharing of the 12 GHz Band with Two-Way Terrestrial 5G Mobile Services: Motivations, Challenges, and Research Road Map." This is a joint project of Virginia Polytechnic Institute and State University, Bradley, Georgetown University and George Mason University, USA. The premise of the article is that the 12 GHz band offers great potential for improving the coverage and capacity of terrestrial 5G networks. However, interference issues between incumbent receivers and 5G radio links present a major challenge. The authors propose a research program to study various ways to achieve the harmonious coexistence of various operators.

The final article in this section is on "Spectrum Management for Local Mobile Communication Networks," by Marja Matinmikko-Blue, Seppo Yrjölä, and Petri Ahokangas Ahokangas, University of Oulu and Nokia Enterprise, Finland. Thanks to local spectrum licensing for 4G and 5G wireless networks, various entities can share the same spectrum and operate their own

mobile communication network within specific facilities, such as factories, mines and ports. Yet, spectrum availability for local mobile communications varies among different countries. This will pose a challenge in the 2030 time-frame, when a large number of local 6G communication networks are envisaged and spectrum sharing will be needed.

The next three articles consider the business models with cloud gaming for an Uber-like telecommunication platform and for the beyond-5G and 6G networks. "Future Business Model for Mobile Cloud Gaming: the Case of South Korea and Implications" is by Seoin Baek, Jaewook Ahn, and Dongwook Kim. The authors are from the Science Technology Policy Institute, SK Telecom and the European Telecommunications Standards Institute (ETSI), respectively. The authors note that providers of mobile cloud gaming have pinned their hopes on 5G because of its high bandwidth and low latency. So far, however, these hopes have not been met due to the characteristics of the gaming market. Gamers fall into three major user segments: mobile gamers, PC gamers, and console gamers. The large segment consists of mobile gamers who are used to the "freemium business model," where users get the basic version of the game for free. Console gamers prefer ultra-high-quality games, with dedicated consoles and large TV screens and are prepared to pay a premium for a high-quality network connection. PC gamers are between these two groups. The reliance on 5G only does not appeal to any of these three segments. The authors recommend that mobile cloud gaming providers focus on the needs of the freemium mobile gamers. To accommodate the lucrative console gamers market, the authors recommend to use Artificial Intelligence (AI) for interference management, reduce the usage fee and, consider higher spectrum bands. The next article in this section is on the "Uberization of Telecom Networks for Cost-Efficient Communication and Computing," by Hanna Bogucka and Bartosz Kopras, from Poznan University of Technology and RIMEDO Labs, Poland. An Uber-like platform business model for telecommunications is discussed. The analysis, however, does not include the impact of the proposal on network management, quality of service and customer support. Accordingly, their caveat that "provisioning of the end-to-end quality of (communication and computing) services is a complex issue that requires the definition of (communication and computing) quality metrics, and the study of methods that guarantee them in diverse market scenarios with multiple service providers" is a reminder that further studies are needed.

The third and final article in this section is "Divide and Conquer: A Business Model Agenda for Beyond-5G and 6G," by Meroua Moussaoui, Emmanuel Bertin, and Noël Crespi. The authors are from France; the first two have joint positions in Orange Innovation and TélécomSud Paris while the third is from TélécomSud Paris. They explore the possible evolutions in the telecommunications ecosystem with 5G and 6G and propose business opportunities for the involved actors.

The regulatory perspective is represented by two articles. The title of the first is "A Path Toward an Internet of Things and Artificial Intelligence Regulatory Framework." The authors are Suada Hadzovic, Sasa Mrdovic, and Milutin Radonjic, from the Communications Regulatory Agency, Bosnia and Herzegovina, the University and the University of Montenegro, respectively. They note that billions of sensors and similar devices collect and transmit via the Internet of things (IoT) to be processed by AI-enabled entities. Unfortunately, at this time, the whole process lacks transparency and accountability. The European Union (EU) is trying to develop regulations that encourage innovation while safeguarding the right to privacy. The authors classify the regulatory and legislative landscape in the EU. Next, they discuss the applicability of these initiatives in EU-candidate and potential candidate countries as well as other developing countries that strive to build human-centered regulations of IoT and the AI environment.

The authors of the second article "Upcoming European Regulations on Artificial Intelligence and Cybersecurity," Markus Dominik Mueck, Amit Elazari Bar On and Stephane Du Boispean are from Intel Corporation. They discuss two draft regulatory initiatives from the European Commission (EU): the Artificial Intelligence (AI) Act and the Cyber Resilience Act (CRA). To meet the requirements of the AI Act, the authors propose a new AI system architecture and discuss its dividual components.

In conclusion, we hope that the above selection will help the readers gain new insights into the global telecommunication industry and help them in their future endeavors.

Finally, we would like to thank the reviewers from many countries for their invaluable assistance in making the selection and improve the quality of the final articles.

Biographies

Eva Ibarrola (eva.ibarrola@ehu.eus) received her Ph.D. degree in telecommunications engineering in 2010 from the University of the Basque Country (UPV/EHU). She was honored with the Best Thesis Award in Management, Economy and Telecommunications Regulation for her work in the area of user-centric QoS management models. She is currently an Associate Professor at the Faculty of Engineering in Bilbao in the area of telecommunications networks and services. Prior to joining the University of the Basque Country in January 2000, she worked at the National Monitoring and Operation Center of Telefónica in Madrid. She has been participating in different R&D projects and cooperating on different standardization bodies in the area of user-centric quality of service (QoS) management models and frameworks.

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