

Understanding the Difference Between Participants and Contributors in a Standard-Development Process

*By Lorenzo Casaccia, Urška Petrovčič & Karyn Vuong
Qualcomm*



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The development of technological standards, such as the fourth generation ("4G") and fifth generation ("5G") cellular standards, is a collaborative effort involving hundreds of companies and thousands of engineers from a variety of industries and representing divergent interest groups. Although the development of standards requires cooperation and coordination among participants, not everyone contributes in the same proportion to the creation of a standard. Only a very small group of participants contributes technologies that underpin cellular standards and thus serves as the research and development ("R&D") arm of the standardization process.

To better understand the difference between participants and contributors in a complex standardization process, it is helpful to look at the 3rd Generation Partnership Project ("3GPP") — a partnership of seven global standards-development organizations that develops protocols for mobile telecommunications. 3GPP plays a critical role in the development of standards for cellular telecommunications technologies, which have provided the foundation for the development of a massive mobile economy and are now revolutionizing new industries, such as automotive and the Internet of Things ("IoT"). Thus, understanding who contributes to the 3GPP's standards is critical to identify the players that are the driving force behind these important technological advancements.

I. Who Are the Participants in the 3GPP Standardization Process?

As of October 2023, 3GPP included about 550 member companies.⁴ This is a significant increase from 2011, when the organization

counted about 250 members. These members represent different industries and verticals, including mobile network operators and vendors, satellite, semiconductors, automotive, IoT, broadcasting, cloud computing, as well as universities, research institutions, and representatives from public bodies. The most widely represented groups (based on the number of member companies) are mobile network operators, academics, and government agencies.

In terms of geographical distributions, 3GPP involves members from a variety of regions, including North America, Europe, China, Japan, India, Korea, but also from countries such as Israel, Australia, and Singapore among others. Although companies from China and India have significantly ramped up their participation in the recent years, western companies continue to account for the largest share of 3GPP members. As of October 2023, companies headquartered in Europe and North America accounted respectively for 38 and 22 percent of 3GPP members, whereas companies headquartered in China and India accounted respectively for 16 and 9 percent.

In short, there is a wide variety among 3GPP members and the interests they represent, which demonstrates the vested interest that a variety of stakeholders have in the development and implementations of standards for cellular communication.

II. Who Are the Contributors to the 3GPP Standardization Process?

Every 3GPP member can influence the development of a standard through direct participation in the process. During standard

¹ Vice President, Technical Standards & IP, Qualcomm Inc. The views and opinions expressed in this article are those of the authors and do not necessarily reflect the policies or positions of the institutions for which they work.

² Director, Government Affairs, Qualcomm Inc.

³ Project Manager, Sr., Standards & Industry Organizations, Qualcomm Inc.

⁴ According to September 2023 membership data, 3GPP had 848 individual members. Several companies have multiple memberships, which reflects their national and regional affiliations. If one discounts the multiple memberships held by single companies, there are in total about 550 member companies.

development, participants submit technical documents—often referred to as "contributions"—to propose solutions and technologies for the discussed standard, or more specifically, the discussed technical specification.⁵ At the 3GPP meetings, participants then evaluate, discuss, and revise these contributions, agree on major features, and conduct feasibility studies to determine the technologies that ultimately underpin a technical standard. Decisions regarding the technology to be included in a technical specification are made by consensus and are technology-driven, meaning that participants select technologies based on their technical merit.⁶

As of October 2023, there have been almost a million written contributions in 3GPP since the beginning of 5G, which reflects the broad scope of the work that lies behind the development of telecommunication standards.

However, not all 3GPP members have contributed to the development of 5G in the same proportion. Rather, a large share of these contributions come from a handful of companies. As of October 2023, 54 percent of the written

contributions from 2016 onward were made by only six companies: Ericsson, Huawei, Nokia, Qualcomm, Samsung, and ZTE (listed in alphabetical order). In other words, this small group of companies, which represents approximately 1 percent of the 3GPP members, is responsible for more than half of the contributions that underpin the suite of 5G standards specifications.

Other 3GPP members also contribute to the standard development process, but their contributions have been more modest, as Figure 1 shows. Beyond the top six companies listed above, contributions made by individual companies did not exceed 3 percent of all contributions and were typically significantly lower than that. For example, the combined contributions made by companies from the satellite industry, which is one of the most heavily represented groups in 3GPP, account for 1 percent of contributions. Similarly, members from the automotive and IoT industries combined made less than 1 percent of contributions. There are also over 300 3GPP members that have made no written contributions at all.

Figure 1: Contributions per Company



Source: Dolcera Tdoc explorer, October 2023

⁵ 3GPP is an engineering organization that develops technical specifications. These technical specifications are then transposed into standards by the seven regional SSOs that form the 3GPP partnership. See Lorenzo Casaccia, *Understanding 3GPP – starting with the basics*, On Q Blog (Aug. 17, 2017), <https://www.qualcomm.com/news/onq/2017/08/understanding-3gpp-starting-basics>.

⁶ For a detailed description of the standardization process within the 3GPP see Lorenzo Casaccia, *Counting 3GPP Contributions — Even the “Approved” Kind — Does Not Measure 5G Leadership and Value*, OnQ Blog (Oct. 22, 2022), <https://www.qualcomm.com/news/onq/2022/10/counting-3gpp-contributions---even-the--approved--kind---does-no>.

In sum, there are enormous differences in the terms of the contributions that 3GPP members make towards the developments of standard specifications. Although when looking at contributions, quantity is certainly not a measure of quality (a point that will be explained shortly), these numbers show that a lion's share of the work at the 3GPP is done by a very small number of companies and there is then a long tail of members that make only minimal contributions, if any at all. Notably, even though 5G is affecting new industry verticals, such as auto and IoT, the contributions made by members from those industries are fairly limited.

III. Understanding the Heterogeneity Among Contributions

There is a further nuance that must be accounted for when examining data about 3GPP contributions. Contributions vary significantly in terms of their inventive content.⁵ Whereas some contributions are fairly simple, such as a proposed editorial modification to the discussed specification, others are more intricate, rely on innovative technologies, and are supported by numerical analysis and/or simulations requiring months of preparation. Some contributions also contribute to the opening of entire new projects that otherwise would not exist.

To understand the difference among contributions, it is helpful to examine more in detail 3GPP's work. 3GPP defines specifications for complete end-to-end cellular systems, including user equipment (or devices), radio access network (RAN), core network, and service framework including voice, video, quality of service, charging, and other operational aspects. In simple terms, this means that 3GPP oversees standardization activities for the entire wireless telecommunications system. Although the work in each individual field is important for the overall functioning of the system, not every field involves

the same level of underlying R&D. That is, whereas some areas of work require extensive reliance on fundamental research, there are areas of work within 3GPP that are less R&D intensive.

This point can be easily observed by comparing the number of contributions and the number of patented technologies within the various working group of the 3GPP.⁶ Whereas several 3GPP working groups record a high number of contributions, advanced technologies (measured using the proxy of declared standard essential patents or SEPs) are mostly found in the standardization work related to two working groups within RAN—the group responsible for the definition of the functions, requirements and interfaces of the radio access networks.⁷ That is, RAN 1 and RAN 2, the working groups that focus on the physical layer of the radio interfaces and radio interface architecture and protocols, collectively account for 93 percent of all declared 5G SEPs,⁸ which reflects the fact that these two working groups are the most R&D intensive parts of the 3GPP work.

Thus, although the number of contributions reflects the involvement and the level of effort of a given company in the 3GPP standardization activities, there is a great divergence among contributions in terms of the inventive content—a factor that needs to be considered when identifying the companies that are responsible for the most important technological advancements.

IV. Why Only a Few Participants Contribute Technologies to a Standard?

The skewness in contributions, particularly complex contributions that incorporate advanced technological solutions, is not surprising considering that the development of technologies used to build cellular standards requires significant investment in risky R&D. According to a 2015 analysis, companies developing cellular

⁵ See *id.*; Lorenzo Casaccia, Top 5 Drawbacks of "Contribution Counting" in 3GPP. (Don't Count on it!), OnQ Blog (Aug. 1, 2017), <https://www.qualcomm.com/news/onq/2017/08/top-5-drawbacks-contribution-counting-3gpp-dont-count-it>.

⁶ See, e.g. SEP Declarations by 3GPP Tech Bodies, Declaration Status, PatentCloud https://app.patentcloud.com/sep/?_hstc=92158149.9c49e44b73bd3bee6fa385653ecd7c96.1601769600115.160169600116.1601769600117.1&_hssc=92158149.11.1601769600118&_hsfp=2827025116.

⁷ See, e.g. *id.*

⁸ *Id.*; see also *How 5G Standard Essential Patents (SEPs) Are Being Used by Telcos*, ABI Research, <https://www.abiresearch.com/blogs/2023/08/04/5g-standard-essential-patents-seps/>.

technologies invest a higher percent of their revenue in R&D than any other industry, except biotechnology.⁹ These investments are made without a guarantee that their research will yield commercial results, that the technology will be included in the standard, and, even if implemented, that the standard will be commercially successful. Contributing to the developments of cellular standard is therefore a risky and resource intensive venture that few companies are willing to undertake.

Yet, when successful, these investments benefit not only the small number of contributing companies but all 3GPP members and the economy more broadly. For example, advancement of high-speed mobile networks had a profound impact on the development of the mobile industry, by not only changing mobile devices from simple phones to fully functional pocket-sized computers, but also spurring a massive growth in end-user applications or “apps.” Advancement in cellular connectivity provided the foundation for the development of the mobile economy, which total economic was estimated to be over 4.8 trillion dollars globally by 2019.¹⁰ In other words, advancement in cellular

communication revolutionized not only the mobile device industry, but the whole economy, benefiting a broad group of industry players as well as consumers.

V. Conclusion

Although the development of cellular standards is a cooperative process that involves cooperation and coordination across a variety of stakeholders, data shows that the heavy lifting is done by only a few industry players. A small group of companies, which represents 1 percent of 3GPP members, is responsible for over half of the contributions made to the 3GPP in relation to the development of 5G. There is then a large number of 3GPP members that make only minimal contributions, if any at all. Although there is a large heterogeneity among contributions in terms of their inventive content, these data suggest that only a few companies make risky investments in R&D to develop the technologies that are used to build cellular standards. Yet, when successful, those investments have and will benefit not only all 3GPP members but also the industry and society more broadly.

⁹ WOLFGANG BOCK ET AL., THE MOBILE REVOLUTION: HOW MOBILE TECHNOLOGIES DRIVE A TRILLION-DOLLAR IMPACT, BCG (Jan. 15, 2015), <https://www.bcg.com/publications/2015/telecommunications-technology-industries-the-mobile-revolution>.

¹⁰ Bowman Heiden, The Value of Cellular Connectivity—from Mobile Devices to the Internet-of-Things, (Sept.21, 2020), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3670222 (page 51).