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3GPP Contributions Analysis – 2022 Update

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Summary

Many aspects of the wireless communication scene are already being changed by 5G. Vendors, operators, and other stakeholders are taking part in the effort to develop 3GPP standards. As can be learned from experience with LTE, vendors' contributions to 3GPP standards development are an indication of how the market looks in terms of market share and equipment installed base.

In the previous versions of this white paper, Omdia identified the market leaders in 3GPP contributions using our comprehensive analysis of 3GPP work items (WIs) and study items (SIs) for the period between 2005 and 2020. In this updated version, our analysis is updated with contributions made up to June 2022.

We also included subtechnologies or vertical use cases that are making it into the headlines for their potential technological and economic impact.

The leadership quadrant shows contributors' position relative to others based on their 3GPP activities during the last two years (2H20–1H22). Huawei and Ericsson have kept their leadership positions based on their total contributions and approved WIs and SIs. Those two companies have very strong presence in all categories analyzed in this white paper.

Figure 1: Contributions leadership quadrant, 2H20–1H22

Note: The leadership quadrant is a relative measure of each 3GPP contributor's position relative to the others. Each contributor's position is based on total submissions made and total approvals earned by that contributor during the period. For this round of the report, those that earned at least 50 approvals during the period appear in the leadership quadrant. Among the strong contributors, those that made fewer than 2,000 submissions are considered frequent contributors.
Source: Omdia

Nokia, one of the leaders up to 1H18, saw a notable decrease in its contributions and approvals. However, the company still has a strong presence in almost all the categories analyzed in this white paper. Qualcomm, Samsung, and ZTE have kept their positions as strong contributors.

In addition to 5G and LTE, this report takes a deeper look into other verticals and areas, including 5G-V2X, LTE-V2X, NB-IoT, eMTC, URLLC, network slicing, Industrial IoT, and 5G energy efficiency.

This analysis is not just a mere counting of vendors' and operators' contributions to 3GPP standards. It is also an indication of what the future telecom market will look like and who the major players will be.

Methodology

Research scope

The scope of this research consists of vendors' and operators' contributions to 3GPP standardization efforts within the following areas:

- Radio access network working groups: RAN 1, 2, 3, 4 & 5
- Service and systems aspects working groups: SA 1, 2, 3, 4, 5 & 6
- Core network and terminals working groups: CT 1, 3 & 4
- Fifth-generation technology: 5G
- Long-Term Evolution: LTE
- Narrowband Internet of Things: NB-IoT
- Enhanced machine-type communications: eMTC
- Vehicle to everything: LTE-V2X and 5G-V2X
- Ultra-reliable low-latency communications: URLLC
- Network slicing: slicing
- Industrial IoT: Industrial IoT, vertical local area networks (LANs), and nonpublic networks (NPN)
- 5G energy efficiency: energy efficiency, network energy savings, and user equipment (UE) power saving

Contribution in the above classifications that were submitted and approved within the period between January 2005 and June 2022 were considered relevant to this research.

Based on this timeframe, the following 3GPP releases are covered:

- Frozen releases: Releases 8–17
- Open releases: Release 18

Counting methodology

The count of contributions is based on the "TDoc Status" flag. TDoc Status is the latest status of the WI or SI. Many statuses are possible, depending on the decision made or action taken on the WI or SI. Examples include approved, agreed, and withdrawn.

For the sake of this research, all possible TDoc Status values were mapped to one of the following statuses:

- *Submitted* includes all possible statuses except withdrawn and revised.
- *Approved* includes approved, agreed, partially approved, endorsed, conditionally agreed, and conditionally approved.

Filters

Type

The following types of WIs were excluded from the count:

- Agenda
- Report
- Work plan
- Terms of reference

All other WI types were taken into consideration.

Technology

The field "Related WIs/SIs" was mapped to one of the following technologies: 5G, LTE, eMTC, NB-IoT, LTE-V2X, NR-V2X, URLLC, slicing, Industrial IoT, and 5G energy efficiency. The mapping was done using keyword matching. The examples are as follows:

- NR_newRAT, NR_eMIMO, NR_CPUP_Split → 5G
- E-UTRAN, eHNB, eMBMS → LTE
- NB_IOTenh → NB-IoT
- LC_MTC_LTE → eMTC
- FS_eV2XAPP → 5G-V2X
- eV2X, V2XLTE → LTE-V2X
- FS_NR_slice → slicing

- FS_5G_URLLC → URLLC
- FS_Vertical_LAN → Industrial IoT
- IIoT → Industrial IoT
- FS_EE_5G → energy efficiency

All other records that did not map to any of the above technologies were excluded. That includes Global System for Mobile Communications (GSM), Universal Mobile Telecommunications System (UMTS), and empty cells.

Assumptions

The source count is based on a multisource method as defined in the project scope. The multisource method means that for any WI or SI, more than one source can be counted as a responsible party:

- A vendor can be both a rapporteur and a contributor at the same time (within the same specification version).
- WI or SIs (records) with no valid 3GPP release are not included in the count per release.
- No WIs or SIs that preceded 3GPP Release 8 were taken into consideration.

Contributions analysis

This white paper analyzes vendors' and operators' contributions to the 3GPP standardization process. The analysis covers, primarily, two major technology domains: LTE and 5G. These domains are the major focus in all 3GPP meetings within the relevant timeframe. LTE and 5G are the primary technology generations for almost all mobile communication networks today.

Omdia analyzes companies' contributions on two main levels: rapporteur and WI/SI contributions. The rapporteur is responsible for organizing the WI or SI and driving the technical evaluation and the design and development of the technical specifications. Usually, the rapporteur is one of the proponents of the technical feature in the WI or SI. A WI or SI, on the other hand, is the result of every vendor's or operator's R&D efforts. It is the actual technical piece that makes up the 3GPP standard, if approved.

Every technology will be analyzed based on the two abovementioned levels. Besides 5G and LTE, other vertical technologies will be discussed. These verticals were chosen based on their potential impact and the importance of use cases in their respective domains.

Contributions analysis: 5G

A very important step in the development of wireless communication technologies, 5G not only enhances overall user experience but also enables other use cases that are speed hungry and latency intolerant.

The commercialization of 5G started in early 2019 and has since spread around the world. Today there are more than 200 commercial 5G networks globally.

From the standardization perspective, 5G has now reached maturity and the focus is shifting toward 5G Advanced with Release 18. This will bring further evolution to mobile broadband and vertical domain expansion in terms of both network and device evolution.

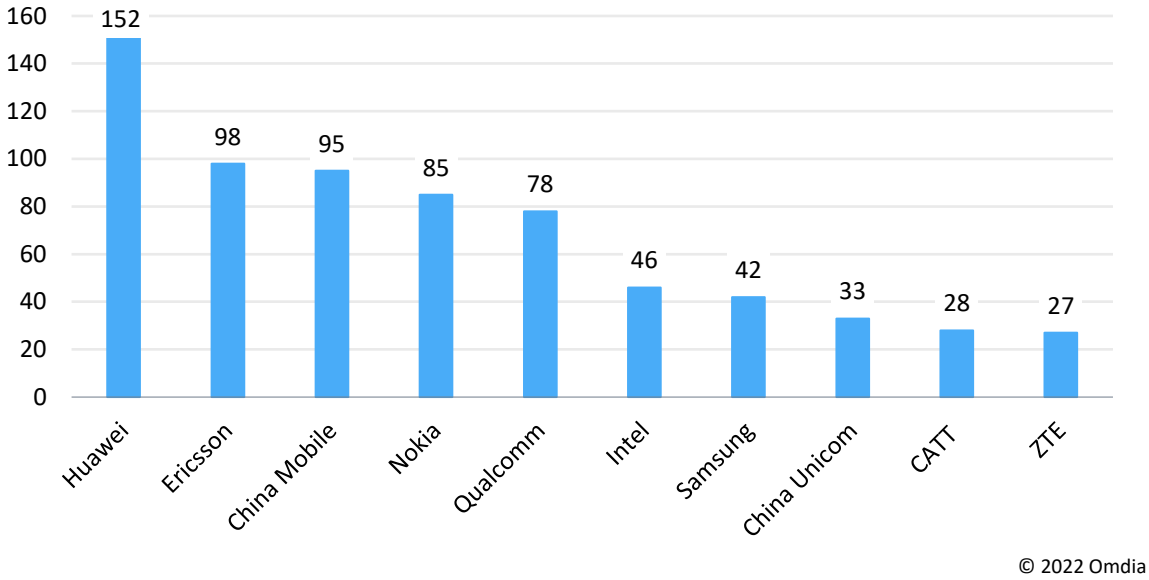
The following analysis will highlight the contributions made by the top vendors and operators within the 5G domain.

Analysis of rapporteurs: 5G

Figure 2 shows the top vendor/operator rapporteurs for 5G technical specifications groups.

During the 2015–1H22 period, the rapporteur role for 5G was dominated by Huawei with a total of 152 rapporteurs, followed by Ericsson (98), China Mobile (95), Nokia (85), and Qualcomm (78). More than 60% of rapporteurs came from these five companies.

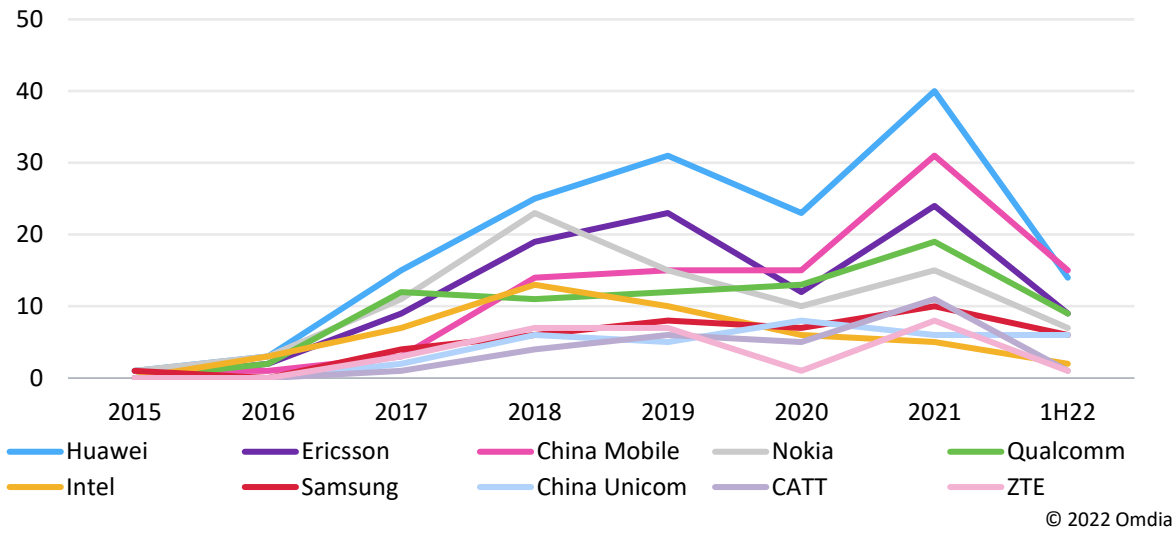
Figure 2: Number of 5G rapporteurs per vendor/operator between 2015 and 1H22



Source: Omdia

As shown in **Figure 3**, the number of rapporteurs started to increase from 2016 and rose until 2020, when it dipped because of the impact of the pandemic and the slowdown of activities. In 2021, the number of rapporteurs increased again. There were 229, more than double the number of rapporteurs in 2020. In 2022, the cumulative number of 5G rapporteurs passed the number of LTE rapporteurs. The leaders have essentially been the same year after year.

Figure 3: Number of 5G rapporteurs per vendor/operator per year, 2015–1H22



Source: Omdia

Analysis of submitted 5G contributions

The same companies and organizations that have been leaders in terms of rapporteurs have also been leaders in terms of contributions. Huawei and Ericsson were the leading 5G contributors with 17% and 14% respectively of all 5G contributions during the 2015–22 period. Together, the top 10 contributors represented 72% of all WIs and SIs related to 5G technology development.

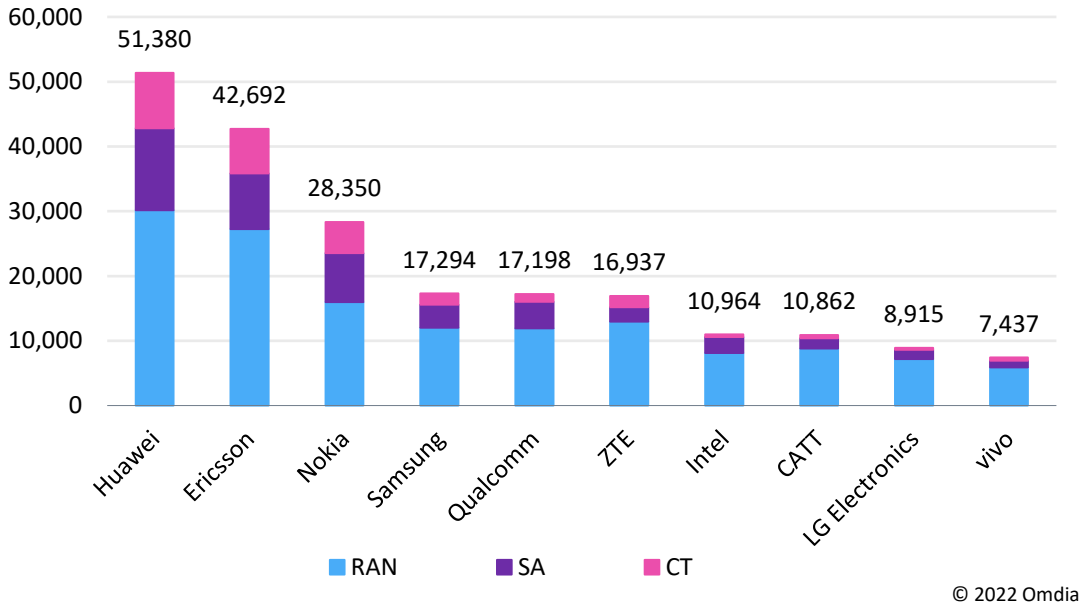
Network equipment vendors, terminal vendors, silicon companies, and service providers are the main contributors.

The RAN work group is responsible for radio access network layer 1-2-3, access network architecture, and interfaces. It has had the highest number of contributions.

Next comes the SA work group, which is looking after system architecture, network management and orchestration, security, application enablement, and so on. The CT work group, responsible for the mobile core network and terminals, comes last in the number of contributions.

As shown below, Huawei and Ericsson have been leading the RAN technical specification group (TSG). Combined, the two companies contributed 30% of the total number of 5G contributions in that TSG during the period. Their leadership was even more established in SA (34%) and CT (45%).

Figure 4: Number of submitted 5G contributions per vendor/operator per 3GPP TSG, 2015–1H22



Source: Omdia

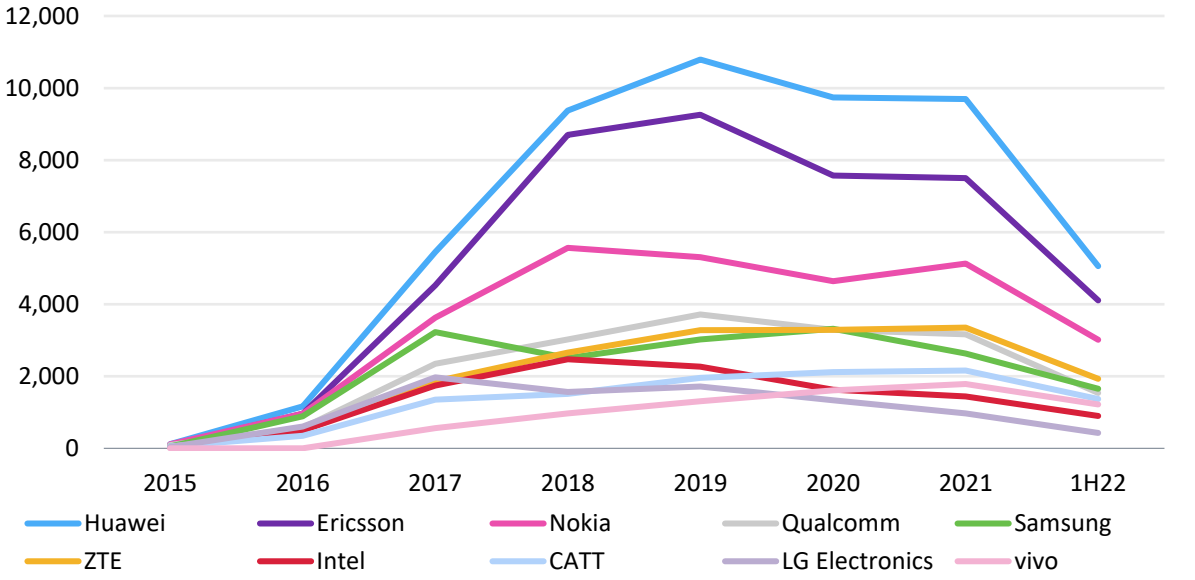
Table 1: Number of submitted 5G contributions per vendor/operator per 3GPP TSG, 2015–1H22

	Huawei	Ericsson	Nokia	Samsung	Qualcomm	ZTE	Intel	CATT	LGE	vivo
RAN	30,167	27,225	15,979	12,031	11,904	12,945	8,103	8,791	7,171	5,890
SA	12,651	8,610	7,557	3,568	4,117	2,232	2,469	1,618	1,452	1,021
CT	8,562	6,857	4,814	1,695	1,177	1,760	392	453	292	526

Source: Omdia

Contribution submissions for 5G were at their highest in 2019 with more than 62,000 in a single year. There were almost 57,000 contributions submitted each year in both 2020 and 2021, and more than 31,000 submissions were recorded during the first half of 2022.

Figure 5: Number of submitted 5G contributions per vendor/operator per year, 2015–1H22



Source: Omdia

Analysis of Approved 5G contributions

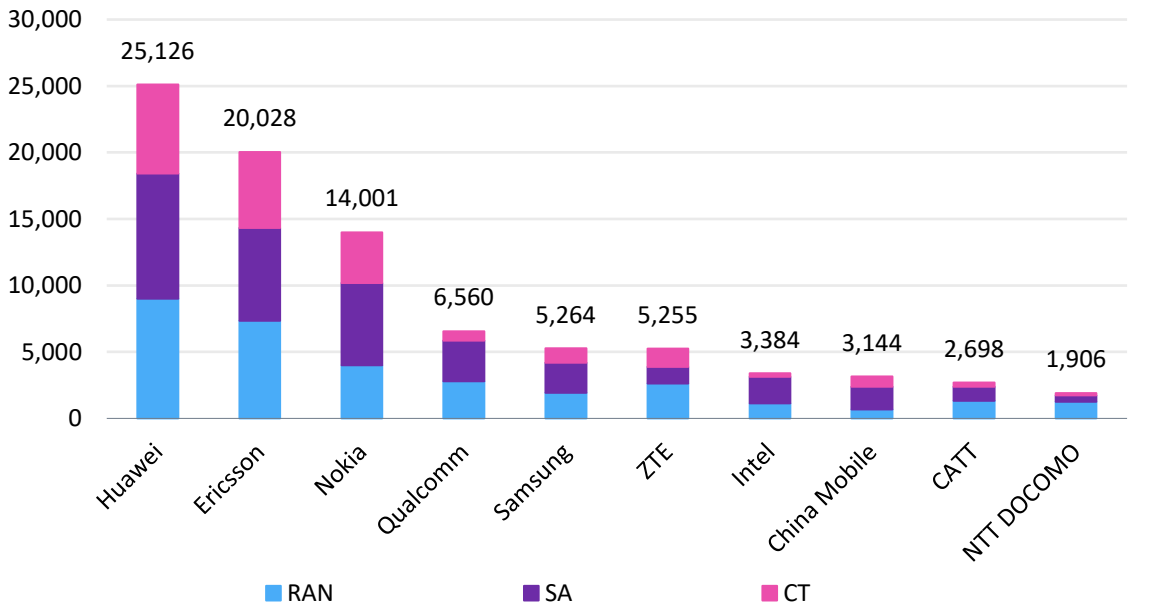
WI approval is an important milestone, after which the technical piece might be included as a standard part of the technology generation. It also gives the contributor the chance to patent the WI and later license it to others.

The top three contributors overall, Huawei, Ericsson, and Nokia, are unsurprisingly also the top three organizations when it comes to approved contributions with approximately 25,000 for Huawei, 20,000 for Ericsson, and 14,000 for Nokia. There is a second group of large contributors comprising Qualcomm, Samsung, and ZTE, which each have more than 5,000 approved contributions. The top 10 organizations shown in **Figure 6** had more than 1,000 approved contributions each, and there is a long tail of smaller contributors.

The TSG analysis for the approved 5G contributions shows a much higher percentage of approved contributions for SA (71%) and CT (72%) than for RAN (22%).

The ratio of approved to submitted contributions is also higher for the leaders than for their main followers. Huawei, Ericsson, and Nokia saw more than 45% of their submissions approved; for Qualcomm, Samsung, and Intel the proportion is between 30% and 40%. One group that tends to see a high percentage of submissions approved is service providers (China Mobile 45%, China Telecom 39%, Orange 86%, Vodafone 84%, Softbank 82%, China Unicom 66%, KDDI 66%).

Figure 6: Number of approved 5G contributions per vendor/operator per 3GPP TSG, 2015–1H22



Source: Omdia

Table 2: Number of approved 5G contributions per vendor/operator per 3GPP TSG, 2015–1H22

	Huawei	Ericsson	Nokia	Qualcomm	Samsung	ZTE	Intel	China Mobile	CATT	NTT DOCOMO
RAN	9,000	7,333	4,009	2,798	1,922	2,636	1,135	684	1,315	1,258
SA	9,410	6,998	6,181	3,053	2,259	1,242	1,986	1,705	1,081	472
CT	6,716	5,697	3,811	709	1,083	1,377	263	755	302	176

Source: Omdia

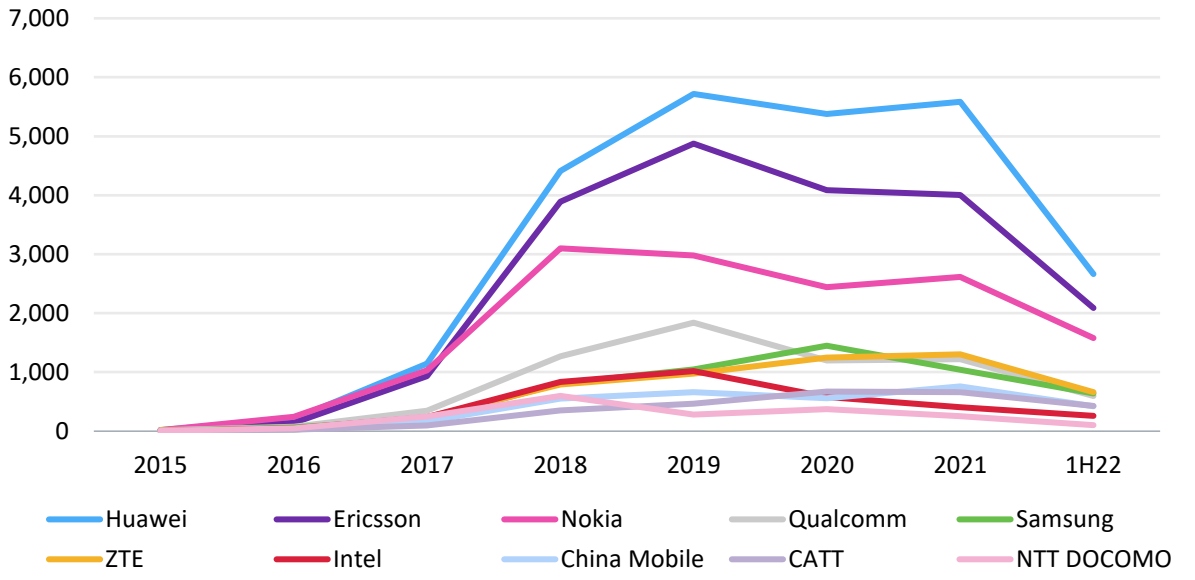
The chart for the yearly analysis of approved contributions essentially follows that for total contributions. The companies that led in total number of contributions also led in approved contributions.

Overall, since 3GPP started working on 5G, almost 139,000 proposals have been approved, 38% of all submissions.

As 5G standardization reached a certain maturity, the number of approved contributions started to decrease after 2019, but it has remained at a high level since with more than 23,000 contributions approved in the following two years. Even if many operators around the world have already

commercialized 5G, many standard WIs require some modifications and fine tuning, and standards continually evolve.

Figure 7: Number of approved 5G contributions per vendor/operator per year, 2015–1H22



Source: Omdia

Contributions analysis: LTE/EPC

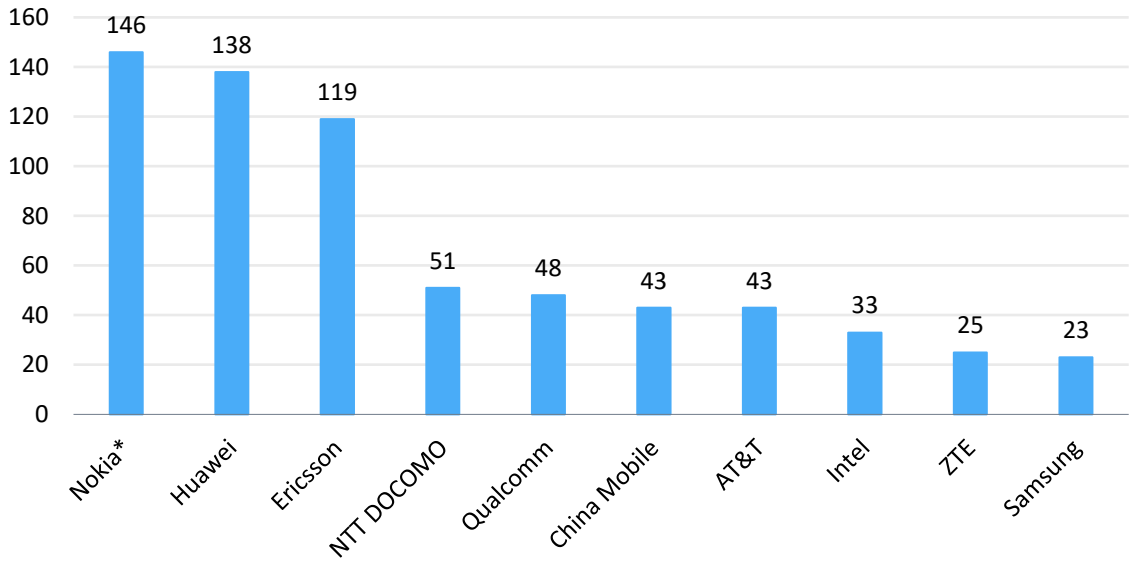
Analysis of rapporteurs: LTE/EPC

For LTE, the analysis considers the period from 2005 to the present.

During this entire period, the rapporteur role for LTE was dominated by Nokia with a total of 145 rapporteurs then Huawei (138), Ericsson (119), NTT DOCOMO (51), and Qualcomm (48). Nokia's contributions in fact represent the combination of the contributions from Nokia, Nokia Siemens Networks (NSN), and Alcatel-Lucent, acquired during the period.

As in the case of 5G, more than 60% of rapporteurs came from the top five companies, with the top three alone representing exactly 50% of the total.

Figure 8: Number of LTE/EPC rapporteurs per vendor/operator, 2005–1H22



Note: *Nokia, ALU, NSN

Source: Omdia

Not all operators have adopted 5G yet, and LTE continues to be deployed around the world, but from a 3GPP and standardization perspective, the LTE era is coming to an end. The number of LTE rapporteurs has been decreasing since 2015 (with a rebound in 2019), and this evolution reflects 3GPP's activities and the market switch to 5G.

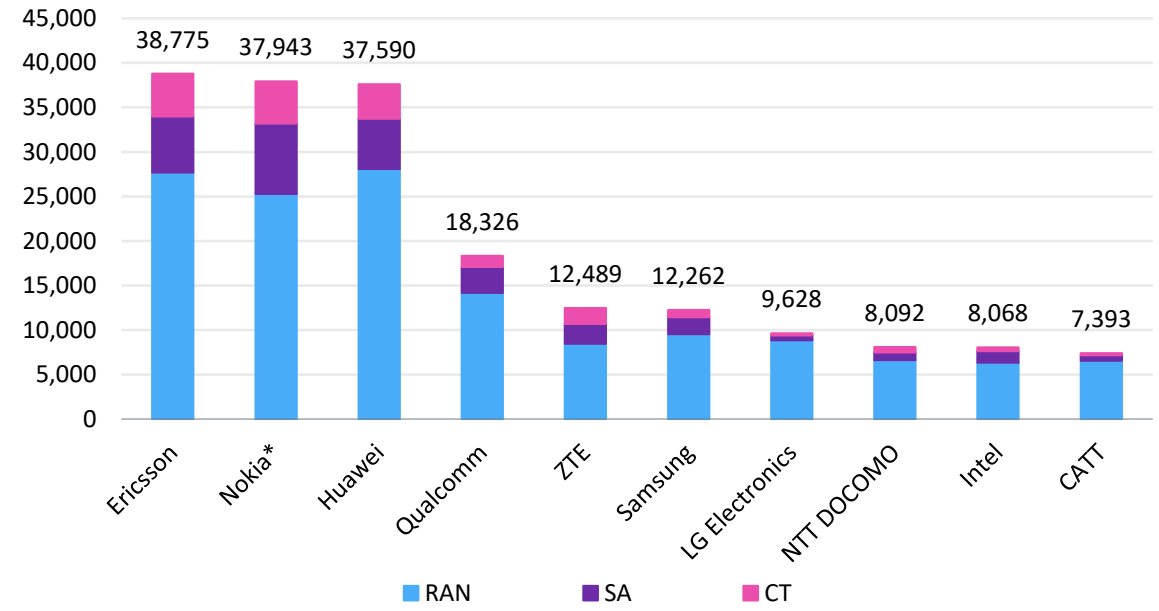
Analysis of submitted LTE/EPC contributions

As with 5G, the same companies and organizations that have been leaders in terms of rapporteurs have also been leaders in terms of contributions. Ericsson, Nokia, and Huawei were the leading 4G LTE contributors, each having 14% of all LTE contributions during the 2005–22 period.

Together, the top 10 contributors represented 69% of all WIs and SIs related to LTE technology development. Network equipment vendors, operators, terminal vendors, and silicon companies were the main contributors.

Also as with 5G, LTE TSG RAN received the highest portion of contributors' efforts. Combined, the top three companies contributed 42% of the total number of contributions in that RAN TSG during the period. But the leadership was more concentrated in SA (47% for the top three) and CT (54%) than in RAN.

Figure 9: Number of submitted LTE/EPC contributions per vendor/operator per 3GPP TSG, 2005–1H22



Note: *Nokia, ALU, NSN

Source: Omdia

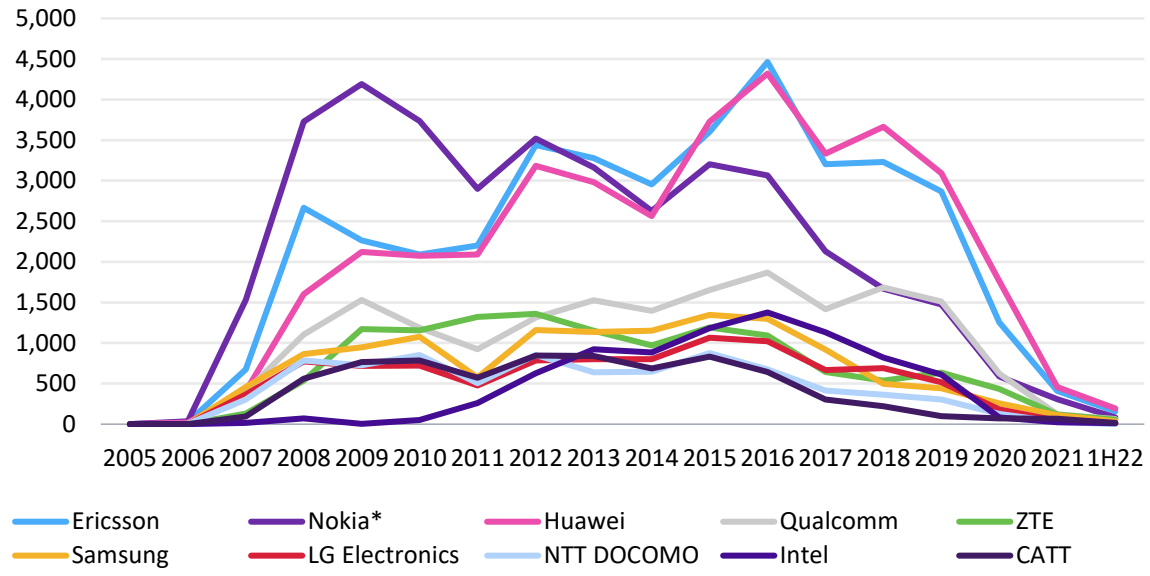
Table 3: Number of submitted LTE/EPC contributions per vendor/operator per 3GPP TSG, 2005–1H22

	Ericsson	Nokia*	Huawei	Qualcomm	ZTE	Samsung	LGE	NTT DOCOMO	Intel	CATT
RAN	27,678	25,285	28,085	14,172	8,439	9,536	8,826	6,616	6,316	6,550
SA	6,296	7,881	5,645	2,891	2,248	1,881	573	867	1,291	615
CT	4,801	4,777	3,860	1,263	1,802	845	229	609	461	228

Source: Omdia

Contribution submissions for LTE were at their highest in 2016 and then started to decline. The influence of Nokia* (a combination of Nokia, NSN, and ALU as explained above) started to decline after 2012, while Huawei's and Ericsson's share of the total increased. Other companies that were more influential in LTE than in 5G include NEC, Rohde & Schwarz, and Panasonic.

Figure 10: Number of submitted LTE/EPC contributions per vendor/operator per year, 2005–1H22



Note: *Nokia, ALU, NSN

Source: Omdia

Analysis of Approved LTE/EPC contributions

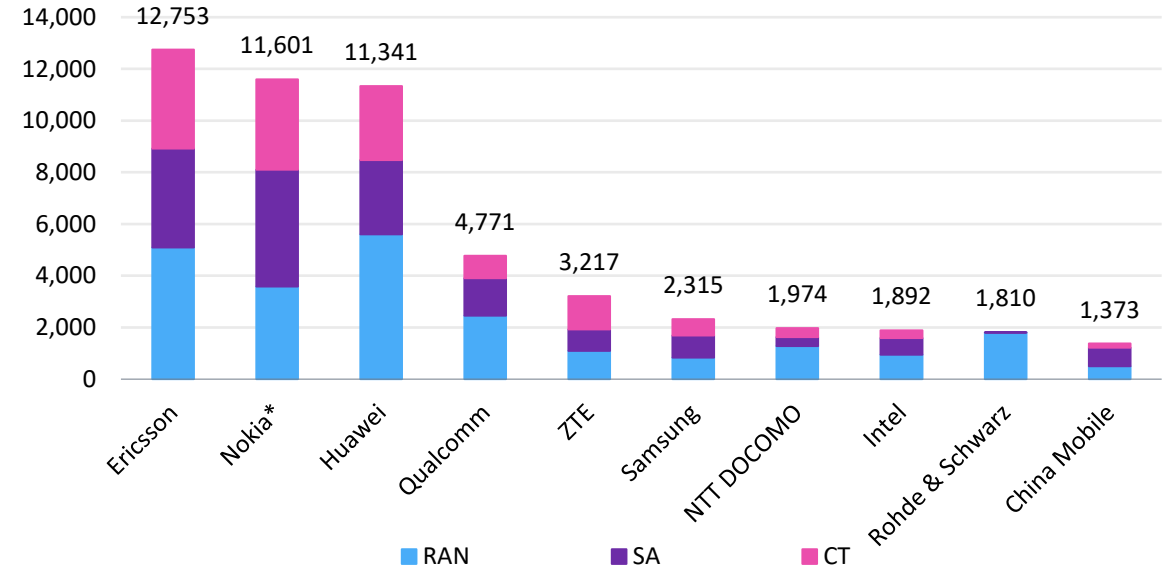
For LTE/EPC, Ericsson led in the number of approved contributions, followed by Nokia and Huawei, which each had more than 10,000 contributions approved.

There is a second group of large contributors comprising Qualcomm, ZTE, and Samsung, which have more than 5,000 approved contributions each. Fourteen organizations had more than 1,000 approved contributions each, and there is a long tail of smaller contributors.

Huawei led the TSG RAN in the number of approved contributions, while Nokia led TSG SA and Ericsson TSG CT. The TSG analysis for the approved LTE contributions again shows a higher percentage of approved contributions for SA and CT (56% and 73%) than for RAN (18%), as was the case for 5G.

The ratio of approved to submitted contributions is also higher for the leaders than for their main followers. Huawei, Ericsson, and Nokia saw more than 30% of their submissions approved; for Qualcomm, ZTE, and Samsung the proportion is between 19% and 26%. Even though there are exceptions, operators tend to see a higher than average percentage of submissions approved (China Mobile 33%, Orange 59%, Vodafone 38%, KDDI 37%, Deutsche Telekom 55%, Telecom Italia 48%).

Figure 11: Number of approved contributions per vendor/operator per 3GPP TSG, 2005–1H22



Note: *Nokia, ALU, NSN

Source: Omdia

Table 4: Number of approved LTE/EPC contributions per vendor/operator per 3GPP TSG, 2005–1H22

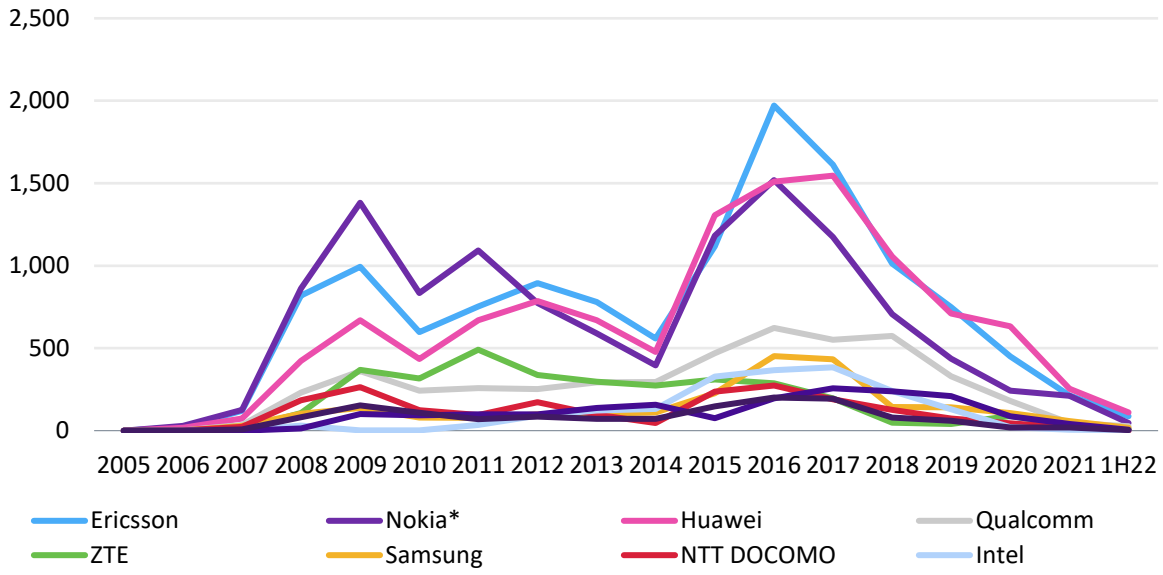
	Ericsson	Nokia*	Huawei	Qualcomm	ZTE	Samsung	NTT DOCOMO	Intel	Rohde & Schwarz	China Mobile
RAN	5,089	3,579	5,606	2,453	1,090	834	1,279	939	1,804	501
SA	3,829	4,523	2,874	1,449	829	857	351	645	6	715
CT	3,835	3,499	2,861	869	1,298	624	344	308	0	157

Source: Omdia

The chart for the yearly analysis of approved contributions essentially follows that for total contributions. The order can be different in certain years, but companies that lead in the total number of contributions generally also lead in approved contributions.

Overall, since 2005, almost 77,000 LTE/EPC-related proposals have been approved, which corresponds to 30% of all submissions, a lower ratio than the one observed for 5G (38%).

Figure 12: Number of approved LTE/EPC contributions per vendor/operator per year, 2005–1H22



Note: *Nokia, ALU, NSN

Source: Omdia

Verticals contributions analysis

Unlike older mobile communication generations, LTE and 5G empower a variety of vertical applications and use cases. These applications depend heavily on the underlying technologies of cellular networks, especially 5G. Network characteristics such as reliability, speed, latency, capacity, ability to prioritize traffic, and guaranteed quality of service are critical to these applications, and 5G provides the performance, robustness, and reliability needed for these use cases to exist.

In this section, Omdia analyzes vendors' and operators' contributions to the development of the standards related to these verticals as well as those related to network management and energy efficiency. As we did with 5G and LTE contributions, we will dive into the contributions made to each of the following categories: V2X (LTE and 5G), NB-IoT, eMTC, URLLC, industrial IoT, slicing, and 5G energy efficiency.

Contributions analysis: V2X

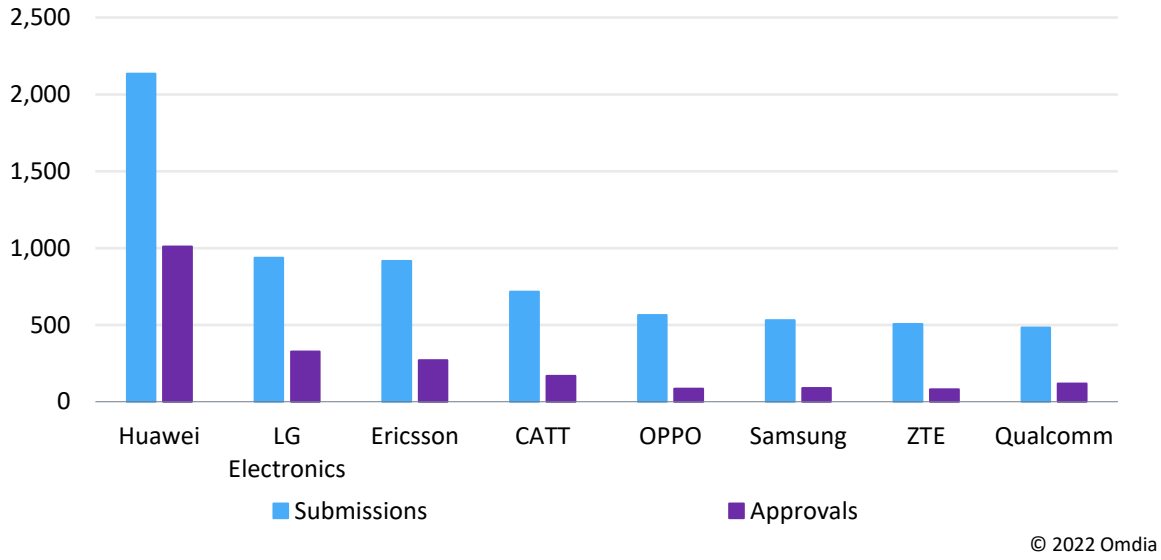
V2X is one of the most awaited 5G use cases. The contributions in V2X will enable the development of network standards for enabling and managing vehicles' communication with everything: vehicle to infrastructure (V2I), vehicle to vehicle (V2V), vehicle to network (V2N), and vehicle to pedestrian (V2P).

The V2X analysis is divided into two categories: 5G-V2X and LTE-V2X. As the name implies, 5G-V2X is related to V2X contributions in 5G WIs and SIs, and LTE-V2X is related to V2X contributions in LTE

WIs and SIs. The 5G-V2X analysis covers the period 2018–1H22, and that for LTE-V2X the period 2015–1H22.

Figure 13 and **Figure 14** show contributions submitted and approved by top contributors for 5G-V2X and LTE-V2X respectively. Huawei is at the top of the list for both 5G-V2X and LTE-V2X with more than 1,000 contributions approved for 5G-V2X and almost 700 for LTE-V2X. The top five for approved contributions for 5G-V2X is completed by LG Electronics, Ericsson, China Academy of Telecommunications Technology (CATT), and Qualcomm.

Figure 13: Number of 5G-V2X contributions per vendor/operator, 2018–1H22

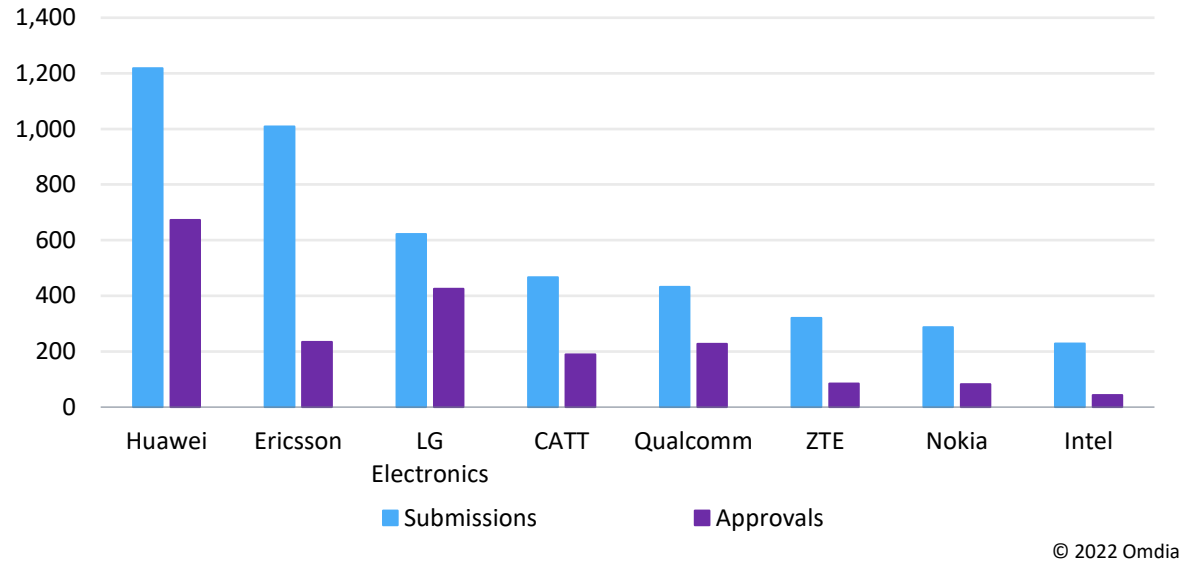


Source: Omdia

For LTE-V2X the top five for approved contributions is completed by LG Electronics, Ericsson, Qualcomm, and CATT.

It is worth mentioning that many contributors have been engaging in trials and demos that involve network equipment vendors, service providers, automotive manufacturers, chipset companies, and device manufacturers. These trials are critical to test the developed specifications and to help stakeholders demonstrate their V2X capabilities.

Figure 14: Number of LTE-V2X contributions per vendor/operator, 2015–1H22



Source: Omdia

Contributions analysis: NB-IoT and eMTC

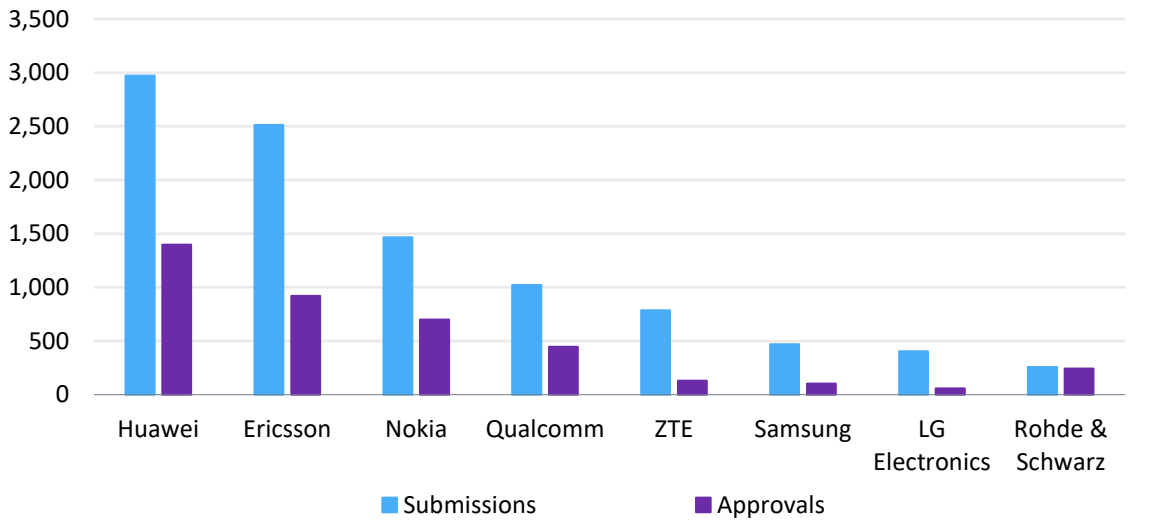
NB-IoT and eMTC are two categories related to IoT, or communications between devices other than smartphones. NB-IoT is focused on low-throughput, delay-tolerant use cases, and eMTC tackles more critical use cases such as cameras, moving sensors, and drones, to name a few. All these use cases need continuous reliable coverage that only a narrowband cellular network can provide.

The analysis below covers the work done during the period 2014–1H22. As is the case for 5G and LTE, a relatively small number of contributors account for the majority of contributions and approved submissions.

Figure 15 and **Figure 16** show contributions submitted and approved by top contributors. Huawei is at the top of the list for NB-IoT, followed by Ericsson, and for eMTC the two leaders are the same but in reverse order.

The top five for approved NB-IoT contributions is completed by Nokia, Qualcomm, and Rohde & Schwarz.

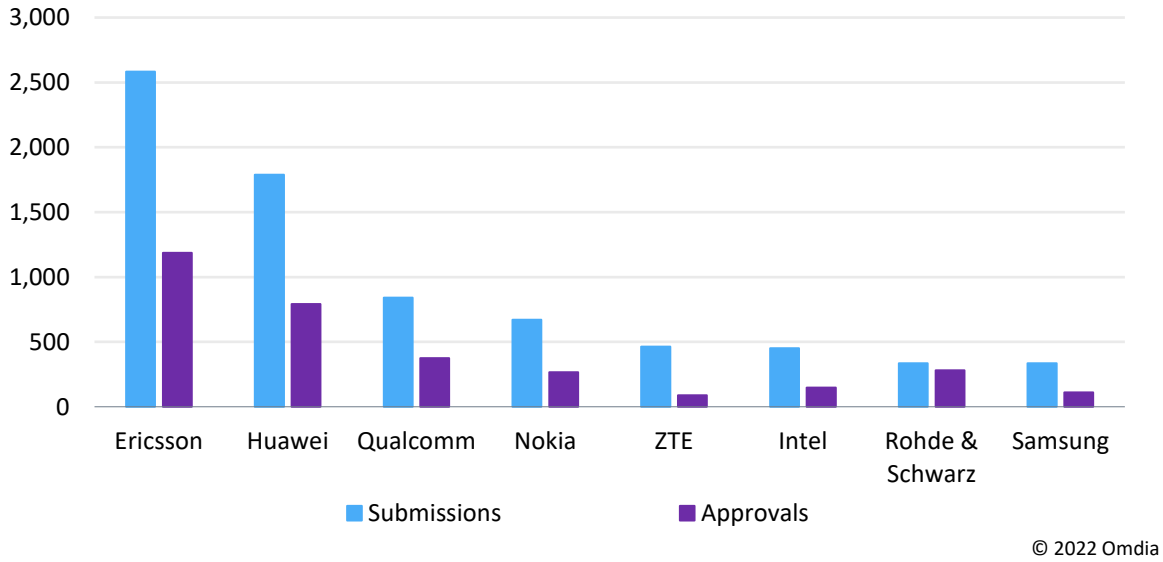
Figure 15: Number of NB-IoT contributions per vendor/operator, 2014–1H22



Source: Omdia

The top five for approved eMTC contributions is completed by Qualcomm, Rohde & Schwarz, and Nokia.

Figure 16: Number of eMTC contributions per vendor/operator, 2014–1H22



Source: Omdia

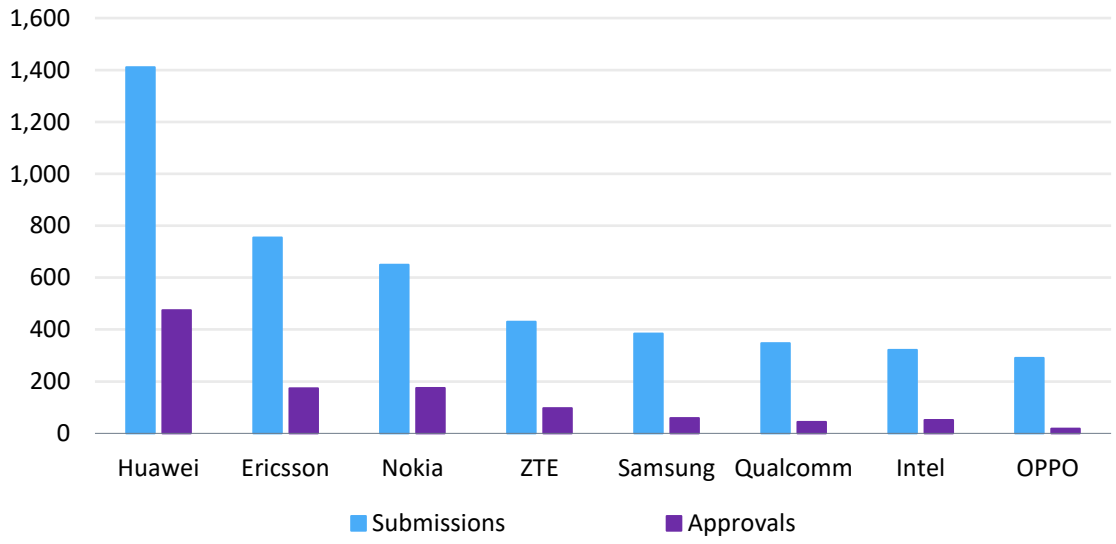
Contributions analysis: URLLC

URLLC is not in itself a use case or application, but URLLC is what makes 5G a suitable enabling technology for the critical use cases mentioned before. Although URLLC is an integral part of 5G, looking at related contributions separately provides some insights about vendors' and operators' contributions for 5G.

URLLC was introduced in 3GPP Release 15 and further enhanced in Release 16. The analysis below covers the work done during the period 2016–1H22.

The list of top contributors looks familiar in that it resembles those for other categories: the leading contributors by approved submissions are Huawei, Nokia, Ericsson, ZTE, and Samsung.

Figure 17: Number of URLLC contributions per vendor/operator, 2016–1H22



Source: Omdia

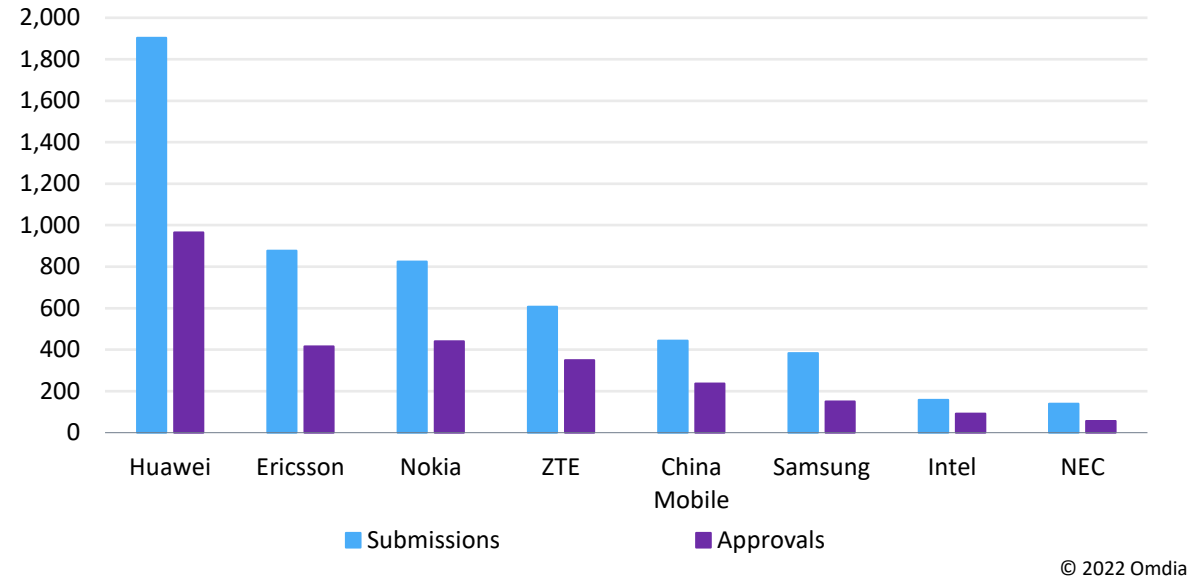
Contributions analysis: slicing

Network slicing is key to better network monetization. It leverages software-defined networking (SDN) and network functions virtualization (NFV) to create virtual network slices that act as dedicated networks over the same physical infrastructure.

The objective is to offer different levels of service on each slice to cater for different services and clients' requirements. For instance, one network slice can be given priority over others in resource allocation if the application served by that slice is critical. Moreover, network slices can be dynamically created to serve temporary needs or events.

Figure 18 illustrates the top vendors' contributions to the development of network slicing. Huawei leads the group with almost 1,000 approved contributions and is followed by Nokia, Ericsson, ZTE, and China Mobile.

Figure 18: Number of slicing contributions per vendor/operator, 2016–1H22



Source: Omdia

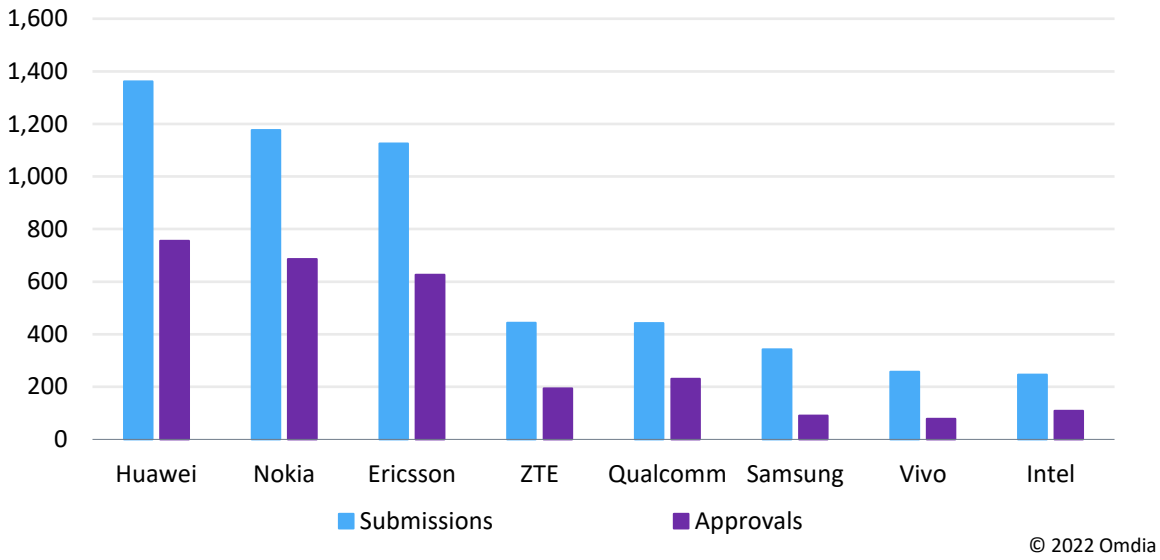
Contributions analysis: Industrial IoT

The concept of private cellular networks started with LTE and is now evolving with 5G. Vertical LANs are private 5G networks that can have many use cases including unserved locations and premises with mission-critical requirements. Vertical LAN brings the speed and reliability of 5G technology to a more controlled environment. It can be built on licensed or unlicensed spectrum. And Release 17 expands the 5G system support for Time Synchronization and Time Sensitive communications for any application.

This category includes vertical LAN, industrial IoT and non-public networks (NPN) and the analysis covers the period 2016–1H22.

In the previous version of this report, Nokia was the leader for this category; as of 1H22 it is Huawei that has become the leader with more than 1,360 contributions and more than 750 submissions approved. Nokia, Ericsson, Qualcomm, and ZTE complete the top five.

Figure 19: Number of Industrial IoT contributions per vendor/operator, 2016–1H22



Source: Omdia

Contributions analysis: 5G energy efficiency

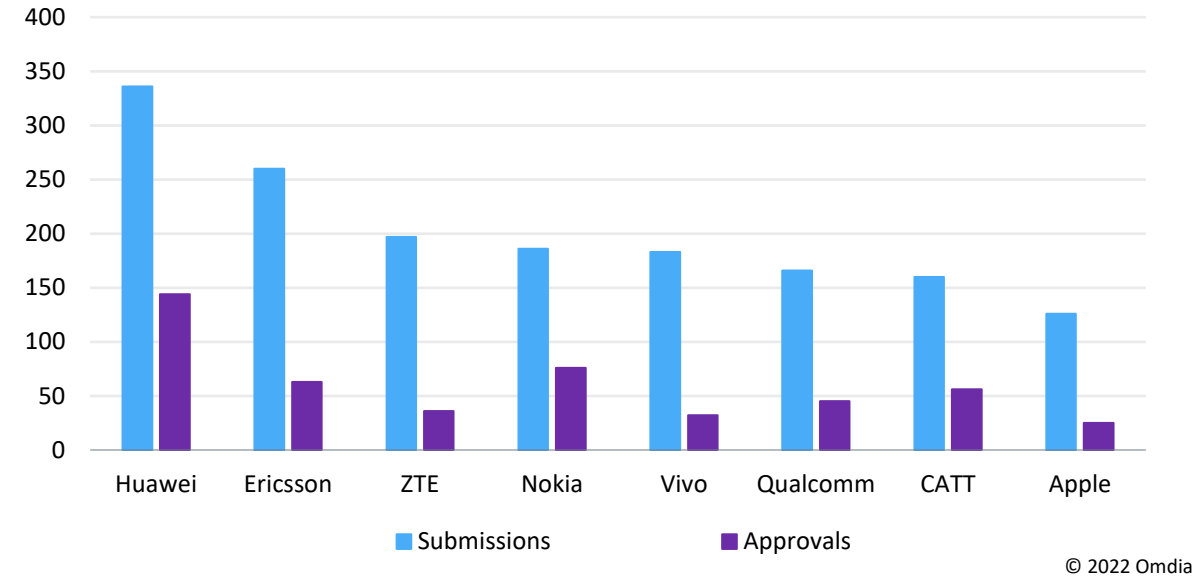
Sustainability and environmental responsibility are a priority for society, consumers, and enterprises. At both the network and the terminal level, 5G must provide enhanced performance and latency while improving energy efficiency. ITU-R defined energy efficiency as one of the minimum technical performance requirements for IMT-2020 and highlighted the need to achieve efficient data transmission in loaded scenarios as well as low energy consumption when there is no traffic.

One of the items of particular interest is UE power saving. Besides environmental responsibility, UE battery life is an important consideration for users and one that influences the adoption of 5G New Radio (5G NR) handsets and services, so it is absolutely critical to ensure the best possible UE power efficiency. UE power-saving items are related to terminal power-saving schemes and the associated procedures.

For this analysis Omdia also considered items related to network energy efficiency and management, which were combined under this 5G energy efficiency category.

More than 3,000 submissions were counted for this analysis, of which more than 900 were approved. The top five organizations for approved submissions were once again led by Huawei, followed by Nokia, Ericsson, CATT, and Qualcomm.

Figure 20: Number of 5G energy efficiency contributions per vendor/operator, 2015–1H22

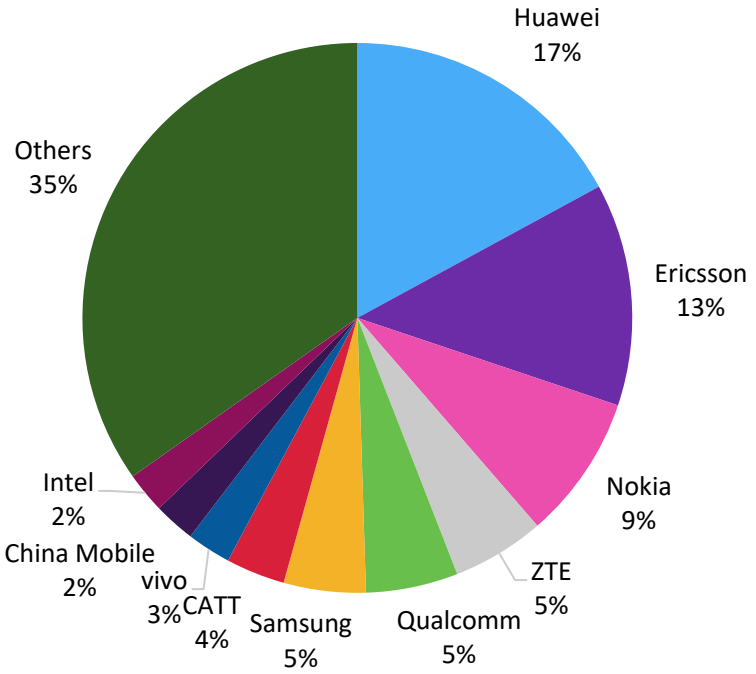


Source: Omdia

The third release of 5G specifications, 3GPP Release17, was put under pressure because of COVID-19 restrictions, but it was eventually successfully frozen on time thanks to experts' efforts. Release 17 is perhaps the most versatile release in 3GPP history in terms of content. But despite the large number of new features, planned timelines were met.

As **Figure 21** shows, Huawei, Ericsson, and Nokia combined contributed 39% of WI and SI submissions in Release 17, and together the top 10 contributed 65% of the total. This is another indication of how dominant a small number of companies are.

Figure 21: 3GPP Release 17 contributions submitted per vendor/operator



Source: Omdia

Conclusion

Omdia analyzed all the major work being accomplished by 3GPP, namely the two major technology generations of 5G and LTE and the most promising subtechnologies of V2X, NB-IoT, eMTC, URLLC, slicing, and Industrial IoT as well as 5G energy efficiency.

From this analysis, we can conclude that the market leaders we identified in the previous version of this report are still holding their positions in most of the areas mentioned above. Overall, Huawei, Ericsson, and Nokia together contributed 46% of all WIs and SIs submitted to 3GPP and 56% of those approved in the past two years. These vendors have dedicated important resources and budgets to research and development over the years, and this is the root of their continuing leadership.

Appendix

Research objective

The purpose of this research is to gain insight into the level of contribution made by telecom vendors and operators in the development of 3GPP standards including 5G and other vertical technologies.

Research approach

This research is based exclusively on data collected from the 3GPP libraries. The data highlights the contributors for all work done within the 3GPP standardization process. For every meeting conducted, there is a comprehensive list of all work done during the meeting and the vendor(s)/operator(s) responsible for the work. The research is based primarily on these lists, namely TDoc_List files.

TDoc_List filename structure: TDoc_List_Meeting_XXXX#XX.xlsx (working group#Meeting number)

Sampling method

The data sample used for the purpose of this research falls within the following criteria:

- Belong to working groups: RAN 1, RAN 2, RAN 3, RAN 4, RAN 5, SA 1, SA 2, SA 3, SA 4, SA 5, SA 6, CT 1, CT 3, CT 4
- Treated between January 2005 and June 2022

Data extraction and transformation methods

Following data extraction, data transformation was conducted to overcome any inconsistencies and irregularities such as spelling mistakes and incompleteness. Data transformation also took into consideration merger and acquisition activities that took place within the relevant timeframe. The following techniques/technologies were used to transform the collected data:

- "R" programming language was used to combine data from several TDoc_List files, filter out irrelevant information, add missing fields, and group records based on different grouping criteria such as technology, year, release, and working group.
- Some manual effort was made to overcome data inconsistencies such as spelling mistakes and the use of abbreviated names.

Microsoft Excel pivot tables were used to develop counts based on technology, year, release, and other classifications.

Counting methodology

The count of contributions is based on each record's status, namely "TDoc Status." Whenever a record matches the status of *submitted* or *approved*, a record is added to the respective count. All counted records are then grouped by company name, technology, year, and release.

Challenges

There were many challenges during this research, all of which can be attributed to data inconsistencies. Data on the 3GPP is highly inconsistent in many forms. Data in Tdoc_List files lacks uniformity in terms of format, completeness, and other factors. For instance, misspelled companies' names were a common problem, which if not addressed, would lead to an inaccurate count. Other companies' names were written without proper separators, which made it extremely difficult to apply automated methods to separate the names for counting.

Error rate

Because of the above challenges, counting inaccuracy exists at many levels. We expect an error rate that ranges between 0.15% and 1.5%.

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