Investigation report on candidates for 5G standard essential patents (5G-SEP) and standardization contributions (excerpted version)

Purpose and Background

The 5th generation mobile radio communication system (hereinafter abbreviated as 5G), which is the next generation communication standard, is currently being studied vigorously at the 3rd Generation Partnership Project (3GPP) which is the standards organization. The study result is approved as the ETSI standard, and Rel 15, where 5 G can be implemented, is nearly completed in September of last year and FINAL is assumed to be June 2019. Since it is still under consideration, it will lack of fairness to evaluate only for patents declared in ETSI in November last year because there are companies and patents that have not declared yet due to differences in thinking on leading declarations by leading companies.

Meanwhile, in addition to conventional high-speed and large capacity requirements, 5G has been working on super low latency for automobile and medical industries, multi terminal connection for smart city and social infrastructure maintenance. The expectation for grasping standardization trends and standard essential patent trends is growing even outside the telecommunications industry.

Under such circumstances, Cyber Creative Institute secured fairness, devised a new evaluation method to analyze trends of patent application targets that become 5G-SEP candidates with respect to technology unique to 5G, and analyzed trends of patent applications related to technology that is important in 5G and the company's focusing degree to 5G-SEP.

Also, in order to reinforce fair evaluation, we analyzed the proposal status of contributions proposed for standardization of 5G and analyzed the degree of focus of companies.

Below is a summary of the results.

< Importance of Standard Required Declaration Patent >

To provide 5G services and technologies, it is necessary to use many patents that conform to the standards. In order for the technology relating to our own patent application to be adopted in the standards, it is necessary to declare the factual FRAND condition for the patent application to the standardization bodies of each country. The 5G standards currently in progress at 3GPP are requested to ETSI as standards for approval when the discussion within 3GPP converges. An enterprise having a patent application conforming to the 5 G standards will satisfy the requirement that technology concerning the patent application be adopted as a standard by declaring its own patent application as ETSI standard essential patents. However, declarations as standard essential patents can be carried out by each company's own judgment, but evaluation of whether it is truly standard mandatory is required separately for each evaluation.

<Study Method>

The evaluation method invented by Cyber Creative Institute judges for patent applications to 15 technical areas indispensable for utilization in 5G whether it is a technology realizing 3GPP's 5G standards which are advanced in discussion. As a result, it is possible to judge the possibility of compliance with the 5G standard for patent applications for which the standard mandatory declaration to ETSI has not been implemented.

Study Contents

Since there are companies that have not been declared standard mandatory yet, the subjects of the survey were patents of patent families extracted using search expressions built on elemental technologies for realizing 5G. We evaluated the 5G conformance whether the patent includes 5G performance target and technical word, based on judgment criteria for rooting standards for 5G currently being studied and keywords etc.

The search system is Derwent Innovation, the patent to be searched is the world patent publication, the analysis unit is based on the INPADOC family base.

In addition, since this is the first survey to be released this time, based on the period when the 5 G discussion started, the survey target period was January 1, 2013 issue date to June 30, 2018 issue date. （Corresponding filing date: July 2011 - December 2016）

The following are element technologies.

No.	Element technologies
1	NOMA
2	Massive MIMO
3	Signal waveform
4	Unlicensed band use
5	Frame structure
6	Data flow aggregation (multiple connectivity)
7	Separation of C and U planes
8	URLCC realization
9	Network slicing / NFV
10	Initial access related
11	5G reference signal related
12	Millimeter wave band support
13	Flexible duplex
14	mMTC/IoT related
15	D2D/V2X related

1. Number of patent application in the survey area and number of application for 5G-SEP candidate

The number of patent families to be surveyed was 29,697, among which 7,348 patent families judged to be 5G-SEP candidates. (24.7%)

2. Application transition of 5G-SEP candidate

It has nearly doubled every year from 80 in 2011, and it is close to 3,700 in 2016. The proportion of patents complying with the 5 G standard in the patents covered by the survey has also been on the rise, and in 2016 almost half of the patent families are becoming 5 G-SEP candidates.

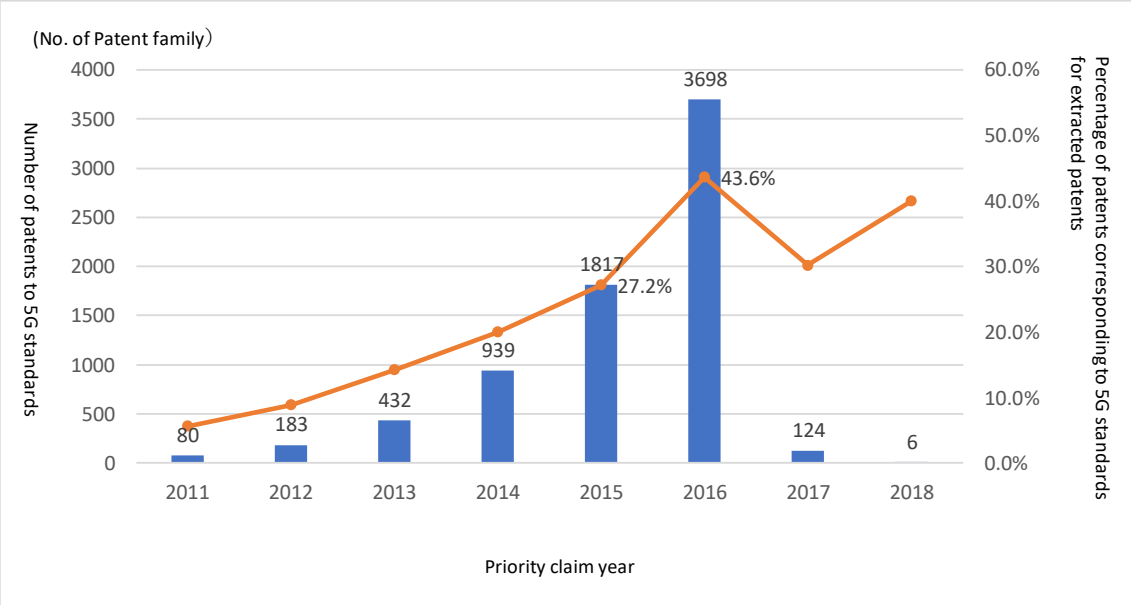

Figure 1 – Application transition of 5G-SEP candidate

3. Top 5G-SEP candidate application corporations

Figure 2 shows the top 5G-SEP candidate application companies. A patent by multiple companies is counted as one for each applicant.

In the graph, the total is 9000, but based on 7348 patents, the top 6 companies account for half of the total.

SAMSUNG, HUAWEI compete for the 1st and 2nd place. The top three companies are the same as the top three companies of the 2013 LTE standard mandatory declaration patent.

In domestic enterprises, NTT DOCOMO is ranked sixth (the leader as a carrier).

NTT DOCOMO, INTEL, SONY are newly added to the top 10 in comparison with the time of the survey in 2013.

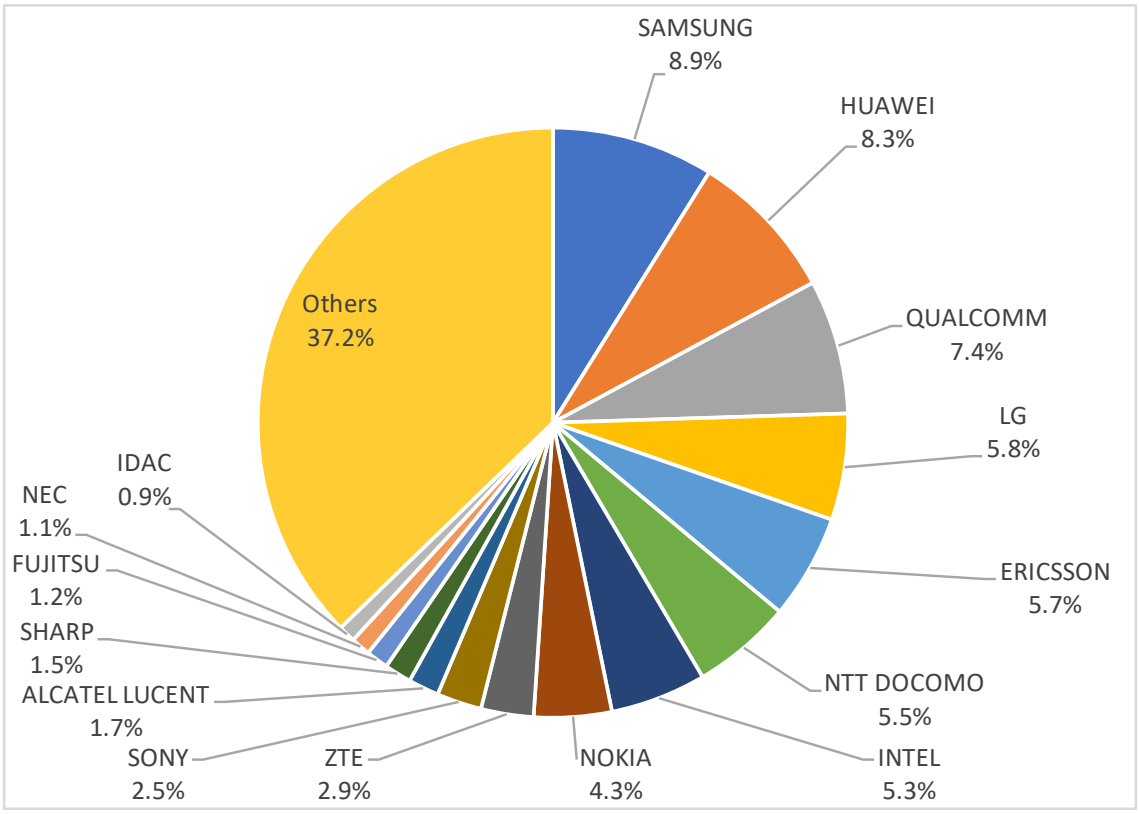

Figure 2 – The top 5G-SEP candidate application companies

4. Companies focusing on patent applications for 5G standards

The percentage of 5G-SEP candidates in the patents covered by the survey is 24.7% overall and 37% on average for the top ten.

Among the top 10 companies, NTT DoCoMo is ranked first with about 65%, then SUMSUNG is about 53%, and the degree of focus on 5 G can be seen.

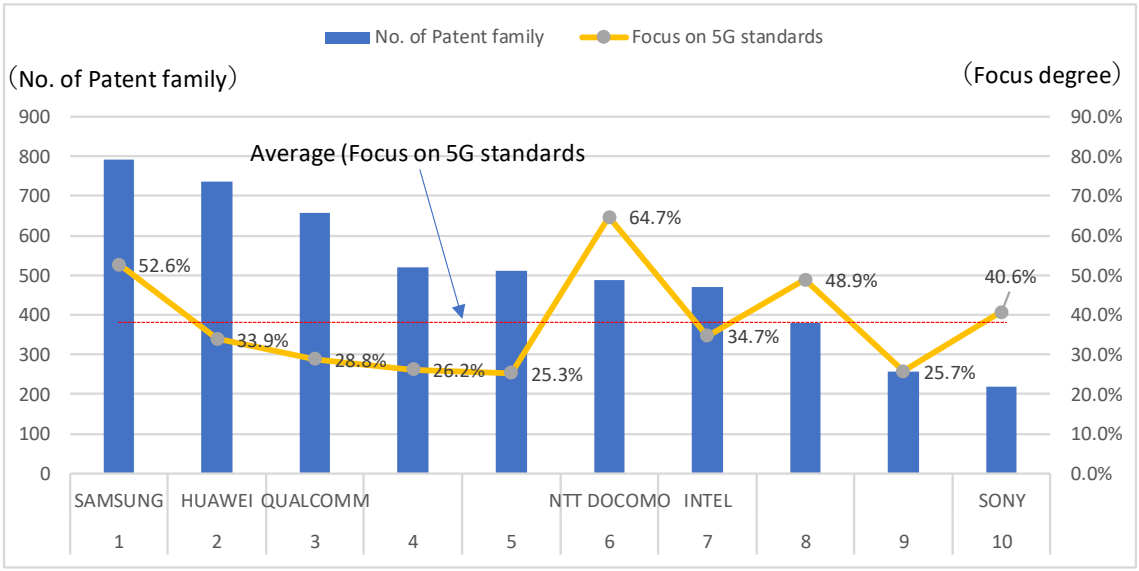

Figure 3 - Companies focusing on patent applications for 5G standards

5. 5G's attention technology (Ultra-low latency)

As a 5G technical item, analysis was conducted in all 48 items.

Furthermore, we analyzed these technical items by separating them into technologies that contribute to 5 G performance goal, high speed, large capacity, multiple terminal connection, and ultra-low latency.

As shown in Fig. 4, the number of patent families aimed at realizing ultra-low latency attracting attention is 646 cases. The growth is rapid.

In the technique of realizing means, the four technical items of frame structure, radio resource management, random access, and (H) ARQ (hybrid automatic repeat request) are top.

V2X and D2D could also be confirmed as keywords related to usage.

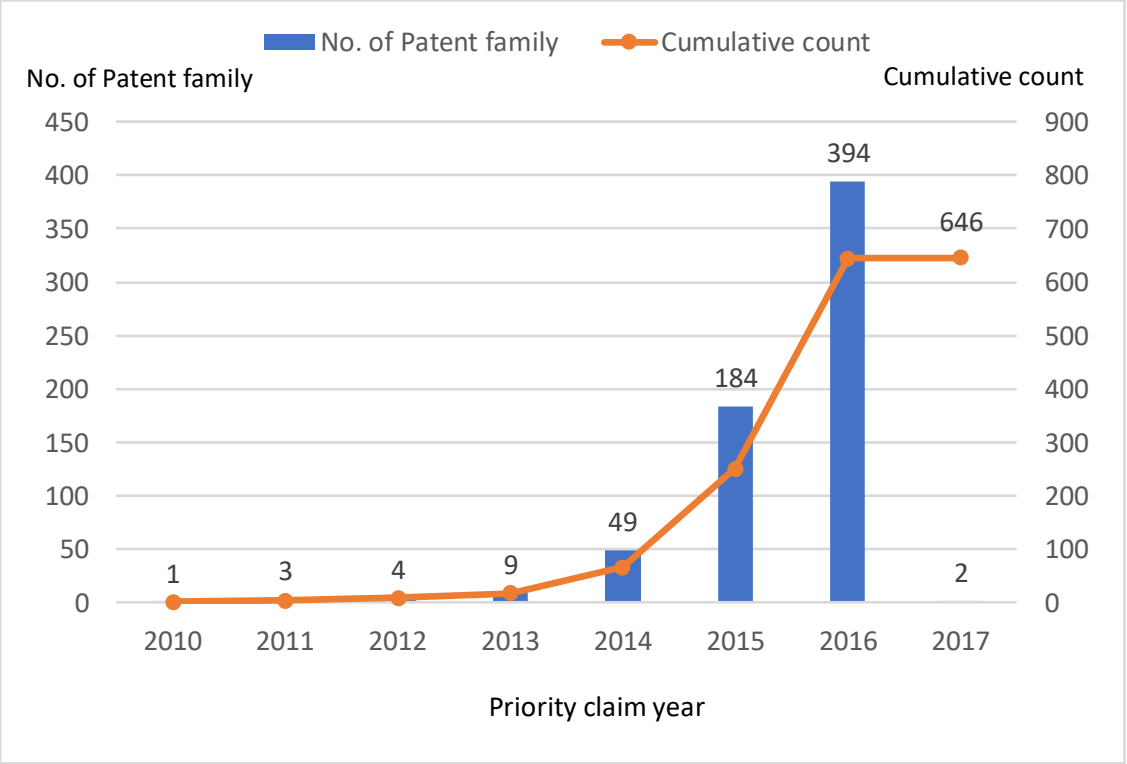

Figure 4 -Transition of patent family application to low latency issues

6. Focus area of major companies' 5G technology

We analyzed technology items that are No. of technical item within 10th place and No. of ttechnical item in the first place by applicants of the top six companies.

The investigation results are shown in Fig.5.

Samsung of No. 1 is within 10th place in the technical item of 40/48, and there are 12 items of 1st place. They are beam control, OFDM, CSI feedback from the item with the largest number of applications among the 1st item.

HUAWEI in 2nd place is within 10th place in 38/48 technical items, and there are 8 items in 1st place. Among the first ranking items, network slicing, nonorthogonal access control, MIMO are the items with the largest number of applications.

QUALCOMM in 3rd place is within 10th place with 40/48 technical items, and there are 8 items in 1st place. From the item with the largest number of applications among the 1st item, radio resource management, frame composition, and synchronization are found.

LG in the fourth place is within 10th place with 36/48 technical items, and there are three items in the 1st place. From the most items, the first place items are a reference signal, centralized arrangement, location registration / detection / decision.

ERICSSON in 5th is within 10th place in 38/48 technical items, and there are 4 items in 1st place. Mobility, system information notification, measurement, monitoring, and maintenance are the items with the largest number of applications among the first place items.

NTT DOCOMO in 6th is within 10th place with 25/48 technical items, and there are 3 items in 1st place. The number one rank items from many items are multi connection, Duplex and cell selection.

Rank	top six companies	No. of technical items within 10th place	No. of technical items in the first place
1	SAMSUNG	40	12
2	HUAWEI	38	8
3	QUALCOMM	40	8
4	LG	36	3
5	ERICSSON	38	4
6	NTT DOCOMO	25	3

Figure 5 - 5G technical area where the top applicants focus

7. Level of contribution to standardization

In the standardization of 3GPP, the number of contributions for 5G is about 120,000 from March 2016 to June 2018

Contributions by the top four companies including HUAWAI (19%), ERICSSON (15%), NOKIA (12%) covers more than 50% of overall contributions.

In domestic companies, NTT DOCOMO is the ninth place (leading as a carrier).

NTT DOCOMO (35%), CMCC (31%), and ORANGE (12%) are carriers that offer 5G services and are accounting for about 80%.

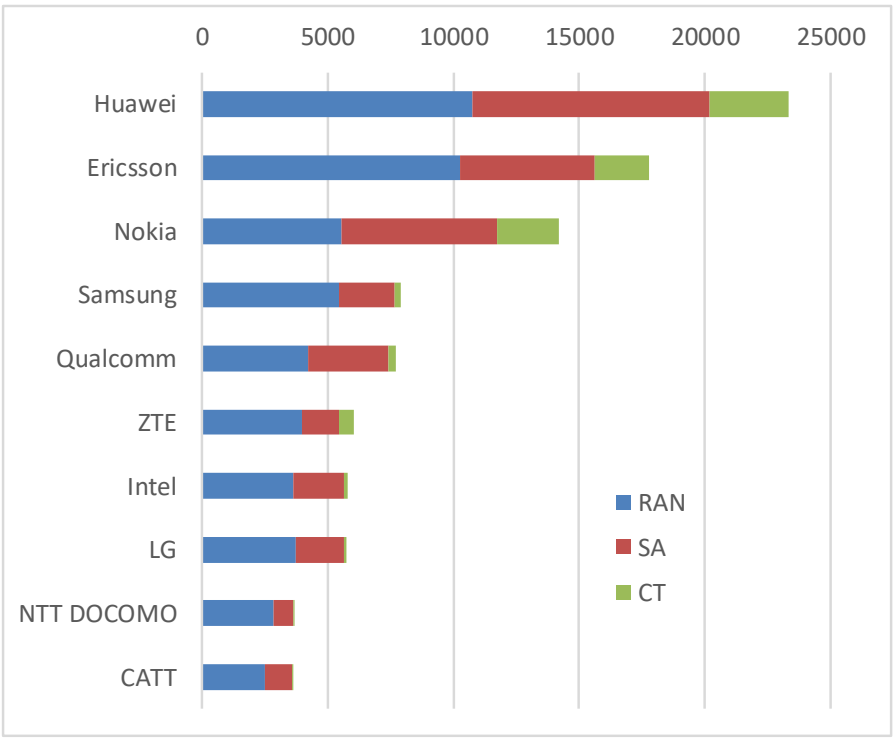

Figure 6 - Overall number of contributions

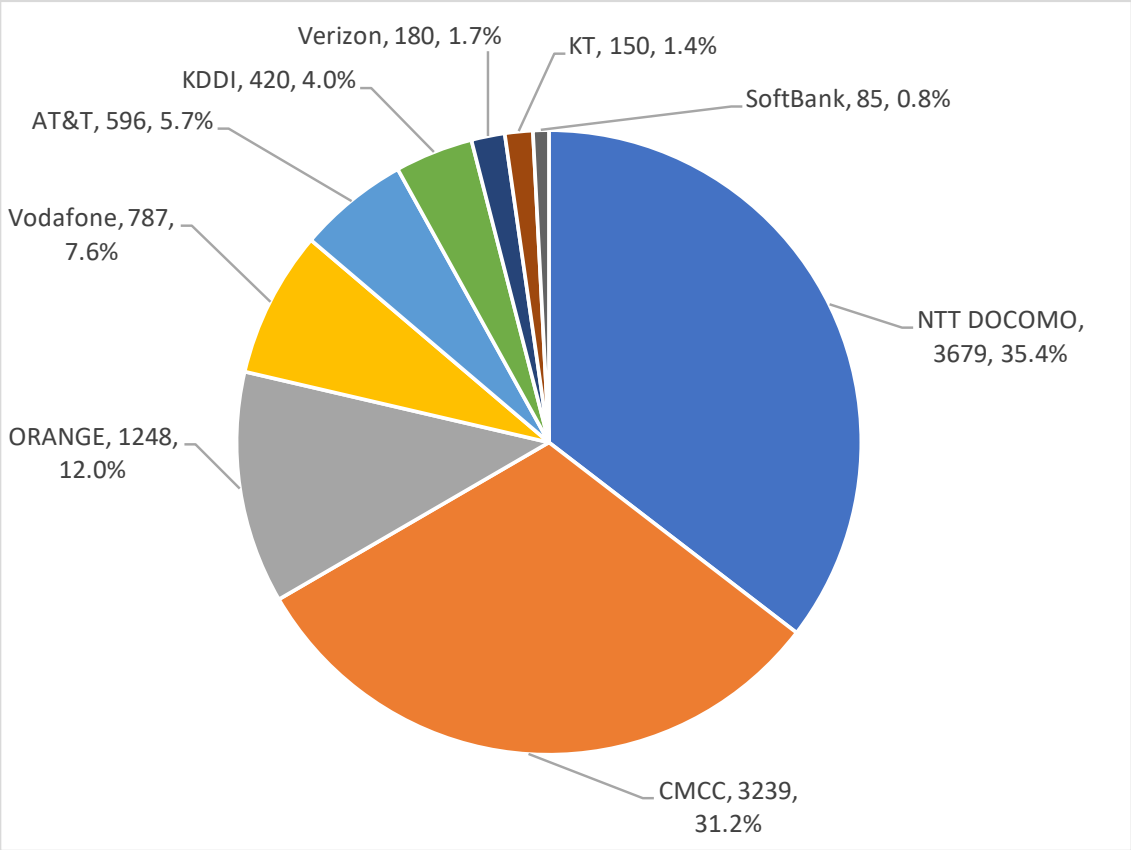

Figure 7 - Contributions by telecom carrier companies

【Service menu】

Survey report: Survey on overall trend, survey on trend by technology classification, survey on application trend of companies of interest etc.

Evaluation result sales: Patents list under the conditions specified by technology classification, applicant etc. (Option, patent overview, presence of ETSI declaration, etc.)

Individual requirements can be consulted。