

DEPARTMENT: MICRO LAW

Analysis of Historical Patenting Behavior and Patent Characteristics of Computer Architecture Companies—Part III: Claims

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Part I of this series analyzed the number and type of patents that were issued to 18 leading computer architecture companies for patents that were filed between 1996 and 2020. Part II analyzed the prosecution time and effective patent term length for those patents. This article builds on that work by analyzing the number and type of claims. Due to the large amount of claims-related data, Parts III and IV will focus on the claims. Part III is presented here and Part IV will be published in the September-October 2022 issue of *IEEE Micro*.

Table 1 lists the number of patents that were filed between January 1, 1996 and December 31, 2020 and that issued by March 31, 2022 for each of the 18 companies. The right-most column lists the number of computer architecture patents.^a

During this timeframe, some companies merged (e.g., Dell merged with EMC) or made significant acquisitions (e.g., Avago acquired Broadcom). In order to ensure that the results accurately reflect the present form of combined companies, this series included the merged or acquired companies if 1) the companies were computer architecture companies and/or 2) had a significant number of patents.

To improve readability, this article will refer to companies with multiple entities generally by the parent company's name. More specifically, this article will refer to AMD+ATI as "AMD," Dell+EMC+VMware as "Dell+

EMC," Marvell+Cavium as "Marvell," NXP+Freescale as "NXP," Renesas+Dialog+IDT+Intersil as "Renesas," and Via+Cyrus as "Via." In addition, this article will refer to Avago+Broadcom as "Broadcom" as the latter may be the more well-known company and the company that is more relevant with respect to computer architecture.

NUMBER OF CLAIMS FOR ALL ISSUED PATENTS

The claims define what is covered by a patent and what is not. Independent claims do not depend on another claim, i.e., they are "independent" of other claims. By contrast, dependent claims depend on at least one other claim and add at least one additional limitation to the parent claim. In other words, a dependent claim has all the limitations of the parent claim, plus the additional limitation(s) described in the dependent claim. As such, the scope of the dependent claim is smaller than that of the parent claim. Because independent claims are broader than dependent claims, the former is generally considered to be more valuable (at least with respect to infringement), but the advantage of the latter is that it may be valid over prior art (as the additional limitation may not be in the prior art), as compared to the independent claim, i.e., provide "validity protection." The total number of claims is the sum of the number of independent and dependent claims.

Table 2 shows the average numbers of total, independent, and dependent for each of the 18 companies, for all issued patents and for computer architecture patents. The numbers in parenthesis are the average number of claims for Apple, Microsoft, Samsung, and SiFive after excluding design patents. The effect of design patents is discussed in more detail below.

Table 2 shows that for all issued patents, the average number of claims per patent ranges from 13.8 (Renesas) to 29.6 (Qualcomm) claims with a median of 19.6 claims. In addition to Renesas, the companies with the lowest average number of claims are

^aAs used here, a patent is a "computer architecture" patent if it was classified in the 345, 708, 709, 710, 711, 712, 713, or 714 patent classes of the U.S. Patent Classification System or G06F, G06T, G09G, G11B, G11C, H03M, or H04L patent classes of the Cooperative Patent Classification System. These are the same patent classes used in prior articles.

TABLE 1. Number of all issued patents and computer architecture patents filed between January 1, 1996 and December 31, 2020, issued by March 31, 2022.

Company	All Issued Patents	Computer Architecture Patents
Amazon	16,383	9,271
AMD+ATI	11,189	4,631
Apple	27,967	12,283
ARM	2,782	2,372
Avago+Broadcom	14,757	6,295
Dell+EMC+VMWare	21,427	14,098
IBM	133,927	82,812
Intel	45,679	24,643
Marvell+Cavium	8,626	5,193
Microsoft	47,561	32,144
MIPS	273	271
NVIDIA	3,957	3,139
NXP+Freescale	11,831	3,742
Qualcomm	29,242	10,155
Renesas+Dialog+IDT+Intersil	14,384	4,403
Samsung	136,045	37,174
SiFive	14	9
Via+Cyrilx	1,981	1,325

Samsung (15.6) and IBM (16.2). To place that in context, those averages are approximately *half* of what the average number of claims is for Qualcomm (29.6). IBM and Samsung may have a relatively low number of claims because they prefer to split claims across two patents (instead of having all of those claims in one patent) in order to obtain as many issued patents as possible. This approach allows IBM and Samsung to increase their number of patents, with the tradeoff of having fewer claims per patent.

TABLE 2 SHOWS THAT FOR ALL ISSUED PATENTS, THE AVERAGE NUMBER OF CLAIMS PER PATENT RANGES FROM 13.8 (RENESAS) TO 29.6 (QUALCOMM) CLAIMS WITH A MEDIAN OF 19.6 CLAIMS. IN ADDITION TO RENESAS, THE COMPANIES WITH THE LOWEST AVERAGE NUMBER OF CLAIMS ARE SAMSUNG (15.6) AND IBM (16.2).

With respect to Renesas, not only does it have the lowest average number of claims per patent, it also has the lowest average number of independent claims (2.5) and dependent claims (11.3) per patent.

On the other end of the spectrum are Qualcomm (29.6 total claims) and MIPS (25.6), with Marvell (23.5) and Broadcom (21.2) third and fourth, respectively. With the exception of Qualcomm, these companies are in the middle to bottom of the pack in terms of the number of issued patents [Broadcom (ninth most patents), Marvell (13th), and MIPS (17th)]. This may indicate that companies that have fewer issued patents try to compensate for that by having more claims per patent.

The average number of independent claims for Qualcomm and MIPS (5.1 and 4.5, respectively) is significantly higher than the next closest companies, ARM, Intel, Marvell, and Microsoft (3.4 independent claims each). Interestingly, these results illustrate that similarly situated companies, in terms of the number of issued patents, have very different average numbers of independent claims. For example, Microsoft, Intel, and Qualcomm had the third, fourth, and fifth, respectively, highest numbers of issued patents, but the average number of independent claims for

TABLE 2. Average numbers of total, independent, and dependent claims for all issued patents and for computer architecture patents filed between January 1, 1996 and December 31, 2020, issued by March 31, 2022.

Company	All Issued Patents			Comp. Arch. Patents		
	Total	Indep.	Dep.	Total	Indep.	Dep.
Amazon	20.9	3.2	17.7	21.5	3.3	18.2
AMD+ATI	19.2	3.2	16.0	20.6	3.5	17.0
Apple	19.7 (22.4)	3.2 (3.5)	16.5 (18.9)	23.7	3.8	19.9
ARM	19.4	3.4	16.0	19.6	3.5	16.1
Avago+Broadcom	21.2	3.2	18.0	21.9	3.4	18.5
Dell+EMC+VMWare	18.9	3.3	15.6	19.4	3.4	16.0
IBM	16.2	2.9	13.3	16.5	3.1	13.4
Intel	19.9	3.4	16.4	20.9	3.7	17.2
Marvell+Cavium	23.5	3.4	20.1	24.0	3.4	20.6
Microsoft	18.6 (20.2)	3.4 (3.6)	15.2 (16.6)	20.2	3.7	16.5
MIPS	25.6	4.5	21.1	25.7	4.6	21.1
NVIDIA	20.1	3.3	16.8	20.4	3.4	17.0
NXP+Freescale	16.8	2.8	14.0	17.4	3.0	14.4
Qualcomm	29.6	5.1	24.6	30.1	5.2	24.9
Renesas+Dialog+IDT+Intersil	13.8	2.5	11.3	13.4	2.5	10.8
Samsung	15.6 (17.0)	2.7 (2.8)	13.0 (14.2)	17.9	3.2	14.7
SiFive	18.7 (21.7)	2.9 (3.2)	15.9 (18.5)	23.1	3.2	19.9
Via+Cyrix	17.0	2.8	14.3	17.7	2.9	14.8

Qualcomm is approximately 50% higher than the average numbers of independent claims for Intel and Microsoft. Similarly, Marvell, ARM, and MIPS had the 13th, 15th, and 17th highest numbers of issued patents, but MIPS had approximately 33% more independent claims per patent as compared to ARM and Marvell. This result may be important as independent claims may be more valuable than dependent claims as the former is broader in scope, which is important for infringement.

The fourth column of Table 2 shows that the average number of dependent claims per patent ranges from 11.3 (Renesas) to 24.6 (Qualcomm), with a median of 16.0. Dividing the fourth column (dependent claims) by the third column (independent claims) shows the ratio of the average number of dependent claims to the average number of independent claims. This ratio ranges between 4.51 (Renesas and Microsoft) and 5.98 (Marvell), with a median of 4.93. The fact that Renesas and Microsoft have the lowest ratios may indicate that these companies do not believe additional dependent claims necessarily provide enough validity protection to make additional dependent claims cost-effective. That said, one key difference between Renesas and

Microsoft is that the former has the lowest average number of independent claims while the latter has one of the highest. This may indicate that Microsoft is less concerned with validity protection than with having generally broader (i.e., independent) claims, or that Microsoft does not believe there is a cost-benefit advantage to having additional dependent claims.

By contrast, Marvell, SiFive, and Broadcom have the highest ratios (5.98, 5.55, and 5.54, respectively) of dependent claims to independent claims. This may indicate that these companies prioritize having more dependent claims for validity protection, which may further indicate that these companies believe that their patents exist within a crowded patent space and the additional dependent claims are necessary in order to differentiate their inventions from other patents. Finally, it is important to note that while SiFive has the second highest ratio of dependent claims to independent claims, because it has only 14 issued patents, SiFive having the second highest ratio may simply be an artifact of a small sample size.

It is important to note that the average numbers of total, independent, and dependent claims for Apple, Microsoft, Samsung, and SiFive are artificially lower

TABLE 3. Numbers of total, independent, and dependent claims for all issued patents filed between January 1, 1996 and December 31, 2020, issued by March 31, 2022.

Company	Total	Independent	Dependent
Amazon	342,862	53,137	289,725
AMD+ATI	214,982	35,532	179,450
Apple	551,355	89,702	461,653
ARM	53,937	9,538	44,399
Avago+Broadcom	313,039	47,854	265,185
Dell+EMC+VMWare	405,087	70,981	334,106
IBM	2,169,218	390,152	1,779,066
Intel	907,942	157,110	750,832
Marvell+Cavium	202,723	29,034	173,689
Microsoft	884,258	160,627	723,631
MIPS	6,992	1,240	5,752
NVIDIA	79,653	13,095	66,558
NXP+Freescale	198,806	33,179	165,627
Qualcomm	866,514	147,919	718,595
Renesas+Dialog+IDT+Intersil	198,029	35,971	162,058
Samsung	2,129,036	362,792	1,766,244
SiFive	262	40	222
Via+Cyrix	33,739	5,469	28,270

due to the relatively large percentage of design patents^b that were issued to each company (12.7%, 8.3%, 8.4%, and 14.3% respectively). Design patents, by definition, have only one total claim, an independent claim.

The numbers in parenthesis in Table 2 show the average numbers of total, independent, and dependent claims after excluding design patents for select companies. These results show that excluding design patents have a significant impact on the average numbers of total, independent, and dependent claims. For Apple, the total and independent claims increased by 13.6% and 9.1%, respectively, after excluding design patents, while corresponding percentages for Microsoft were 8.6% and 6.6%, Samsung were 8.6% and 5.0%, and SiFive were 15.8% and 10.8%, respectively.

Given the wide range in the average number of claims per patent and given that the claims define the invention, rather than counting the number of patents as a proxy for a company's innovativeness, counting

the number of claims may be a better proxy of innovation. Towards that end, Table 3 presents number of total, independent, and dependent claims in all issued patents filed between January 1, 1996 and December 31, 2020, issued by March 31, 2022.

TABLE 3 SHOWS THAT IBM HAS THE LARGEST NUMBER OF CLAIMS IN THIS TIMEFRAME, WITH SAMSUNG A CLOSE SECOND. THIS IS THE OPPOSITE OF THE ORDER IN TABLE 1, WHICH WAS BASED ON THE NUMBER OF PATENTS.

Table 3 shows that IBM has the largest number of claims in this timeframe, with Samsung a close second. This is the opposite of the order in Table 1, which was based on the number of patents. The switch in the order between these two companies is due to the fact that Samsung had over 11,000 design patents, which have only one claim each. The difference in the number of claims

^bA design patent protects how an article looks, or its "ornamental appearance," while a utility patent protects how an article is used and works.

for IBM and Samsung is 40,182 while the difference in the number of independent claims between the two companies is 27,360 (also larger for IBM). In other words, most of the difference in the total number of claims between the two companies is due to the difference in the number of independent claims. Therefore, given that independent claims are broader than dependent claims, the gap between IBM and Samsung in terms of innovation—as measured by the number of claims—may be even greater than difference in Table 3 may indicate.

Intel and Microsoft also switched spots, with Intel rising one spot in Table 3, as compared to Table 1. The switch in the order between these two companies is due to the fact that Microsoft had almost 4,000 design patents, which have only one claim each, while the difference in the number of total claims was 23,684 claims. Interestingly, despite having fewer total claims than Intel, Microsoft has more independent claims (160,627 for Microsoft versus 157,110 for Intel).

Comparing the relative rank (from largest to smallest) of each company in Tables 1 and 3 show that two other companies, AMD and Marvell, went up in the rankings in Table 3. More specifically, AMD went from 12 in Table 1 to 10 in Table 3; Marvell went from up from 13 to 11 in Tables 1 and 3, respectively.

On the other hand, NXP dropped one spot (from 11 in Table 1 to 12 in Table 3) while Renesas dropped by three spots (from 10 to 13 in Tables 1 and 3, respectively). The drop for Renesas is not surprising given that it has the lowest average numbers of total, independent, and dependent claims.

NUMBER OF CLAIMS FOR COMPUTER ARCHITECTURE PATENTS

The rightmost columns in Table 2 shows that, for computer architecture patents, the average number of claims per patent ranges from 13.4 (Renesas) to 30.1 (Qualcomm) claims with a median of 20.5. In almost all cases, computer architecture patents have a higher average number of claims as compared to all issued patents. The only company that had a lower average number of patents for its computer architecture patents was Renesas. More specifically, the average number of claims for all issued Renesas patents was 13.8 claims, but for Renesas computer architecture patents, the average number was 13.4 claims. Because the average number of independent claims in both all issued Renesas patents and Renesas computer architecture patents is 2.5, the lower average number of claims in Renesas computer architecture patents is entirely due to a lower average number of dependent claims (11.27 for all Renesas patents and 10.83 for Renesas computer architecture patents). This may

indicate that Renesas believes that it needs fewer dependent claims for validity purposes.

THE RIGHTMOST COLUMNS IN TABLE 2 SHOWS THAT, FOR COMPUTER ARCHITECTURE PATENTS, THE AVERAGE NUMBER OF CLAIMS PER PATENT RANGES FROM 13.4 (RENEASAS) TO 30.1 (QUALCOMM) CLAIMS WITH A MEDIAN OF 20.5.

Comparing the middle columns with the rightmost columns in Table 2 shows that the companies that had largest difference in the average number of total claims for all issued patents and computer architecture patents were SiFive (4.4), Apple (4.0), Samsung (2.3), and Microsoft (1.6). The thing these four companies have in common is that they all have a significant number of design patents, which, as described above, artificially lowers the average number of total claims. After excluding design patents, the difference in the number of total claims for all issued patents and computer architecture patents drops to 1.4 for SiFive, 1.3 for Apple, 0.9 for Samsung, and 0.0 for Microsoft. Although the difference dropped after excluding design patents, SiFive, Apple, and Samsung still are among the companies with the top five largest differences (the other two companies are AMD (1.3) and Intel (1.0)).

Comparing the middle columns with the rightmost columns in Table 2 shows that the difference in the number of independent claims for all issued patents (excluding design patents) and computer architecture patents ranged from 0.01 (MIPS) to 0.36 (AMD), with a median of 0.2 claims. The reason that there is essentially zero difference for MIPS is because nearly all of MIPS's patents are computer architecture patents (271 of 273).

Finally, the fact that all companies—except for Renesas—have a higher average number of claims for their computer architecture patents appears to indicate that these companies believe it is worthwhile to have a higher number of claims for their computer architecture patents, either to have a broader scope and/or for additional validity protection. It may also indicate that they believe their computer architecture patents are more valuable, so they want to ensure they protect those inventions with a higher number of claims.

EFFECT OF EXCESS CLAIM FEE

Table 2 shows that the average number of total claims for most companies is very close to 20 while the average

TABLE 4. Average numbers of total and independent claims for all issued patents, excluding design patents, filed before and after December 8, 2004, that issued by March 31, 2022.

Company	Before December 8, 2004		After December 8, 2004	
	Total	Indep.	Total	Indep.
Amazon	35.5	4.6	21.4	3.3
AMD+ATI	19.2	3.2	19.3	3.2
Apple	28.5	5.3	22.1	3.4
ARM	23.4	3.3	18.9	3.5
Avago+Broadcom	23.4	3.8	20.6	3.1
Dell+EMC+VMWare	22.5	4.3	18.7	3.2
IBM	19.0	3.7	15.2	2.7
Intel	21.2	4.0	19.5	3.2
Marvell+Cavium	50.2	7.8	21.3	3.0
Microsoft	25.9	5.0	18.5	3.2
MIPS	28.4	5.6	23.4	3.7
NVIDIA	24.3	4.3	19.4	3.1
NXP+Freescale	17.5	3.1	16.7	2.8
Qualcomm	24.5	5.4	30.2	5.0
Renesas+Dialog+IDT+Intersil	15.0	3.1	13.4	2.3
Samsung	16.4	3.2	17.1	2.7
Via+Cyrix	16.2	2.8	17.8	2.7

number of independent claims is very close to three. One major reason for this is that after December 8, 2004, the U.S. Patent and Trademark Office started to charge fees for patent applications that had more than 20 total claims and/or three independent claims. Currently, for larger companies, the cost for each additional independent claim in excess of 3 is \$480 while the cost for each additional total claim in excess of 20 is \$100.¹ For context, the current fee for a utility patent application is \$320.

Table 4 shows the average numbers of total and independent claims for all issued patents, excluding design patents, filed before and after December 8, 2004. Table 4 does not show the average number of dependent claims as there is no excess claim fee specifically for dependent claims. Table 4 does not include SiFive as it did not have any patents filed before December 8, 2004.

The results in Table 4 show that the companies can be divided into three groups:

- 1) Average number of total (or independent) claims *above* the excess claim threshold of 20 total claims (or three independent claims) before and after December 8, 2004.

- 2) Average number of total (or independent) claims *above* the excess claim threshold of 20 total claims (or three independent claims) before December 8, 2004, but *below* the threshold after December 8, 2004.

- 3) Average number of total (or independent) claims *below* the excess claim threshold of 20 total claims (or three independent claims) before and after December 8, 2004.

Companies in the first group apparently believe that the cost-benefit of having a few additional claims above the thresholds is worth the associated excess claim fees. By contrast, companies in the second group apparently do not believe there is a cost-benefit of having a few additional claims above the thresholds as they reduced the average numbers of total or independent claims below the corresponding threshold after the excess claim fee took effect. Excess claim fees do not affect companies in the third group, as their average numbers of total and independent claims were already below the thresholds prior to December 8, 2004. By contrast, these companies may actually be able to slightly increase the average

numbers of total and independent claims without incurring the excess claim fees.

With respect to the *total* number of claims, companies in the first group include Amazon, Apple, Broadcom, Marvell, MIPS, and Qualcomm; companies in the second group include ARM, Dell+EMC, Intel, Microsoft, and NVIDIA; and companies in the third group include AMD, IBM, NXP, Renesas, Samsung, and Via. Of the companies in the third group, IBM and Samsung stand out because the fact that their total claims were below the threshold of 20 claims before and after December 8, 2004 could indicate that these companies prefer to have more patents with fewer claims than fewer patents with the same number of total claims. One potential advantage to having more patents, albeit with fewer claims, is that it helps those companies in the year-end rankings of the companies with the most patents. The potential disadvantage of such an approach is that because the second patent has a later issue date than the first patent, this reduces the damages the patentee can recover as a patentee can generally only recover damages only after the patent issues.

With respect to the number of *independent* claims, companies in the first group include Amazon, AMD, Apple, ARM, Broadcom, Dell+EMC, Intel, Marvell, Microsoft, MIPS, NVIDIA, and Qualcomm; companies in the second group include IBM, NXP, Renesas, and Samsung; and the only company in the third group is Via. The fact that more companies are willing to exceed the independent claim threshold (as compared to the total claims threshold) could indicate that these companies believe it is worth the additional fee for excess independent claims, despite the fact that that current excess independent fee (\$480) is significantly higher than the total claim fee (\$100).

For almost all companies, both before and after December 8, 2004, the average number of total and independent claims for computer architecture patents was higher than the corresponding number of claims for all issued patents. The notable exceptions were Amazon (1.3 more total claims for all issued patents filed before December 8, 2004), Microsoft (0.3 more total claims for all issued patents filed before December 8, 2004), and Renesas (on average 0.7 more total claims for all issued patents filed *after* December 8, 2004). The result for Amazon may be due to a relatively small sample size. More specifically, Amazon had only 175 issued patents and 46 computer architecture patents that had a filing date before December 8, 2004. As such, a larger sample size could have reduced or even completely eliminated any difference.

With respect to Microsoft, although the difference of 0.3 is relatively small, the fact that there is a

difference is particularly interesting because a very high percentage of Microsoft's issued patents were computer architecture patents. More specifically, of the 9,879 utility patents that Microsoft filed before December 8, 2004 that resulted in an issued patent, 7,841 of them were computer architecture patents (79.3%). But despite being only 20.7% of total number of issued patents, the noncomputer architecture patents still increased the average number of claims for all issued patents by 0.3 claims.

With respect to Renesas, it is unclear why its computer architecture patents have a lower average number of claims as compared to all of its issued patents. It may be that Renesas considers computer architecture patents to either be less innovative (and thus does not require as many claims to cover the invention) or are less important (such that adding additional claims is not worth it from a cost-benefit point-of-view).

TABLE 4 SHOWS THAT, FOR NEARLY ALL COMPANIES, THE AVERAGE NUMBERS OF TOTAL AND INDEPENDENT CLAIMS DECREASED SIGNIFICANTLY AFTER DECEMBER 8, 2004, WHICH INDICATES THAT MOST COMPANIES WERE UNWILLING TO PAY THE ADDITIONAL FEES.

Comparing the middle columns with the rightmost columns in Table 4 shows the difference in the average numbers of total, independent, and dependent claims for all issued patents filed before and after the excess claim fee became effective on December 8, 2004 (i.e., average number of claims for patents filed *after* December 8, 2004—average number of claims for patents filed *before* December 8, 2004) for all issued patents and for computer architecture patents only.

It is important to note that because the excess claim fee applies to the number of claims in the patent *application*, the results in Table 4 (which represent the number of claims in *issued* patents) underestimate the effect of the excess claim fee. The averages in Table 4 underestimate the number of claims that are in a patent application because applicants frequently abandon some patent claims during prosecution and thus those claims are never issued.

Table 4 shows that, for nearly all companies, the average numbers of total and independent claims decreased significantly after December 8, 2004, which

indicates that most companies were unwilling to pay the additional fees. For example, the average numbers of total and independent claims for Marvell decreased from 50.2 and 7.8, respectively, for patents that were filed before December 8, 2004 to 21.3 and 3.0, respectively, for patents that were filed after December 8, 2004. This represents a decrease of 57.5% and 61.4%, respectively, from the pre-December 8, 2004 averages. By reducing the average number of total claims from 50.2 to 21.3 and the average number of independent claims from 7.8 to 3.0, Marvell was able to save $(50.2 - 21.3) * \$100 + (7.8 - 3.0) * \$480 = \$5,194$ in excess claim fees for each patent (using the current excess claim fee rates). This is a significant amount given that the average cost to draft a patent application from scratch is around \$10,000 (not including filing and other PTO-related fees).² It is important to note that while the average number of total claims decreased significantly, the post-December 8, 2004 average is still above 20. By contrast, while the average number of independent claims also decreased significantly, the post-December 8, 2004 average is at 3.0. This could imply that while Marvell is willing to pay \$130 for the 1.3 additional claims over and above 20 total claims, it was unwilling to pay \$480 for an additional independent claim over and above three independent claims.

As a second example, the average numbers of total and independent claims for Amazon decreased from 35.5 and 4.6, respectively, for patents that were filed before December 8, 2004 to 21.4 and 3.3, respectively, for patents that were filed after December 8, 2004. This represents a decrease of 39.8% and 29.1%, respectively, from the pre-December 8, 2004 averages. This corresponds to a savings of \$2,034 per patent. But, as described above, this result may be due to a relatively small sample size for the pre-December 8, 2004 patents. Nevertheless, Marvell and Amazon are particularly notable examples of how adding excess claims fees affect companies' patenting behavior.

Table 4 also shows that, except for AMD, Qualcomm, Samsung, and Via, the average number of total claims decreased for the remaining companies, from a low of 0.8 (NXP) to a high of 7.4 (Microsoft). While the average number of total claims did not decrease for AMD, Samsung, and Via, because these companies were already below the 20-claim threshold, they were unaffected by the excess total claim fees.

Table 4 also shows that, except for AMD and ARM, the average number of independent claims decreased for the remaining companies, from a low of 0.4 (NXP and Qualcomm) to a high of 4.8 (Marvell). While the average number of independent claims for AMD and ARM increased after December 8, 2004, the

corresponding increases were very modest (0.1 and 0.2). That said, because both companies were already above the independent claim threshold before December 8, 2004, this makes even those relatively modest increases more noteworthy.

BUT RATHER THAN DECREASE THE AVERAGE NUMBERS OF TOTAL AND INDEPENDENT CLAIMS AS OTHER COMPANIES DID, QUALCOMM ACTUALLY INCREASED THE NUMBER OF TOTAL CLAIMS FROM 24.5 TO 30.2, WHILE SIMULTANEOUSLY DECREASING THE NUMBER OF INDEPENDENT CLAIMS FROM 5.4 TO 5.0.

Finally, rather than decrease the average numbers of total and independent claims, Qualcomm did the opposite. More specifically, before December 8, 2004, Qualcomm had an average of 24.5 total claims and 5.4 independent claims, which would have resulted in \$1,602 of excess claim fees if Qualcomm continued to have that many claims after December 8, 2004. But rather than decrease the average numbers of total and independent claims as other companies did, Qualcomm actually *increased* the number of total claims from 24.5 to 30.2, while simultaneously *decreasing* the number of independent claims from 5.4 to 5.0. This approach resulted in a net additional excess claim fees of \$378 (on top of the \$1,602 it would have incurred). These facts appear to indicate that Qualcomm strongly believes in having more claims per patent, as opposed to more patents, even if significantly increases its patent prosecution costs.

Finally, while not presented in Table 4, the data shows that the decrease in the average numbers of total and independent claims is generally larger for computer architecture patents than for all issued patents. For example, for Marvell, the decrease in the average number of total claims for computer architecture patents was -29.5 while the decrease in the average number of total claims for all issued patents was -28.9. While this may appear that these companies are trying to save money at the expense of computer architecture patents, this ignores the fact that the average numbers of total and independent claims for computer architecture patents is generally higher than the average numbers of total and independent claims for all issued patents both before *and after*

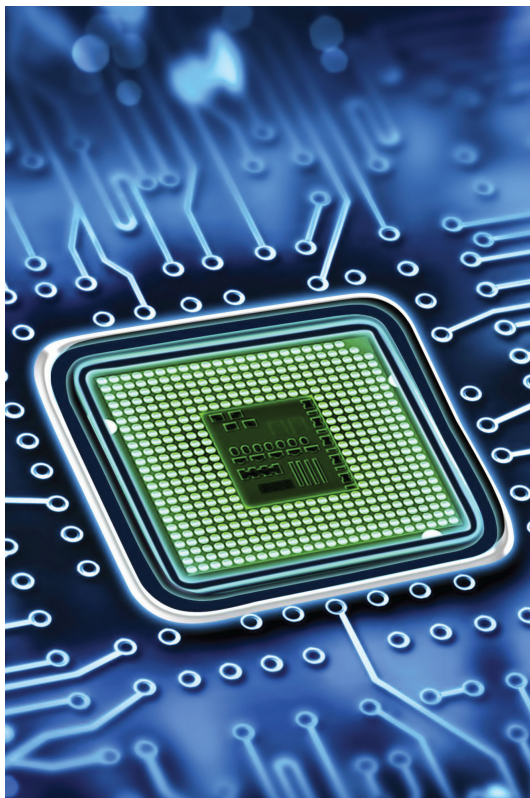
December 8, 2004. As such, the larger decrease in the number of claims for computer architecture patents appears to be a case of companies saving money by cutting claims from patents that have larger number of claims, i.e., computer architecture patents.

Part IV in this series will continue to analyze the number and type of claims for these companies for patents filed between January 1, 1996, and December 31, 2020.

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