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Market reaction to patent infringement litigations in the information technology industry

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Abstract Intellectual property portfolios that include unique inventions and discoveries are potentially inimitable resources that provide strategic leverage to Information Technology (IT) firms. The increasing patent related litigations in the IT industry, and the high costs associated with litigations make this an economically significant activity. Taking a market oriented view to this issue we investigate the economic impact of patent infringement litigation on both the plaintiff and the defendant firms in IT industry. Event study methodology is used to assess the effect of the litigation on the stock market returns around the date of litigation announcement as well as the date of settlement/termination. Our results suggest that the news of patent infringement litigation was unfavorably accepted in the stock market for the defendants. On the other hand, abnormal returns for plaintiff firms around litigation announcement date as well as settlement/termination date were significantly positive. We find evidence to the effect that patent litigations are not zero-sum games since combined abnormal returns for the plaintiff and defendant firms are negative. Patents belonging to the electronic and electric categories are more likely to influence market returns, whereas computer and communications patent categories are less likely to do so. Patent importance (as measured by patent citations) is found to be an important contributor to market's evaluation of a patent litigation's impact.

Keywords Intellectual property · Patents · Litigations · Event study · IT innovations

1 Introduction

Over the years, patent infringement litigations in Information Technology (IT) industry have increased tremendously. The increase in patent disputes can be partly attributed to the increase in the number of patents issued. The number of patents granted has risen from 66,170 in 1980 to 157,717 in 2005.[1] Of the 12,184 intellectual property litigations in 2005, 2,720 pertained to patents[2]. The damages awarded to patentees in such litigation are substantial, as is the cost of litigation.[3] For instance, Intel Corp. and AMD Corp.,

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[1] Statistic is available at: http://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports.htm#by_type

[2] http://www.fticonsulting.com/web/services/Intellectual_Property_Charts_and_Statistics.html

[3] The average cost to litigate a patent case today is $2.5 million, and each year that increases 10 to 15%. In light of the amounts at stake, law firms and plaintiffs treat Intellectual Property (IP) litigation as a growth industry (Pearson, Nickson and Marvel, 2001).

collectively spent almost $200 million on patent disputes over several years.[4] In assessing strategic knowledge management strategies, Earl (2001) identifies aggressive intellectual property protection through patents a significant part of organizational knowledge management strategy (such a strategy is labeled as the "commercial school" in his taxonomy of knowledge management strategies). Aggressive protection of "knowledge assets" is the main driving force behind this strategic approach to knowledge management (Abril and Plant 2007; Davenport et al. 1998). Interestingly, past literature on patenting clearly points to industry specific strategies for patenting and patent protection (Somaya 2003). Firms in IT industry typically use patents for blocking and cross-licensing negotiation by controlling key technologies—"*the threatened sanction is often less the expectation of exclusion pending the resolution of a lawsuit, but the more certain and immediate economic harm due to the legal action alone.*(Cohen et al. 2000)" Given that patent litigations are a major component of IT industry's knowledge management strategy, empirical assessment of its economic value to the firms involved becomes an important issue for research.

Firms in the IT industry carefully manage their intellectual property portfolio that includes computer software, industrial designs, and other unique inventions and discoveries. The strategic logic driving the attention to intellectual property in IT industry stems from the leverage that it provides in licensing and cross-licensing in an industry that has seen a significant increase in patenting activity. Recent empirical evidence has identified licensing and cross-licensing strategy as distinct to the IT industry (Cohen et al. 2000). Interestingly, the genesis of many patent related disputes stem from stalled or failed licensing negotiations.

Since empirical evidence on the benefits of patents at the individual patent level is hard to obtain, an indirect way to determine patent impact is to examine the impact on firm value when firms attempt to copy another firm's patented innovation. If one observes tangible impact on firm value when such infringement activities are disclosed, it can be construed as evidence for the value of the innovations to the firm and enable us to identify firm specific and patent specific factors that drive this value. Additionally, this approach enables the investigation of whether litigations are zero-sum games for the involved firms.

The increase in patent litigations can be attributed to the developments in patent enforcement and enactment policies of the US government since the early 1980s. These developments include the Supreme Court decision in the early 80s declaring that software could be patented. Prior to this decision, computer software had been protected under the copyright and trade secret laws. The creation of the Court of Appeals of the Federal Circuit in 1983 has also been cited as another crucial development that triggered the boom in litigation relating to patents in the IT industry (Ewert 1995). The Court of Appeals of the Federal Circuit (CAFC) was established in order to decide appeals on all patent cases regardless of the district court from which the case originated. The objective was to create a coherent body of patent law in the hope that this would encourage greater investments in technology. Many cases have been cited in (Rutter 1993) as landmark developments in the IT industry as far as patent litigations are concerned. This includes the almost $1 billion award in favor of Polaroid in the Polaroid vs Kodak dispute, which put Kodak out of the instant photo business, and Texas Instruments taking legal actions on nine Asian companies for infringing on its DRAM (Dynamic Random Access Memory) patents.

A rich set of literature on litigations (Bhagat et al. 1994; Koku et al. 2001) has argued for an examination of market-based approaches to studying economic impact of litigations. In (Bhagat and Romano 2002), an extensive summary of event studies applied to issues of litigations and corporate law is presented to demonstrate its usefulness in assessing the impact of corporate policy on shareholder wealth creation. Event study in patent litigation context enables us to study patent impact in the context of a rival firm that may also benefit from the innovation and investigate the influence of both firm specific and patent specific variables. Event studies have also been used in litigations as evidence for damages and liabilities. Litigations have a big impact on indirect costs such as management distraction and difficulty in obtaining credit on favorable terms. Such high indirect costs cause market to reevaluate the litigating firms' market valuation. We therefore utilize capital market reactions to litigation announcements as a measure of the economic impact of patent litigations in this study. In this context, the contribution of this study is two fold: First, using a market based approach, it examines the economic significance of patent litigations in the IT industry to the firms involved and demonstrates the market's bias towards patent holders in litigations. Second, it investigates factors that could affect the market's reactions to patent infringement litigations in the IT industry and explores the possibility of systematic differences in the market's reactions based on a number of covariates related to the litigation. The empirical evidence shows that the market's reaction is clearly slanted to the holder of the patent rights. Significantly, we demonstrate that litigations are not zero-sum games—the loss to the defendant is potentially larger than the gains to the patent holder. The size of the opponent in the patent litigation is found to influence the market returns. Patents

[4] Electronic Business Buyer. Vol. 20, No. 4, Apr. 1994, p38.

belonging to the electronic and electric categories are more likely to influence market returns, whereas computer and communications patent categories are less likely to do so. We also find plausible evidence for the influence of patent qualities (as measured by its citation impact) on market returns.

The rest of the paper is organized as follows. In Section 2 we present the research background for the study. In Section 3 we develop the research hypotheses. Section 4 presents the details of the data and sample followed by a discussion of the event study methodology in Section 5. In Section 6, we provide a discussion of the research results and present the concluding remarks in Section 7.

2 Research background

Patents as a means of competitive advantage and barrier to entry have long been recognized in the management literature (Chakrabarti et al. 1993; Porter 1980). Several articles have appeared in economics, strategic management and marketing literature on various aspects of patents and its administration. The rich variety of articles in this area emphasizes the importance of patents as a strategic tool for high technology firms. The economic value of obtaining patents and overall importance of patents has been discussed quite extensively. The effectiveness of patents as a mechanism for appropriating returns to R&D investments has been questioned by many scholars and managers (Cohen et al. 2000; Levin et al. 1987). For example, R&D managers consistently report that as a performance measure, patents were among the least effective mechanisms to recoup investments in R&D (Hall and Ziedonis 2001). However, the 1994 Carnegie Mellon Survey on Industrial R&D in the U.S. Manufacturing Sector (Cohen et al. 2000) shows that patents are an effective mechanism in other industries such as pharmaceuticals, chemicals, and biotechnology and medical devices. Using patent citations as a main indicator of an IT firms' potential and growth, (Dang et al. 1999) found that the frequency of patent citations are positively associated with the stock price performance of these firms.

Success of a technology-based company can be significantly shaped by its strategic use of patents by establishing a proprietary market advantage, by improving financial performance, and by enhancing overall competitiveness (Rivette and Kline 2000). The power of patents to influence and even determine competitive outcomes will only increase—especially in the technology-based industries. Tirole (1988) considers the purpose of patents as a means to create a temporary monopoly for the innovator in return for the efforts put forth towards the innovation. However, the ability of the inventor to benefit from the patent depends on how broad the patent is and how difficult it is for the competitors to provide a similar product without infringing on the patent (the process of imitation; Gilbert and Shapiro 1990; Klemperor 1990). The competitor's decision to imitate depends on the length and the breadth of patent protection.

Another aspect of managing innovations is patent licensing. Transfer of patented technology to another firm is always fraught with risk, especially in an environment where patent protection is uncertain (Vishwasrao 1994). Licensing contracts for innovations can vary with respect to form and size of the payments, the degree of exclusivity, and the division of rents. Licensing however necessitates information sharing which has the potential to facilitate imitation (Gallini and Wright 1990). That many patent litigations in the IT industry trace their origins to problems in licensing agreements corroborate this assertion. In a more recent study on patent litigation, Lanjouw and Schankerman (2001) test the relationship between various characteristics of patents and their owners and the likelihood that they become involved in legal conflicts. Their work focuses on examining the determinants of patent litigations, but it does not look at the economic or financial impact of patent-infringement litigations on the participant firms.

There are a few empirical studies to support the theoretical foundations of patent economics. In (Lerner 1994), an empirical analysis of the importance of patent scope is conducted. In (Shapiro and Lorne 1993), the stock market response to changing drug patent legislation in Canada is conducted. Cockburn and Griliches (1988) study the stock market's valuation of R&D and Patents with respect to industry segments and appropriability measures. They find that the returns to a firm from investing in patent protection differ according to industry and firm specific conditions. In a similar study of imitation costs in three industries, viz. chemicals, drugs and electronics (Jaffe 1986), it is found that patented products were imitated within four years of innovation. An interesting finding of the study is that without patents it would have been difficult for the competitors in the industry to imitate a new product. The reason for this is that it is quite difficult for imitators to determine from a new product how it is produced. In general, the study found that patents are considered more important in the drug industry than in the other two industries. However, the imitation costs to the competitors were found to increase irrespective of the industries in the presence of a patent. An empirical study involving chemical, electrical and electronics industries in UK found that smaller firms innovate proportionately less than larger firms and innovative activity is not related to prior profitability of the firm (Smyth et al. 1972).

3 Research hypotheses

It is evident that the market evaluates the value of a firm based on the net income that the firm can generate from its tangible and intangible assets (Cockburn and Griliches 1988). R&D efforts, intellectual property rights, goodwill, advertising and marketing skills, human resources are some of the intangible assets that are considered important for a firm's long-term survival in its industry. Patents and copyrights (the two most important forms of intellectual properties), which are the outcomes of the firm's R&D and innovation efforts, are of significant economic importance to the firm (Porter 1980; Tirole 1988). Additionally, empirical support for the economic significance of patents to firm value is available in (Lerner 1994; Shapiro and Lorne 1993). Dang et al. (1999) found that their set of patent-related measures are closely associated with stock performance, concluding that patent attributes provide a useful tool for the analysis of valuation for technology and science-based firms.

The holder of a patent is granted monopoly rights to exploit the invention for a specified time period. In essence, patents and copyrights (to some extent, especially as applicable to computer software and literary works) are a form of reward given to a firm for its innovations. This monopoly right is threatened when a competitor infringes on the patent. A rational firm would evaluate the threat in terms of the costs and benefits of pursuing litigation. A commencement of litigation could convey new information to financial markets even if the markets were previously aware of the threat from a competitor.

The revaluation could be either an increase or a decrease in the market value of the firms involved. The market's reaction to the intellectual property right dispute depends on a number of factors. These factors include the probability of a judicial enforcement of patent rights protection and the economic significance of the patents. Because of the often unclear nature of the intellectual property laws, a patent grant does not necessarily mean that the patent will be considered as valid in a court of law. The probability of the validity of a patent depends on a number of factors, such as the clarity of the law, disclosure regulations, and information on prior art (Nordhaus 1969). Additionally, prevailing legal environment has a significant effect on the outcome of intellectual property disputes. The application of the patent laws may not be uniform in all courts. This flaw in the US patent system has been overcome to some extent by the establishment of the US Court of Appeals for patents. The government's attitude towards anti-trust regulations could also be a determining factor. A large number of patents issued in the computer industry over a small period of time have contributed to the problem as well. In general, litigations do cause markets to reevaluate the firms—prior research on the impact of litigation announcements has found that the filing of litigations led to a 2–3.1% average decrease in the market value of the firms involved (Bhagat et al. 1994; Lerner 1994).

Legal experts reviewing cost effectiveness of patent litigations have suggested that even though it is highly expensive to engage in patent infringement litigation, the expected economic benefits far outweigh the costs, especially for the patent owner (Ewert 1995). Other empirical studies have found that markets view patent grants as significant events. For example, a study of biotechnology patent announcements, shows that cumulative abnormal returns vary upwards from 0.33% for the full sample to 6.8% for patents announced in the Wall Street journal (Levin et al. 1987). To the extent that an "average" reaction exists at the time of commencement, we would expect that plaintiff and defendant firms would exhibit opposite signs for the abnormal returns, i.e. if, on average, plaintiff firms gain from announcing a litigation, the defendant firms would lose.

Hypothesis 1 On average, the initial announcements of IT patent infringement litigation will lead to positive abnormal returns for the plaintiff firms and negative abnormal returns for the defendant firms.

The termination of litigation results in revealing the validity of the firm's sole ownership of the relevant intellectual property. In (Koku et al. 2001), the potential for litigation induced financial distress is shown for both plaintiff and defendant firms. The reduction in firm value reflects a change in the way investors perceive the inherent validity of a patent. If the patent is subsequently declared "invalid" the firm should lose whatever value was contributed by that patent. Stock price for prevailing appellate plaintiffs has positive effects on the day of the decision as well (Lunney 2005). On the other hand, the change in firm value following a "valid and infringed" decision reflects the damages that are likely to be received and a stronger perception of the patent by the market. For example, while defendants may experience economically meaningful and statistically significant wealth losses upon the filing of the suit, defendants involved in government suits suffer even larger declines in shareholder wealth (Bhagat and Romano 2002). Though the markets may be monitoring the progress of the litigation and update forecast of the firm's prospects, the termination may still contain enough new information which is unanticipated by the markets as a reflection of the uncertainties surrounding patent law and patent granting process. To the extent that an "average" reaction exists at the time of settlement, we would expect that plaintiff and defendant firms would exhibit opposite signs for the abnormal returns.

Hypothesis 2 On average, announcement of settlement or termination of IT patent infringement litigation will lead to positive abnormal returns for the plaintiff firms and negative abnormal returns to the defendant firms.

Litigations have a range of outcomes at termination—settlement, dismissal, withdrawal, or award of damages. Previous research on patents shows that a court ruling that a patent is "invalid" immediately destroys the income stream that the patent has conferred to its owner. This stream of income may include the monopoly power of the patent, licensing opportunities, and expected damages form any future litigation. For example, in (Bhagat et al. 1998) it is shown that the 31 defendant firms included in their study lost an average of 1.2% of their market value. Consequently, we expect that settlements or terminations that favor plaintiffs will positively affect the plaintiffs' stock prices and negatively affect defendants' stock prices at the announcement of settlement or terminations.

Hypothesis 3a Settlement or termination in favor of the plaintiff will lead to positive abnormal returns for the plaintiff firms.

Hypothesis 3b Settlement or termination in favor of the plaintiff will lead to negative abnormal returns for the defendant firms.

4 Event study methodology

Event study has been commonly employed in economics and management literature (Agarwal and Kamakura 1995; Muoghalu et al. 1990; Cavusoglu et al. 2004; Ranganathan and Brown 2006; Dos Santos et al. 1993). The rationale for employing event study methodology is that it assumes that financial markets are at least semi-strong-form efficient (Fama 1970). Market prices of securities reflect all publicly available information relevant to determining the expected cash flows and profits to the firm. The new information, if any, contained in the commencement (or termination) of a patent infringement litigation causes the market to revise its expectations about the magnitude (or risk) of the future cash flows and profits, and adjust the value of the firms accordingly. These adjustments are immediately witnessed by changes in the stock prices of the firms.

The abnormal stock returns attributable to the commencement or termination of litigations thus form the basis of a measure of the economic impact of patent litigation. One example is the substantial direct and indirect costs entailed by patent rights enforcement. According to American Intellectual Property Law Association (AIPLA), direct legal costs alone can run in the range of $1 to $3 million dollars for each side through trial. More importantly, patent litigation involves considerable indirect costs such as organizational dislocation, absorbing time and energy of top managers, lawyers, engineers, and scientists in the company.

The event study methodology is based on the assumption of efficient capital market theory (Fama 1970). The efficient capital market theory states that the market value of the firms at any time fully reflects the available information at that time. As a result, whenever new information is made available to the market, the market adjusts the firm's value to reflect the changes in the present value of the cash flows and profits resulting from the new developments. In this research, the new information available to the market is the commencement of the patent infringement litigation and later, the termination of the infringement litigation. A similar approach has been applied to study the effect of hazardous waste litigations (Muoghalu et al. 1990) and merger related litigations (Wier 1983).

The Dodd and Warner methodology (Dodd and Warner 1983) is used for the event study conducted in this research. The event is the announcement of an imminent patent infringement litigation or its commencement (whichever occurs earlier), and subsequently the announcement of a judgment by the court or a settlement reached out of court (i.e., litigation termination).

It is assumed that the daily common stock returns of a company are described by the Market Model. Under this model, the normal returns on the firm's stock are described by:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

Where,

R_{it}	Rate of return for the firm i on day t
R_{mt}	Rate of return for the market portfolio on day t
α_i, β_i	Estimated Parameters
ε_{it}	Error Term for firm i on day t

Equation (1) has two components in the return on the common stock of a firm, R_{it}. The part $\beta_i \times R_{mt}$ is due to the market, and the part $\alpha_i + \varepsilon_{it}$ is independent of the market. The term β_i indicates the sensitivity of the firm's stock returns to market fluctuations. The term R_{mt} is representative of the information available at time t, which affects the stock returns of all the firms. The term ε_{it} on the other hand, is assumed to reflect the information available to the market about the specific firm, i, at time t. Since the parameters, α_i, and β_i are unbiased estimates, the estimate of ε_{it} is also unbiased but noisy. However, by measuring the effects on event-time portfolios of a large sample of firms, the noise in the estimate of the individual abnormal returns can be reduced.

The event date is noted as the reference day 0. The event window is from day −1 to 0. The daily stock returns for each firm are used over a long interval (generally about 200 trading days) to estimate the parameters α_i, and β_i in Eq. 1. The parameter values are then used to estimate the expected daily stock returns in the event window. Deviations of the actual stock returns recorded in the stock markets from the predicted values in the event window constitute abnormal returns. The abnormal returns are considered as the reaction of the market to the patent litigation. Abnormal returns for each firm are computed for the event window from day −1 to 0 (Muoghalu et al. 1990).

The abnormal return for the security i on day t is computed as

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{\mathrm{m}t}) \quad (2)$$

The standardized abnormal returns for the firm i's stock on day t is:

$$SAR_{it} = AR_{it}/s_{it} \quad (3)$$

where, s_{it} is the standard deviation of the regression residuals.

Then, the standardized cumulative abnormal returns for security i from day T_1 to T_2 is calculated as:

$$\mathrm{SCAR_i} = \sum_{t=T_1}^{T_2} \mathrm{SAR}_{it} \Big/ \sqrt{(T_2 - T_1 + 1)} \quad \ldots\ldots\ldots \quad (4)$$

The mean standardized cumulative abnormal returns (MSCAR) for the sample of firms is given by:

$$\mathrm{MSCAR} = \frac{1}{\mathrm{N}} \sum_{\mathrm{i}-1}^{\mathrm{N}} \mathrm{SCAR_i} \quad \ldots\ldots\ldots \quad (5)$$

To test whether the standardized mean cumulative abnormal return is different from zero, we use the test statistic defined as:

$$Z = \sum_{\mathrm{i}-1}^{\mathrm{N}} \mathrm{SCAR_i} \Big/ \sqrt{(\mathrm{N})} \quad \ldots\ldots\ldots \quad (6)$$

The SCAR's are assumed to be unit normal in the absence of abnormal returns. Since Z is also unit normal, it is an appropriate test statistic for the mean cumulative abnormal returns.

The methodology assumes that the commencement of the patent infringement litigation or the termination is not anticipated by the market before public announcement. However, if the announcements were anticipated by the market the abnormal stock returns provide a lower bound estimate of the impact of the litigation on the stock returns (Dos Santos et al. 1993).

5 Data and sample

The study focuses on both groups of firms involved in patent infringement litigation, viz. the firms that are claiming damages for infringement (the plaintiffs) and the target firms of litigations (the defendants). The impact on the stock returns are measured around the day of the commencement of litigation and subsequently the day the litigation is settled or a judgment is made. The use of stock returns as a metric for litigation impact requires that both plaintiff and defendant firms be publicly traded. This narrows the sample of firms that are studied but prevents the possibility of results being skewed by a preponderance of non-publicly traded firms among either type of litigants. This approach enables the investigation of patent litigations as a zero-sum transaction between defendant and plaintiff firms.

Data on patent infringement litigations filed and settled are collected over the period between 1984 and 2002 for the study. While market data on patent litigations up to 2005 are available, patent related data drawn from the NBER database limit inclusion of these litigations in the current study. The data is collected from the following three sources: (1) Lexis/Nexis news stories, (2) Lexis/Nexis case history database, and (3) NBER Patent Database. The data is restricted to patent litigations filed in the computer and information technology industries. PR Newswire and Business Wire covered most of the news stories found on the LEXIS/NEXIS database. Exemplar announcement and settlement/termination stories are presented in Appendix.

The news stories collected from the database were then closely analyzed to identify the real date of the announcement of the litigation and the date of the settlement or termination. Due to a number of litigations and counter-litigations, in some cases it is harder to identify plaintiff and litigants clearly. To maintain consistency across the sample, we define the plaintiff as the firm holding the patent rights and the defendant firm as the one that is either infringing on the patent or is disputing the patent. News items pertaining to the firms around the event dates (2 weeks on either side of the event window) were examined to see if any other significant event had taken place that would seriously contaminate the results. For some parts of the analysis, we limited our data sample to the ones that match for announcement and settlement/termination events. Some firms were not publicly listed and hence had to be eliminated from further analysis (this eliminated a large number of cases from our sample). Additionally, where disputed patent information was not available, we had to eliminate those cases as well from the regression analysis. In all, we discovered 158 litigations and were able to utilize 75 cases in the final sample for announcement related event study. Some firms ceased to exist by the time judgment

(or settlement) happened and consequently had to be eliminated from our sample. Where multiple judgments (including appeals) were involved, the first major judgment at a court was used as the settlement date (preliminary injunctions and interim judgments were not considered). We also had to eliminate some data points because matching settlement dates were not found, litigations were not yet settled, or the stock market data were not yet available from CRSP database.

For litigation announcement, we find a total of 75 cases where plaintiff information was available. For these 75 cases, a corresponding set of 88 defendant firms were identified (in 8 cases, there were multiple defendant firms, this results in a slightly larger defendant firm sample). There were, however, 65 cases where we could find all of the relevant information on the litigation announcements and settlement for *both* plaintiff and defendant firms (matched sample). Descriptive statistics for the firms involved in litigations are presented in Table 1.

The key facts needed were the dates of announcement and settlement/termination, names of the litigation participants, main patent information, and basic settlement/judgment records. The average length of the litigations in our sample was 654 days (or 1.8 years), 62 days being the shortest and 2,284 days the longest.

The categorization of patents follows the taxonomy of Hall et al. (2001). The two main categories pertaining to IT industry are Computers and Communications patents and Electrical and Electronics patents. Litigations in this study included 52 cases on Computers and Communications patents, 17 cases on Electrical and Electronics patents, 5 cases that involved patents belonging to both categories and 11 cases that did not belong to either category ($52 + 17 + 11 - 5 = 75$). Subcategories included in Computers and Communications patents are: Computer hardware and software, communications, computer peripherals, and information storage. Subcategories under Electrical and Electronics patents include electrical devices, semiconductor devices, and measuring and testing patents. The categorization, however, does not include all patent categories; for example, some patent disputes involved mechanical or optical patents relating to hardware devices such as disk drives. As a result, 11 cases belonged to other categories. Average age of patents involved in the litigations was 4.64 years, which was measured from the time of patent awarded to the announcement date. Average number of citations (Smyth et al. 1972) derived from these patents was 9.35.

Obtaining and categorizing settlement or termination (including court judgment) data proved to be more challenging. In many cases, the litigation settled out of court between the relevant parties, and the settlement specifics were often not revealed. Cases for which outcome classification was possible in two categories—plaintiff favored or neutral/defendant favored included 65 plaintiff firms and 79 defendant firms (a number of defendant firms were dropped due to lack of information on settlement details or due to merger and acquisitions). Out of these, 31 of 65 (48%) and 35 of 79 (44%) settlements/termination were decided in favor of plaintiffs[5]. Refer to Table 4 for more details.

6 Results and discussion

6.1 At announcement

Table 2 summarizes the abnormal returns for a portfolio of matched opponents and for defendants and plaintiffs alone during the announcement period [denoted as (−1, 0)—day 0, the announcement date, and day −1, the preceding day]. Other event windows tested for confirming robustness of the results, but not reported here, include (0, +1) and (−1, +1). Additionally, we checked for abnormal returns in the windows (−10, −1) and (+2, +10); these returns were not significant. On average, there was positive abnormal return for plaintiffs at the announcement of patent infringement litigation (Hypothesis 1). In the unmatched sample, the Cumulative Abnormal Returns (CAR) during the event window of (−1, 0) was 2.55% for plaintiffs ($p<0.001$)[6]. Median CAR was 1.44%, and in about 61% of the cases the returns to plaintiff firms was positive (46 out of 75 plaintiffs). The average CAR for the defendant firms in the unmatched sample is significantly negative with −2.66% ($p<0.001$) for the test window of [−1, 0]. The median CAR for the same period was −1.92%. Only 32% of defendant firms had positive cumulative abnormal returns during the [−1, 0] period (28 out of 88 total defendants)[7].

A total of 65 cases had available market data for both plaintiff and defendant firms (i.e., the matched sample). In this matched sample, we calculated the combined CAR of plaintiff and defendant firms at the time of litigation announcements, and found that on average, investors suffered a negative combined return of −1.61% ($p<0.001$)

[5] There are more number of defendant firms (and correspondingly more number of plaintiff won cases) due to multiple defendant firms being involved in litigation with a single plaintiff in some cases.

[6] Other tests for significance yielded the same p values, including tests that correct for cross sectional correlation. Bootstrap significance tests also yielded the same p values for all results reported in this study.

[7] Returns immediately outside the event window were tested for any significance (the windows were (−10,−2) and (+1,+10)). Abnormal returns were not significant in all cases but one—the abnormal returns in the (+1,+10) window for defendant firms were negative at $p<0.10$ level.

Table 1 Descriptive statistics on the firms in the sample (Standard deviation in paranthesis)

Variable	Overall sample	Plaintiff firms	Defendant firms
Sales	6,891.79 (14,361.65)	4,295.58 (10,082.49)	9,221.72 (17,059.95)
Assets	8,189.47 (17,541.49)	5,526.1 (13,958.42)	10,579.69 (20,015.1)
R&D expenses	558.33 (1,087.52)	366.38 (892.94)	735.13 (1,219.4)
Liabilities	4,988.32 (12,178.30)	2,980.72 (9,071.08)	6,969.14(14,402.86)
Age of patents in dispute (in years)	4.43 (4.08)	–	–
Patent citation index	9.5 (12.62)	–	–

for the test window [−1, 0] [See Bhagat et al. (1994) for details on the analysis approach]. 26 out of 65 total cases (40%) had positive CAR during [−1, 0]. This result implies a negative market impact for the firms involved in patent litigation. This significant negative impact can indicate the effect of legal expenses and diluted management attention to operations following the litigation announcements. Although we cannot possibly obtain accurate information on the legal expenses involved in a patent litigation, it is documented that indirect costs such as financial distress costs and other costs involved in reduced customer support, reduced trade credit, etc. as well as direct costs such as lawyer fees and bargaining costs can affect both plaintiff and defendant firms (Bhagat et al. 1994). This result implies that litigations are not zero-sum games—defendants lose more than plaintiffs gain. The significant combined negative abnormal return for the matched sample is consistent with previous findings on patent infringement litigations. For instance, combined abnormal return was −3.13 ($p<0.001$) for a sample of 20 firms (from all industries) in (Bhagat et al. 1994).

Combined wealth effect for the matched firms were obtained by calculating a weighted return, where the weight for each firm is equal to its proportion of the combined market value of the two firms' common stock at the end of the fiscal year just before to the year in which the event (i.e., the litigation announcement) occurred. Separately, the shareholder wealth is significantly positive for the plaintiff firms and significantly negative for the defendant firms in the unmatched samples (Table 3). While the combined shareholder wealth increased by $12.01 million on average, the median value shows a drop in shareholder wealth by $12.38 million. Both average and median values are not significant based on *t* test, Sign test and Sign-Rank test. We conjecture that the smaller sample size in the matched dataset is perhaps contributing to the mixed results on shareholder wealth impact.

In addition to the univariate test we discussed earlier, we also performed a multivariate regression analysis to verify the relationship between being a plaintiff in a patent infringement litigation and the abnormal stock returns at the time of litigation announcement after other effects of firm characteristics and types of the patents on the firm's abnormal returns are taken into account. For accounting information, the COMPUSTAT database is utilized. When matching the CRSP dataset with the COMPUSTAT set, some cases had to be dropped due to missing information in the COMPUSTAT data. The regression model is as follows:

$$\begin{aligned}\mathrm{PERF_i} = {} & \alpha_i + \beta * \mathrm{PLTF_i} + \gamma * \mathrm{EECat_i} \\ & + \delta * \mathrm{COMPCOMCat_i} + \zeta * \mathrm{SIZE_i} \\ & + \eta * \mathrm{OPPSIZE_i} + \iota * \mathrm{RD_i} + \lambda * \mathrm{LIAB_i} \\ & + \mu * \mathrm{PATAGE_i} + \rho * \mathrm{CITES_i} + \varepsilon_i\end{aligned}$$

where

$\mathrm{PERF_i}$ cumulative abnormal returns during the event window [−1, 0] for the ith firm

$\mathrm{PLTF_i}$ 1 if plaintiff and 0 if defendant

$\mathrm{EECat_i}$ 1 if patents involved in the litigation belong to NBER Electrical & Electronics patent category

0 otherwise

$\mathrm{COMPCOMCat_i}$ 1 if patents involved in the litigation belong to NBER Computers & Communications patent category

0 otherwise

$\mathrm{SIZE_i}$ natural log of the total assets of the firm during the year the litigation commenced

$\mathrm{OPPSIZE_i}$ natural log of the total assets of the opponent firm during the year the litigation commenced

$\mathrm{RD_i}$ R&D expenses/sales

$\mathrm{LIAB_i}$ total liabilities/sales

$\mathrm{PATAGE_i}$ average age of patents

$\mathrm{CITES_i}$ average number of patent citations adjusted for patent age

As mentioned earlier, our dependent variable is cumulative abnormal stock returns on the one day before and at the announcement date. The independent variables include whether the firm is a plaintiff or defendant firm, patent category, R&D expenses, liabilities, firm size and opponent

Table 2 Test results of analysis on the abnormal stock returns for plaintiffs and defendants at announcements (Hypothesis 1)

	Plaintiff	Defendant	Matched Plaintiff and Defendant
Average CAR (−1,0)	2.55%	−2.66%[a]	−1.607%
Median CAR (−1,0)	1.44%	−1.92%	−1.260%
Z Statistic[g]	3.388***	−3.824***	−3.108***
Rank Test Z	3.137***	−3.438***	−2.897**
Number Positive	46**	28**	26
Sample Size	75	88	65
Mean Change in Shareholder Value ($ Millions)	−6.84[b]	−238.279[c,d]	12.01[e,f]
Median Change in Shareholder Value ($ Millions)	2.86[b]	−6.059[c]	−12.381

[a] CAR for the event window (1,10) is −2.89% (Z Score=−1.852*)
[b] Non-normal (Shapiro-Wilk and Kolmogorov Tests significant at $p<0.0001$); Skewness=−0.075, Kurtosis=24.99; Sign Test ($M=9.5$) and Sign Rank Test ($S=409$) p value=0.037 and 0.02 respectively
[c] Non-normal (Shapiro-Wilk and Kolmogorov Tests significant at $p<0.0001$); Skewness=−5.61, Kurtosis=38.84; t score=−1.96 ($p=0.0521$), Sign-Test ($M=-15$) and Sign-Rank Test ($S=-733$) p value=0.0018 and 0.0019 respectively
[d] Exclusion of five largest and five smallest shareholder wealth data items leads to (in $millions) Mean=−74.95; Median=−6.059. t score=−2.11; Sign Test ($M=14$) and Sign-Rank Test ($S=-692.5$)
[e] Non-normal (Shapiro-Wilk and Kolmogorov Tests significant at $p<0.0001$ and $p<0.01$); Skewness=2.97, Kurtosis=21.02; t test, Sign test and sign-rank test are insignificant
[f] Exclusion of five largest and five smallest shareholder wealth data items leads to (in $millions) Mean=23.16; Median=−11.87. t test, Sign test and sign-rank test are insignificant
[g] Values are significant with other tests such as standardized cross-sectional test and sign-rank test. Cumulative window Z statistics are adjusted for serial dependence
*$p<0.1$
**$p<0.05$
***$p<0.01$

firm size. Additionally, two variables characterizing the patents are included (average age of patents involved in the litigation, and the average citations per year as recorded in the NBER database for the concerned patents).

Patent types appear to be of special interest in IT industry and their impact has been studied in patent literature (Cohen et al. 2000; Levin et al. 1987; Hall and Ziedonis 2001). For instance, due to the nature of semiconductor industry, it is found that litigation events over patented technologies have become more frequent during the 1973–2001 period (Ziedonis 2003). The aggressive patenting in this sector is driven by a desire to deter such litigation and to negotiate more favorable access to external technologies (Cohen et al. 2000; Ziedonis 2003). The 1994 Carnegie Mellon Survey on Industry R&D in the US Manufacturing Sector found that computer and communications patents are not an effective mechanism by which to appropriate the returns to R&D, while it also found that there was an unprecedented surge in patenting in the U.S. unaccounted for by the increases in R&D spending alone (Kortum and Lerner 1998).

Firm size variable (SIZE) was added to control the effects of differential impact on the stock prices due to the size of the firm involved. It can be argued that the overall impact of the litigation on a firm's business and its ability to generate future earnings should be greater to small-sized firms than to large firms. Large firms can rely on other products and technologies to dampen the impact of unfavorable litigation outcomes. Smaller firms, however, may not have the kind of flexibility and resources that larger firms enjoy, especially when the legal battle is prolonged. Bhagat et al.(1994) explain that the average drop in value for the plaintiff and defendant firms combined is partly due to the increased financial distress imposed on the defendant. These costs of financial distress not only include the direct costs such as legal and other administrative costs but also indirect costs that include considerable organizational dislocation, lower sales, greater difficulty of raising funds or obtaining credit and the distraction of management. Ohlson (1980) estimates the change in bankruptcy probability using financial statement information for the failed and surviving firms. In his model, firm size measured by log of total assets was negatively related with bankruptcy costs (i.e., costs of financial distress). Based on similar logic, size of the opponent firm (OPPSIZE) is also relevant in predicting how well a plaintiff or defendant will fare in times of financial and organizational hardship caused by the long litigation process and outcome of the litigation. A firm's outstanding liabilities is another variable that directly affects the costs of financial distress. The aforementioned model (Ohlson 1980) calculates bankruptcy probability using the level of total and current liabilities as its main determinants of total bankruptcy costs.

Traditionally, R&D spending by the firm is one of the most important variables in patent production. R&D

intensity (R&D expense deflated by total sales) also proved to be highly associated with growth expectations, as reflected by the M/B (Market value over Book value) ratio (Dang et al. 1999). Although the direct relationship between R&D intensity and its impact on stock returns at announcement is not straightforward, defendant firms with relatively high R&D spending are expected to fare better with market returns around the event date since those firms may be projected to be the likely winners of the litigation due to their higher spending on R&D.

Average age of patents is considered in the regression to address the newness of the invention under dispute and the time remaining before expiration of patent protection. It is expected that the lower the age of innovation, the more important it is to the firm's products and higher the impact on the market value at the time of litigation announcement.

Number of citations has been one of the most widely used measures to estimate the value of an invention as future citations received by a patent (forward citations) are one indication that an innovation has contributed to the development of subsequent inventions (Chakrabarti et al. 1993; Lanjouw and Schankerman 2001; Chakrabarti 1991). The NBER database was utilized to determine the number of citations for the patents involved.

We report the results of the regression estimations in Table 3. While the diagnostic statistics did not detect multicollinearity problems, they revealed the existence of heteroscedasticity. We used the GMM (Generalized Method of Moment) method to obtain valid estimates. Table 3 shows that there is a strong and positive relationship ($p<0.0001$) between being a plaintiff and cumulative abnormal stock returns at the announcement of litigations after controlling for the effect of other possible variables on the plaintiff and defendant stock prices at litigation announcement. This result robustly supports our previous univariate test results that found the same association between these two variables, and reconfirms that on average the market perceives a potential value creation for plaintiffs in the future brought about by patent infringement litigations.

Electrical and electronic category patents appear to be positively correlated with abnormal returns ($p=0.0317$). Electrical and electronic category patents include electrical devices, semiconductor devices, and measuring and testing patents. Computers and communications patent category, however, did not have a significant relationship to abnormal returns. This finding in a litigation context is in conformance with earlier studies that have reported that computers and communication patents did not appropriate adequate returns to R&D investments (Cohen et al. 2000; Hall and Ziedonis 2001).

Findings from the two size variables are interesting. At $p<0.01$ level, the size of the opponent firm (OPPSIZE) contributed to the abnormal returns negatively. In other words, on average a small-size plaintiff with a small-size defendant performed better than the one with a bigger-size defendant. This also applies to any other type of plaintiffs and defendant. This provides us evidence that firm size did matter, but on average, investors considered the opponent firm size to have a bigger impact on the outcome of the litigation. When patents are studied as part of the intellectual property of the applicant alone, they do not reveal the nuance of patent impact in the context of the competitive landscape that the firm operates in. A patent litigation context, however, presents a unique opportunity to study the patent impact in the context of a rival firm that may benefit from the innovation.

Patent importance (as measured by citations) has considerable positive impact on abnormal return value around patent litigation announcement (albeit at $p<0.1$ level). Evidently, the market reaction considers the relative importance of patents involved in the litigation.

Table 3 Regression results of abnormal stock returns at litigation announcements (Alternative testing for Hypothesis 1)

Independent variables	Estimated coefficients	*t* value	*p* value
Intercept	0.009	0.51	0.6126
Plaintiff?	0.038	4.32	<0.0001
Electrical and electronic patent category?	0.031	2.17	0.0317
Computers and communications patent category?	0.0003	0.38	0.7081
Firm size[a]	0.0007	0.40	0.6917
Opponent firm size[a]	−0.005	−2.61	0.0102
R&D expense[b]	−0.008	−1.81	0.0722
Liabilities[b]	−0.0000	−0.56	0.5793
Avg. number of Citations (adjusted for patent age)	0.0009	1.66	0.0991
Average age of patents	−0.002	−1.73	0.0871
Adjusted r-square	0.1244		
Number in sample	127		

[a] Firm sizes are represented by the natural logarithm of the total assets of the firm during the year the litigation commenced
[b] R&D and liability values are deflated by Firm's total sales

We did not find any meaningful association between the stock performance measure and Liabilities (LIAB). Other variables such as R&D intensity (RD), and age of patents (PATAGE) do show negative relationship at the $p<0.1$ level. While the result with R&D intensity is a bit puzzling, it appears to reinforce results from previous studies that find the relationship between R&D intensity and patent activities as, at best, tenuous. The age of patents, especially in IT industry is significant—especially because of the past pace of change of technology landscape.

6.2 At settlement/termination

The results from the tests for Hypothesis 2 and 3 are shown in Table 4. Hypothesis 2 states that plaintiffs will have positive abnormal returns at the time of settlement/termination of patent infringement litigation, whereas defendant firms will suffer negative abnormal returns. Based on the sample of 65 plaintiff firms, the average CAR for the plaintiffs during [−1, 0] period was 1.17% ($p<0.05$). The median CAR for plaintiff firms was 0.32%. However, the average CAR for the defendant firms was not statistically significant, although they had relatively large average CAR of 1.36% during the same test period (sample size=79). The results indicate that plaintiffs did enjoy positive abnormal returns when the settlement/termination of litigation was announced regardless of the outcome while defendant firms did not have negative returns, which contrasts with the litigation announcement results that we observed earlier. The investors may already have considered the potential costs related with the litigation for defendant firms as soon as the first announcement of litigation occurred. Therefore, most of the damage was done at the announcement of litigation for the defendant and the reaction to the settlement/termination news was primarily based on the discrepancy between investors' expectation of how the outcome would turn out to be and the actual outcome.

To test whether settlement or termination in favor of the plaintiff had differential effect on each litigation participant (i.e., Hypothesis 3a and 3b), we first classified the plaintiff and defendant groups from our sample into two sub-groups: (1) plaintiff favored and (2) neutral or defendant favored. Next, CAR for each sub-group was calculated for the event test period [−1, 0]. There were 31 firms under the plaintiff-favored sub-group among 65 total plaintiffs, and the average CAR for this group was 5.02%,. Median CAR was lower with 1.55% due to the presence of a few exceptional performers, but it is still an unusually high 2-day return. This result was significant at $p<0.001$ level. The average CAR of other sub-groups are insignificant. On average, investors responded most enthusiastically when outcomes favored plaintiff firms.

7 Concluding remarks

Using a market based approach, we have examined the economic significance of patent litigations in the IT industry to the firms involved. Additionally, this study investigated factors that could affect the market's reactions to patent infringement litigations in the IT industry and explored the possibility of systematic differences in the market's reactions based on a number of covariates related to the litigation. Results from this research suggest that the news of patent infringement litigation was unfavorably accepted in the stock market for the defendants. This is especially plausible since the best-case scenario for defendant firms is not to lose in the litigation. Even if defendant firms eventually get a favorable outcome, the expected direct and indirect costs incurred by the litigation must be large enough for the stock market to penalize the defendant

Table 4 Test results of analysis on the abnormal stock returns for plaintiffs and defendants at settlements/termination (Hypothesis 2, 3a and 3b)

	Plaintiff			Defendant		
	All	plaintiff favored	Neutral or defendant favored	All	Plaintiff favored	Neutral or defendant favored
Average CAR (−1,0)	1.17%	5.02%	−2.34%[a]	1.36%	1.60%[b]	1.17%
Median CAR (−1,0)	0.32%	1.55%	−0.33%	0.65%	−0.65%	1.10%
Z statistic	2.079**	4.136***	−1.076	1.588	1.038	1.202
Rank test Z	2.065**	2.578**	0.566	0.817	0.165	0.911
Number positive	34	19	15	44	16	28
Sample size	65	31	34	79	35	44

The event window (1, 10) shows CAR of −4.87% (Z-statistic=−1.813*). The event window (−10,−2) shows CAR of 4.65% (Z-statistic=2.103**)
*$p<0.1$
**$p<0.05$
***$p<0.01$

firms, particularly at the time of announcement. On the other hand, abnormal returns for plaintiff firms at litigation announcement date as well as settlement/termination date were significantly positive.

The results are also confirmed in a multivariate regression analysis that investigated the influence of firm-specific and patent-specific variables. With the abnormal stock returns at litigation announcements as the dependent variable and after controlling the effects of other variables such as the patent type, firm size and innovation importance, there was a significant and positive relationship between being a plaintiff and abnormal stock returns at litigation announcements. When patents are studied as part of the intellectual property of the applicant alone, they do not reveal the impact of the patent in the competitive landscape that the firm operates in. A patent litigation context, however, presents a unique opportunity to study the patent impact in the context of a rival firm. Interestingly, we find that patent litigation impact is dependent on who the opponent is. The larger the rival firm—lower the favorable impact on firm value. Additionally, number of citations to the patent, i.e., importance of the patent, has a positive effect on the announcement related abnormal returns. We find that patents belonging to the electronic and electric categories are more likely to influence market returns, whereas computer and communications patent categories are less likely to do so. Among other firm-specific variables, liabilities did not have a significant impact on abnormal returns whereas R&D expense appears to have a negative impact. In sum, financial markets view patent infringement litigations in the IT industry as being of merit and not frivolous on average. This is supported by positive returns to the plaintiff and negative returns to the defendant.

Although we find evidence that the type of patents had a meaningful effect on the abnormal returns at announcement, a more detailed analysis of patent types and characteristics is desirable in the IT industry context. Recently, patents (as opposed to copyrights) have become an increasingly popular method of protecting software. The number of applications for software-related patents has increased 350% between 1987 and 1995, and the number of patents actually issued has increased fourfold since 1987 (Millonzi and Passannante 1996). The trend is accelerating through the late 1990s and early 2000s. Therefore, it would be worthwhile to investigate market reactions to litigation announcements specific to computer software patents. At present, insufficient number of cases involving publicly traded software firms preclude such an analysis. Another intriguing aspect of this study could be that patent infringement litigations in the IT industry may be value-destroying transactions as the test results of matched abnormal stock returns at announcements of litigation commencement portend a negative abnormal return for the combined portfolio. However, this observation needs further corroboration by investigation of the impacts of patent litigations on the operating performance of the firms during and after the litigation period.

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Appendix

Exemplar announcements and settlement/termination stories

Announcement of patent infringement litigation

AMD vs Alliance Dec. 12, 1996-AMD (NYSE: AMD) announced today that it has filed a patent infringement suit against Alliance Semiconductor International Corp. of San Jose, Calif.

The suit, filed in US District Court in San Jose, alleges that Alliance is infringing AMD patents that cover flash-memory technology.

> "AMD has made the investment required to become a leading worldwide supplier of flash memory," said Tom McCoy, AMD vice president and general counsel. "We have an obligation to AMD's shareholders to protect the company's intellectual property."

The suit asks for both preliminary and permanent injunctions, an accounting of damages and the trebling of such damages, an assessment of interest on damages, a declaration that this is an exceptional case under federal law, and an award of attorney's fees and costs.

xFlash memory is used in products such as cellular phones and battery-powered computation and communication equipment. Flash currently constitutes the fastest-growing segment of the semiconductor industry.

Cirrus Logic vs OPTi Jan. 20, 1997-Crystal Semiconductor Corporation, a wholly owned subsidiary of Cirrus Logic Inc. (Nasdaq: CRUS), today announced that it has filed a litigation in the United States District Court for the Western District of Texas (Austin Division) against OPTi Inc. (Milpitas, Calif.), TriTech Microelectronics Pte Ltd. (Singapore) and Tech Microelectronics International Inc. (San Jose, Calif.).

Crystal filed the litigation for infringement of Patent Nos. 4,746,899, 4,851,841 and 5,220,483, which includes claims

implemented in its multimedia codecs, analog-to-digital converters (ADCs) and digital-to-analog converters (DACs).

Crystal believes the OPTi 82C931 series product and the TriTech TR88015 series product directly infringe upon Crystal's patents. Crystal Semiconductor is asking for an injunction to stop OPTi and TriTech from selling products that infringe on any Crystal patents, as well as damages on past infringements.

Crystal Semiconductor Corporation, headquartered in Austin, Texas, designs, manufactures and markets advanced analog and digital integrated circuits for applications in the multimedia, telecommunications, data communications, consumer audio, data conversion and signal acquisition markets.

Announcement of settlement or termination of patent infringement litigation

AMD vs Alliance In the wake of the settlement, AMD and Alliance will discuss future joint projects that could take advantage of AMD's strength in the Flash memory market, and Alliance's strength in the SRAM market.

The two disputed patents are United States Patents Nos. 5,077,691 (relating to AMD's negative gate erase technology, issued Dec. 1991) and 5,126,808 (relating to AMD's sector architecture, issued June 1992). Both are fundamental patents that were the result of AMD's early innovations in Flash memory technology and represent critical technologies required to produce competitive products in the Flash memory market today.

> "This judgment clearly recognizes the importance and validity of AMD's intellectual property," said Walid Maghribi, group vice president of AMD's Memory Group. "We will continue to enforce and vigorously protect our valuable patent portfolio and we are extremely pleased that our patents have withstood an extensive legal challenge."

> "I am pleased that AMD and Alliance have been able to reverse the tide from a legal battle to a potential partnership where we can both benefit from each other's strengths," said Dr. Ritu Shrivastava, vice president of technology development and general manager of Flash Products for Alliance Semiconductor. "Alliance is a leading supplier of memory products, and is one of the few companies in the world with expertise in all three major CMOS memory segments: SRAMs, DRAMs and Flash. Our resources and energies are much better spent creating new products and markets which leverage our expertise. We do not believe that the settlement will have substantial impact on our Flash product development strategy or the financial performance of our company."

Cirrus Logic vs OPTi In what may be a record-setting patent case judgement, a US federal court jury has awarded the Crystal Semiconductor unit of Cirrus Logic Inc. [NASDAQ:CRUS] $50 million.

The patent dispute was with two Silicon Valley vendors and the Singapore parent corporation of one of them. The outcome may affect audio chip and system design vendors throughout the industry, said Tim Callan, speaking to Newsbytes for Cirrus.

The suit was brought in January, 1997, by Crystal Semiconductor of Austin, a subsidiary of Fremont, Calif.-based Cirus. In the filing, Crystal named as defendants Opti, Inc. of Milpitas, Calif., TriTech Microelectronics International Inc. of San Jose, Calif., and Tritech Microelectronics Pte Ltd. of Singapore.

Crystal alleged in its filings that the defendants violated several mixed-signal patents covering digital-to-analog and analog-to-digital converters. Rights to multimedia codecs also were involved.

Callan described the judgement as "one of the largest in US history."Callan told Newsbytes that the US District Court for the Western District of Texas also labeled the actions of the defendants as "willful misconduct" and promised to add millions of dollars more to the total awarded by the all-female Austin jury.

Cirrus had sought an injunction against the sale of infringing products, plus compensatory damages and treble damages for past infringements. Although Opti has left the audio chip business since the litigation was filed, Cirrus says it will remain liable for prior patent infringements.

In the suit, Cirrus alleged infringement of patents 4,746,899, 4,851,841 and 5,220,483, which include its multimedia codecs, analog-to-digital converters (ADCs) and digital-to-analog converters (DACs).

The defendant firms were not immediately available for comment.

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