Case Study: Stanford's FM License

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The inside story of mutually beneficial licensing agreement between major U.S. university and Japanese company

On April 19, 1994, a Stanford-assigned patent known as the frequency modulation synthesis, or "FM," patent, to which Yamaha Corporation of Japan had a worldwide life-of-the-patent exclusive license, expired. With the expiration of this patent went the second largest royalty flow in the history of Stanford technology licensing. Such is life in the patent world.

The goal of this paper is to describe the truly unique 21-year *relationship* between Stanford and Yamaha that grew out of this license and to further explain how the expiration of the FM patent was only the end to a license, and not to the interaction or relationship. As you will read, the relationship is strong and lives on under a new license to a technology called "digital Waveguide synthesis, virtual acoustics, physical modeling synthesis, or simply and most often, "Waveguide."

This paper will take a case study approach to the FM license and its multiple amendments. It will also give a brief overview of the Waveguide license, and finally summarize some of the benefits to date that Stanford has received as a result of its interactions with Yamaha.

It should be noted that Mr. Niels Reimers, both former LES President and Stanford Office of Technology Licensing (OTL) Director, was responsible for founding and nurturing the relationship between Stanford and Yamaha. It was not until the late 1980s that Mr. Reimers turned the FM case over to the author of this paper with one simple and clear instruction: "Don't mess it up!" With this transfer, it became my responsibility to keep the Yamaha relationship strong. As you will read, it has been a great opportunity and challenging experience.

THE FM CASE STUDY

The FM story begins prior to1971 with Professor John Chowning experimenting with various sound-producing algorithms under the umbrella of Stanford's Artificial Intelligence Lab. Professor Chowning heard something very interesting. He called it an "ear discovery." This ear discovery was FM synthesis.

Professor Chowning disclosed the FM invention to Mr. Reimers at Stanford's Office of Technology Licensing, who then immediately began to contact companies in the United States to find out if any of them had interest in FM synthesis. Diligent as always, Mr. Reimers even contacted Bing Crosby. Unfortunately for North American companies — and Bing — there was no interest.

In 1973, in some frustration with these domestic marketing efforts, Mr. Reimers decided to place a cold call to Yamaha's Los Angeles office. This was a long-shot because at the time Yahama was not known in the U.S. for electronic musical instruments. Fortunately for both Stanford and Yamaha, Mr. Kazukiyo Ishimura just happened to be visiting from Japan, so Niels arranged a meeting between Mr. Ishimura and Professor Chowning, and the courtship between Yamaha and Stanford began.

To Professor Chowning's excitement, Mr. Ishimura understood and recognized the potential of FM synthesis "in a short 10 minutes," and in July 1974, the parties became engaged via a letter option agreement to the FM technology.

In March 1975, after some serious evaluation by Yamaha, Yamaha and Stanford were married via an exclusive license. Almost simultaneously, Professor Chowning and others founded the Center for Computer Research in Music and Acoustics and decided that its acronym, CCRMA — perhaps in anticipation of some form of Hinduistic transmigration between Yahama and Stanford — would be pronounced "karma."

CCRMA was a one-room center, located off the Stanford campus. It fell under the umbrella of the Artificial Intelligence Lab. CCRMA was supported by modest funds from Stanford internally, Mrs. Doreen Townsend, the National Science Foundation (NSF), and the National Endowment for the Arts (NEA). CCRMA considered itself lucky to have any funds and any space to do research in the arcane world of computer music. Further, it knew that its days of funding were limited because sound synthesis was not, and never would be a national priority.

THE FM AMENDMENTS CCRMA ENDOWMENT FUND

Within two years of execution of the original agreement, an amendment was needed. This first amendment was nonsubstantive, but the five that followed are worth studying because they show how the relationship evolved. They also show that Yamaha had a very good understanding of what might happen in the markets.

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The second amendment to the original agreement was executed in 1977 and addressed the definition of Musical Instrument. The original definition focused on a digital electronic *organ.* But even as early as 1977, organs were losing popularity, and small, inexpensive synthesizers were starting to become realistic. So the word "organ" not to mention a digital one in 1975, was too limiting. Yamaha requested a change, and the definition was broadened to focus on a musical instrument or device.

The salient point of Amendment No. 2 is that times were changing quickly even in 1977, and the precedent of modifying the language of the agreement to track changes in the market without undue delay or posturing by either side was being established.

In July 1979, Amendment No. 3 was executed, the significant parts being:

1. That Stanford would not terminate the agreement "for want of diligence." Stanford was very much in touch with Yamaha's progress and knew that Yamaha had too much time and money invested in FM to just walk away. But there was also obviously a certain degree of trust involved, because Yamaha still had no significant FM product on the market.

2. Relaxing of the mandatory sublicensing provisions so that Yamaha would not be required to sublicense prior to July 31, 1983. Yamaha did not want to show how practical FM was in one market only to be forced to sublicense into other markets that it had not yet had the opportunity to explore.

3. Granting rights of first refusal to future related Stanford technologies.

From CCRMA's perspective, Amendment No. 3 is one of the most important. Stanford received a modest one-time royalty payment for it. Modest by Yamaha and Stanford standards, but huge to the one-room CCRMA, *if* CCRMA could get its hands on it.

Under Stanford's normal royalty distribution policy, net royalties are distributed one-third each to the school and respective department in which the invention was discovered, and one-third to the inventor(s). Unfortunately, CCRMA was neither school, department, nor inventor.

So CCRMA separated from the Artificial Intelligence Lab in 1979 and merged with the School of Humanities and Sciences (H&S). Fortunately for CCRMA, Professor Chowning was looking to the future and acting in the present. He persuaded the Department of Music and H&S to deviate from normal royalty distribution policy for the one-time royalty payment under Amendment No. 3, and distribute their shares to CCRMA. Professor Chowning pledged that if this was done, he would also donate his personal share of the royalties from this one-time payment to CCRMA. All agreed, and the result was that 100% of the Net Royalties for this amendment went to CCRMA so it could buy a computer system to continue its research in computer science, music, and engineering, and support a small staff.

Professor Chowning also negotiated another excellent agreement at this time. He convinced H&S and the Music Department, which would have otherwise collectively received two-thirds of future Net Royalties, to "donate" their future royalty shares to fund CCRMA's operating expenses, and to place any excess in an endowment fund for CCRMA. All agreed to do so until an endowment level was reached that was sufficient to support CCRMA.

INDEPENDENT GOALS

In 1979, Stanford and Yamaha were meeting three independent goals:

1. Yamaha was methodically securing what might be a lucrative market under the amendments to the original FM Agreement.

2. Stanford, with the modest amendment fees, was able to nurture the growth of CCRMA, which was becoming a multi-disciplinary research center.

3. OTL was proving, along with other cases in other more traditional sciences, that technology transfer was good thing for Stanford to be involved in.

In May 1981, yet another amendment was needed to address the earned royalty. But because the original agreement with its multiple amendments was becoming too cumbersome, a new agreement was drafted that addressed the earned royalty.

The FM earned royalty was originally negotiated to be a fixed dollar amount per unit. The amount was based on the presumption that a Licensed Product(s) using FM would be a large system that would sell for tens of thousands of dollars. But by 1981, the concept of small digital synthesizers was a reality, and it appeared that the average retail price would be more in the $2,000 range. So, the earned royalty was reduced to a more reasonable amount based on a percentage.

THE DX-7 — THE WORLD'S BEST SELLING MUSICAL INSTRUMENT

In 1983, for unique reasons beyond the scope of this paper, CCRMA received a five-year grant for $2.7 million. Also in 1983, Yamaha introduced the first significant FM product, called the DX-7. This would eventually be the best selling electronic musical instrument ever made.

Yamaha had taken more than 10 years to develop FM into a superb product. The DX-7 was received with rave reviews. The flow of royalties to Stanford would now include significant earned royalties and account for a substantial percentage of OTL's total income (third largest in OTL).

Soon after 1983, there were new markets that would not compete directly with Yamaha's musical instrument business, and Yamaha wanted to spread the FM technology into these areas. So on April 26, 1984, Amendment No. 1 to the new agreement specified what the earned royalty for integrated circuits would be. Shortly thereafter, Yamaha began to explore the opportunities of selling integrated circuits in the game industry.

In 1985, Yamaha's FM royalties were used to rejuvenate a building on Stanford campus known as the

Knoll, which became CCRMA's permanent home. The Knoll was at one time the home of Stanford's President, and it still boasts one of the best views on campus of the San Francisco Bay Area.

By 1987, the royalties on sales of the DX-7 were flowing steadily. The timing was perfect because CCRMA's five-year, $2.7 million grant would soon expire, and there were no other sources of funding to replace it. Fortunately, the FM earned royalties were large enough to support CCRMA's operating expenses.

OTL and CCRMA were thrilled. Technology transfer was working. FM was a Cinderella story. Except for one thing: Stanford had licensed FM exclusively to Yamaha, a Japanese corporation, and the U.S. music industry now wanted in. This was only a relatively minor political problem in 1987 because OTL had been diligent in marketing the FM technology to the U.S. keyboard industry, and since this industry was relatively small, the groaning wasn't too loud. Regardless, the "Stanford bashing" had begun, the question being, why had Stanford licensed Yamaha exclusively?

One reasonable concern that came out of this early fussing was that there should be a second source or supplier for integrated circuits. This is a good way of keeping integrated circuit prices down and ensuring that market demands can be met. So on April 11, 1987, Amendment No. 2 to the new agreement stated that should sales of integrated circuits reach a level at which Yamaha would be strained to supply the market demand, Yamaha would sublicense to a North American company the rights to sell integrated circuits. This never became necessary.

DIGITAL WAVEGUIDES IN MUSIC — HISTORY REPEATS ITSELF

Concurrently in 1987, just as the FM royalties were leveling off, Yamaha was taking a serious look at Stanford's new "Waveguide" technology under an exclusive option. History will always repeat itself without divine intervention.

The Waveguide story started off the same way as FM: Stanford marketed Waveguide extensively to North American companies, but there were no interested parties. By 1989, Yamaha had concluded that Waveguide was the future of sound synthesis and expressed interest in another Stanford exclusive license. Stanford obliged with a caveat. In an attempt not to put itself in the same position with respect to FM and North American companies, Stanford issued Yamaha a Waveguide license that was exclusive *but for North American companies!*

Leaving rights to license North American companies to Waveguide turned out to be a very interesting move for reasons that were not apparent in 1989. A new industry was on the horizon in which North America would become very interested, and that industry would be hungry for sound technologies. This, of course, was multimedia.

By 1991, however, Yamaha had established FM as the *de facto* synthesis standard. Its integrated circuit business was flourishing, not for games as originally anticipated, but for this new multimedia industry. North American multimedia companies were springing up all over Silicon Valley, right in Stanford's backyard. They wanted synthesis techniques. Waveguide was now of interest to them, but it would take years to develop a Waveguide product. North American companies were frustrated because there was a lucrative FM market before them, but the only way they could get in was to buy FM integrated circuits from Yamaha. The FM politics grew worse.

◄ Threaten Lawsuit ►

One company threatened to sue Stanford over the issuance of the FM license to Yamaha. It was not a threat that concerned Stanford from a legal perspective but, from the political side, it was significant. I received complaining calls almost daily for awhile, but all I could do was to communicate the concerns to Yamaha. Fortunately, as you will read, Yamaha was very sensitive to the issues.

At the time, Yamaha was doing a great business just selling FM integrated circuits to makers of sound boards. These are computer add-on boards that make it possible to get FM into the home for a few hundred dollars instead of two thousand, providing, of course, that you already have a computer. Sales volumes for integrated circuits were much higher than for keyboards, and royalties to Stanford increased by almost a factor of two *each year* from 1991 to 1994.

A great deal of infringement of the FM patent started around 1991, and many companies called me to find out how Stanford was going to help them get into the FM market or support them should Yamaha take infringement action against them. Some companies assumed that once the Stanford FM patent expired, they could release an FM product. They were either oblivious to Yamaha's own FM patent position, which I informed them was significant, or were simply in denial. On top of this problem for Yamaha and Stanford, illegal FM integrated circuits were also entering the United States.

Even though Yamaha had its own patents in FM, it was not until the day after the expiration of the Stanford FM patent, (April 20, 1994) that Yamaha asserted infringement actions against North American companies. Coincidence? Maybe. Regardless, this was politically good for Stanford and strategically good for Yamaha. Yamaha could, without causing problems for Stanford, enforce FM with its own patents and show that the expiration of Stanford's FM patent did not mean that Yamaha's proprietary position in FM had eroded. Stanford assumes this was a brilliant strategy that once again mutually benefited both parties.

Just before the expiration of the Stanford FM patent, Yamaha introduced its first Waveguide product, the VL1. The VL1 is clearly the most sophisticated synthesizer on today's market and promises to be another industry standard and generate significant royalties for Stanford. However, while Stanford and Yamaha are still definitely partners, due to the "but for North American companies" nature of the

Waveguide license, they have become at some level, competitors. With Yamaha holding 45 issued patents to date in the Waveguide area, our relationship and discussions will continue to be interesting.

BENEFITS TO STANFORD

In summary, there are clearly two entities within Stanford that have received the most benefits from licensing interactions with Yamaha: these are the Office of Technology Licensing and CCRMA.

Benefits to Stanford OTL

In 1975, when the FM license was executed, Stanford's Office of Technology Licensing was trying to prove that the then relatively unique concept of technology licensing was a good idea, and that licensing all kinds of technologies was something in which Stanford should be involved. Yamaha helped prove this concept. The FM royalties were critical to OTL's recognition and helped support a staff who are busy looking for other big hits so that associated royalty flows can be used to support research and education as the Yamaha FM royalties have so successfully done.

In 1975, Stanford OTL had two employees and brought in under $500,000 in royalties. Today, OTL has 20 full-time employees, and it brought in $38.2 million last year. Ironically, the percentage of FM royalties, as compared to OTL's total royalty income, was the same in 1994 as it was in 1975.

FM royalties helped OTL grow and gain respect as an organization.

Benefits to CCRMA

The FM royalties helped CCRMA grow from a one-room lab into a multi-disciplinary research center, with students majoring in mechanical and electrical engineering, as well as computer science and music, and helped graduate over 50 PhD students to date.

Perhaps more importantly, the FM royalties in excess of CCRMA's operating expenses have nearly reached the projected endowment level, which means CCRMA will soon be able to survive indefinitely at its current staff and student level, perpetually educating some of the brightest minds in the world. This, in turn, results in another benefit to Stanford OTL: the practical applications of the work of CCRMA's staff and students, who are currently some of the most active patent generators on campus, with an exceptional ratio of issued to licensed patents, are continuously creating more opportunities for successes like FM.

I believe what you have just read about must be the most mutually beneficial licensing agreement to date between an American university and a Japanese corporation. It is hard to image that in today's patent and licensing world there will be another single patent, single licensee license that will mean so much to a U.S. university or its respective corporate partner.

On behalf of Stanford as a whole, but especially its Office of Technology Licensing and Center for Computer Research in Music and Acoustics, this paper is dedicated in thanks to Yamaha for this very valuable relationship and all it has meant to Stanford. We further wish the best of luck to Yamaha in its new endeavor to again take a Stanford fundamental technology to market and be as successful as it was with FM.