

Episode 14

Legal Battle over Microprocessor

In 1989, the imperial era in Japan was changed to Heisei from Showa, and the structure of Hitachi's semiconductor business also entered a new turning point. One day, an unexpected change occurred in my semiconductor life as well.

As I already mentioned, Hitachi's semiconductor sector had switched from a traditional "factory-profit-center system" to a market-oriented "business-division-center system" in 1969, exactly 20 years before. It was returned back again to its original factory-profit-center system in 1976, due to the poor performance caused by the subsequent oil shock.

This time, the system was once again returned back to the business-division-center system. The reason for this change was that, from the customer's point of view, it became clear that total solutions could not be delivered as the Semiconductor Division by the separate factory based operations like Musashi or Takasaki operations.

In February 1989, the Semiconductor Design & Development Center (SDDC) was organized in the Semiconductor Division, and I was appointed the first GM of this SDDC from the GM of Takasaki Factory. The task of the GM of the Center was to manage all the design and development activities that had been in the factory organizations so far. All the product areas were covered, including memory, microprocessor, logic, bipolar IC, and discrete devices. Furthermore, basic technology development like process, package and CAD were also included.

Well, the first major task, as the SDDC GM, was to deal with the legal battle over microprocessor against Motorola.

By the way, the word of "microprocessor" is rather broadly defined here as to include not only MPU (Microprocessor Unit) but also MCU (Microcontroller Unit).

The patent dispute problem had occurred about a month before I became GM of SDDC. Let me talk about that.

Hitachi developed its own 4-bit microprocessor in 1974, but the development of 8-bit products did not progress well. Yoshinobu Imamura, who became the new GM of Semiconductor Division, was worried that Hitachi's microprocessor business would be lagged behind in this situation. In order to find some solutions on this issue, he visited the major semiconductor makers in the United States in 1974, and I accompanied him.

When we visited Motorola, discussion between the executives was focused on the possibility of technology exchange. In other words, it was intended to exchange technologies of fields of specialty with each other. The picture below was taken when we visited Motorola.



Photo 14.1 Imamura's visit to Motorola (1974)

From left, Tohru Abe (late), Yoshinobu Imamura (late), and the author

After that, practical discussions were conducted between the two companies. Hitachi proposed automated bonding machine as a candidate for technology exchange, and Motorola proposed 8-bit microprocessor, 6800 series.

Hitachi's bonding machine was developed by the team of Equipment Development Department under the leadership of Jun Suzuki as the Dept. Manager. It was the highest performance machine in the world at the time, and Motorola had a strong interest in it. In return, Hitachi indicated an intention to introduce 6800 series microprocessors from Motorola. After several negotiations, it was finally approved by Hitachi's Executive Committee in November of 1975.

At that time Intel was by far the top manufacturer in the field of microprocessors, and Motorola was seeking a partner as their second source to catch up with Intel. Therefore, by having Hitachi as a partner in the microprocessor field, Motorola would obtain a strong reinforcement for competing against Intel. Simply stating, it was a scheme to compete against Intel by 6800 series products with Motorola as the head of the camp.

Hitachi worked on two major technological developments to strengthen the 6800 series. One was application of high-speed CMOS technology to the microprocessor, and the other was ZTAT technology to be described later.

As mentioned earlier, Hitachi established the world's top position with 4K and 16K bit SRAM, for which high-speed CMOS technology was first applied, and we chose 8-bit microprocessor as the next product to apply this technology.

Although the first product introduced from Motorola was NMOS version, it was converted to CMOS in a year's development work, and the product was announced in October 1991 with the type name of HD 6301. Based on the agreement between the two companies, 6301 was immediately transferred to Motorola.

Another breakthrough development was ZTAT technology. ZTAT means Zero TAT, that is, "zero turn-around-time".

This expresses that users can write programs into the chips by themselves. At the time, there was a term of QTAT (Q means Quick), but I named our technology as ZTAT, which meant zero turn-around-time, or ultimately quick TAT.

At the time, the mask change was required to write programs in the ROM (Read Only Memory) on the chip. While there is an advantage that the memory cell area is small, long lead time is a disadvantage, since rewriting is performed by a semiconductor manufacturer each time. On a mass-production basis it may take a few weeks to a month from the order to the shipment.

In our ZTAT microprocessor, we devised a new method of using OTP (one-time-programmable) ROM instead, so that customers could write programs in the chips by themselves on their sites. While there is a disadvantage that the memory cell area becomes slightly larger, almost zero TAT is an overwhelming merit for the users.

Development of these microprocessors was promoted by up-and-coming youngsters such as Shiro Baba, Naoki Yashiki, Yasushi Akao, Tsuneo Sato, and Kiyoshi Matsubara, with Toshimasa Kihara as the leader. Until today, they have been playing leading roles in the microprocessor field at Hitachi semiconductor, continuing into Renesas Technology.

Introduction of high-speed CMOS technology and ZTAT technology gained high reputation from customers. We thought that it would be highly appreciated by Motorola as well. But unexpectedly, a gap between the two companies was growing little by little. Two factors as the background seem to have been top executive replacement of Hitachi's semiconductor and its improved competitive position in the market.

As mentioned above, Imamura, previous GM of Semiconductor division, first opened up a friendly relationship with Motorola, but the next GM who succeeded-him was not necessarily enthusiastic about this relationship, rather he was negative about it.

In addition, it also might have been a reason that CMOS technology and ZTAT technology did not sufficiently contribute to their business. And suddenly one day, Hitachi received a message from Motorola that they would not grant their patent right to the ZTAT version of microprocessors. Hitachi had no choice but to withdraw ZTAT microprocessors from the market.

Since I was in the post of GM of Musashi Factory at that time, I was pushed into a very difficult decision.

How should we develop the microprocessor business in the future? Should we continue the second source contract with Motorola? Or should we develop microprocessors with our own architecture? After repeated discussions including the research laboratories in the company, we decided our strategy that, "We should terminate the second source contract with Motorola and go on with our own original microprocessors", and we announced it in October 1986. It was the unwavering determination of Hitachi's semiconductors.

The Microprocessor Design Department (Hajime Yasuda as Dept. Manager) worked on developing the original microprocessors with all the best engineers. Also, we received strong support from research laboratories inside the company.

However, after the start of this project, I was assigned the new position as GM of Takasaki Factory, and I was away from the microprocessor business for the next two years from 1987 to 1989.

Meanwhile, the development of Hitachi's original microprocessor named H8 progressed steadily and the product was announced in June 1988.

However, an unexpected incident occurred at this point.

Soon after the announcement of H8, in January 1989, Motorola filed a lawsuit on the grounds that "H8 infringes Motorola's patents". In Hitachi, it became a huge issue across the whole company, and immediately we filed a counterclaim that "Motorola infringes Hitachi's patents."

Should we call it a trick of fortune? Next month after Motorola filed a lawsuit, I was appointed to the GM of SDDC from the GM of Takasaki Factory. Since this microprocessor law suit was the case of which SDDC was mainly in charge, I had to spend a lot of my time on this issue as the GM.

The trial dragged on and the judgment came out in March 1990, and the settlement was established in October 1990 based on that judgment. For nearly two years, the sales activities of microprocessors were in stagnant situation. Now the case was finally settled, and the reconstruction of the microprocessor business started.

The microprocessor dispute with Motorola left with us various lessons. One important lesson is that, in developing original architecture in microprocessors, we need to develop totally novel one which never existed before. With the conclusion of the trial, we gathered our engineering power aiming at what can be said, "This is very Hitachi!" in the development of the higher range family of H8.

The powerful members of the development team included Baba, Akao, Kurakazu, Shunpei Kawasaki, and Ikuya Kawasaki with the leader Toshimasa Kihara mentioned before. They were the best engineers in this field available from SDDC.

From the laboratory side, Noguchi and Uchiyama from the Central Research Laboratories, Maejima and Katsura from Hitachi Research Laboratories, and Domen and Kainaga from System Research Laboratories were engaged in this project.

The SH microprocessor was developed in this way. SH was named from SuperH and it made a debut in November 1992.

For me as the head of SDDC, the development and commercialization of SH microprocessors were the most important task, and I took the initiative in top sales. Photo 14.2 below is a photograph for the commercial advertisement at the time, and it showed SH was nothing but "microprocessor with our firm resolution".

日経エレクトロニクス 8月30日号 (隔週刊曜日発行) 1993年8月30日発行 第589号 1971年5月1日第三種郵便物認可

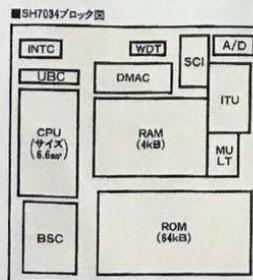
HITACHI



株式会社 日立製作所
常務取締役 半導体事業部長
牧本次生

そこから生まれた、32ビットRISCマイコンです。

SHシリーズ誕生の背景には、果敢な決断がありました。機器組み込み用マイコンとしてのRISCチップ開発。日立がはじめから目指したのはシングルチップのRISCマイコンです。このためには、CPUサイズを小さくし、メモリをはじめとする周辺機能を内蔵することが必須条件です。技術的な難しさを承知のうえでこの選択に踏み切ったのは、ユーザーの視点で製品づくりに取組みたいという私たちの強い意志があったからです。その成果としての32ビットシングルチップRISCマイコンSHシリーズ。16MIPS (20MHz) を達成する高速処理に加え、DSP機能も内蔵した、きわめてコストバランスに優れたマイコンです。



日立シングルチップ
RISCマイコン
SuperH
RISC engine

株式会社 日立製作所

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printed in Japan

Photo 14.2 SH microprocessor advertisement (1993)

We succeeded in opening up a new market segment called digital consumer products, including digital cameras for consumer use such as “QV-10” which was first commercialized by Casio, and the game machine of Sega. I would like to touch on this subject in another opportunity.

Now, F-ZTAT technology is another pillar of the microprocessor business along with the new architecture of SH. As I already mentioned about it in the previous episode, it is a Flash based program ROM on the microprocessor chip.

The previous ZTAT technology using OTP-ROM enables the users to program memory only once, but F-ZTAT makes it rewritable in number of times, and the flexibility becomes much higher. After its market introduction in July 1993, it started to gain strong momentum from 1995. Cumulative shipments have already exceeded the world's largest 1 billion, and it is now the core product of Renesas Technology.

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