Lecture, Vision Track: C&C User Forum 2005

NEC's Technology Innovation Strategy

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1. Present Status of the Japanese Science & Technology (S&T) and High-Tech Industries

(1) The Recession in the Japanese Manufacturing Industries in the 1990's

The Japanese high-tech industries experienced their peak period in the 1980's and particularly in 1986, when a total of 6 Japanese firms were counted among the world's top 5 sellers in all of the three fields of semiconductor chips, communications and computers. The situation in these industries is now showing a decline with only 2 Japanese firms counted among the world's 5 top sellers.

The causes behind this situation lie in the following two points:

❶ Re-evaluation of the yen: The Japanese currency has increased in value rapidly since the Plaza Agreement in September 1985, and this has tended to reduce our export competitiveness.

❷ China: has now assumed the status of "Workshop of the World". The wage in Japan is 20 times higher than in China (the average annual wage is 15,000 yen in China and 300,000 yen in Japan).

As a result, a hollowing of the Japanese manufacturing industry has begun due to successive bankruptcies of local businesses and the shifting of production to China by big businesses.

When we review the growth of the manufacturing industries in different countries in the context of the increase in the production indices of the mining and manufacturing industries, China's input has increased by about 3 times, Korea's by about 2.3 times and the USA's by about 1.5 times, but Japanese industries have been stagnating over the same period. The period is now called the Lost Decade.

What attracts attention in this context is Korea. Although the wage in Korea is not so different from Japan and more than 10 times higher than in China, the country has achieved the impressive growth of 2.3 times. We will discuss the causes of this growth in the following.

(2) The Growth and Strength of Samsung Electronics

The high-growth business that represents Korea is Samsung Electronics. This firm presently holds top shares in eight products including NAND Flash, TV, monitors, CDMA cellular phones, SRAM, LCD, VCR and DRAM, and is aiming at increasing its number of products in the world top shares to 20 in 2010.

The operating income of Samsung Electronic reached 1.3 trillion yen in 2004, which is higher than the total operating income of 0.8 trillion yen of five Japanese manufacturers including Hitachi, Toshiba, Mitsubishi Electric, NEC and Fujitsu. The strength of Samsung Electronics lies in the following points.

1) The company has been targeting capture of the world market for 20 years.

• A very high education level has led to an accumulation of human resources.

• The Koreans show a very strong rivalry and competitiveness with regard to Japan. They have an impressive motivation that makes them work very hard.

• The small size of the Korean market compared to Japan (particularly before 1985) has made it absolutely necessary for them to advance in the world. (The Japanese GDP in 1985 was 150 trillion yen, which was about 15 times greater than the Korean GDP of 10 trillion yen.)

2) Large scale advances in plant investments has led to them being able to defeat the competition in the field of mass-production.

• The Korean government defined science and technology as the national identity and positively supported private businesses such as Samsung.
• Accurate "selection and concentration" judgments and investment strategies of the top managements enabled business expansion.
• Massive investments were focused on target fields as seen with the semiconductor industry. (The semiconductor plant investments of Samsung Electronic in 2005 were about 550 billion yen.)

As described above, the principal reason for the growth of Samsung Electronics is that they have maintained a spirit of challenging global leadership over the last twenty years and that they have implemented major investments in state of the art plant facilities.

2. Revival of Japan by Promoting "The S&T Creation Country" as the National Policy

The Japanese government has also started recently to promote the revival of Japan as an "S&T creation country". Fortunately, Japan still retains high technical abilities. It holds the second position after the USA in the world ranking of patent registrations (source: Annual Report on Patent Administration 2005).

The Japanese government is planning to appropriate the budget for the Third Science and Technology Fundamental Program with the intention of fostering new industries. This program is expected to enhance R&D in the four key fields of life sciences, information communications, environmental technologies and nanotechnology.

Among them, let us review the governmental efforts made in the field of information communications, as this field is the most closely related to the business of the NEC Corporation.

1) e-Japan Strategy (Started in 2001)

This project was begun by setting the target to introduce broadband network high-speed lines to 30 million households and ultrahigh-speed lines to a further 10 million households. It has advanced more than was expected and has led to the spread of permanent connection environments to 46.3 million households using DSL, 33.1 million households using CATV, 35.9 million households using FTTH.

2) u-Japan Strategy (Started in 2005 under the leadership of the Ministry of Internal Affairs and Communications)

This project promotes the active use of the most advanced networking systems aiming at realizing the Ubiquitous society in which communications are possible "anytime, anywhere, with anyone and by any means."

The information communications equipment of the Ubiquitous society is composed of three elements. These are; 1) dedicated terminals including cellular terminals, digital home appliances, PCs, ATM machines and ticket purchase terminals, all of which are connected to; 2) broadband networks, which are connected to; 3) groups of servers that process everything as the brain of the Ubiquitous system.

Now, let us introduce the servers that from the core of the Ubiquitous society.

3. NEC's Server Strategy

Servers can be classified roughly into the following two types (**Fig. 1**).

❶ High-end servers: These are the mission-critical servers used by society in general, private businesses and governmental institutions. They need to feature extremely high technical abilities in order to function effectively. Also, in consideration of their high value-added status and high quality, we hope to produce them in Japan and to market them worldwide.

❷ Commodity servers: These are the servers installed in individual departments. As they need to be at competition in the areas of mass-production, mass-sales and cost reduction, we are planning to produce them in China, etc. on a massive scale and at a low cost using standard parts and components, so that we can expand our world share of sales.

One of the most important commodity servers is the IA server. Actually, NEC set its most ambitious target in 2005, when it aimed at achieving a tenth successive victory in the shipment of the Express 5800 Series IA servers in Japan.

(1) Technical Points of High-End Servers

Most of the servers in use incorporate Intel microprocessors, that contribute a server controlled, large-scale integration (LSI) environment, which is variable depending on the manufacturer. As a result, the key component determining the fate of each product is the server controller LSI. NEC is developing original LSI, featuring high performance and advanced functions by making full use of its device technology and semiconductor processing technology. These efforts have led to a server controller that contains 41 million transistors in a 16.7mm wide chip, a device that we currently boast of as the world's Number-One chip.

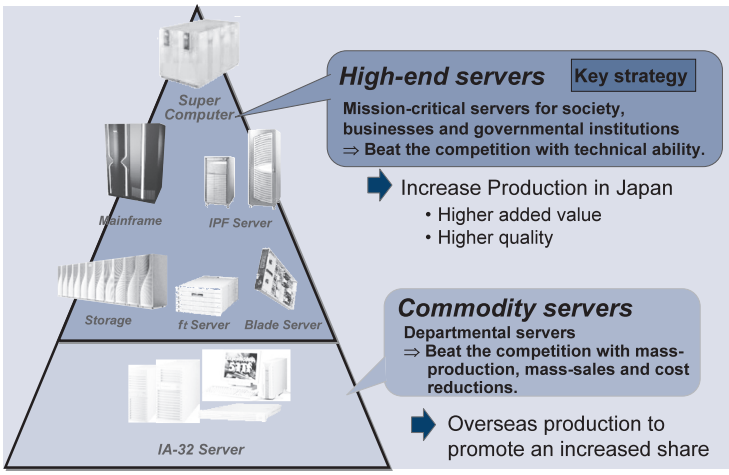

Fig. 1 NEC's server strategy

(2) Development of High-Performance, Advanced-Function LSI for Servers

NEC has been developing high-performance, advanced-function LSI by challenging the conventional wisdom of the world.

"Moore's Law" is a very famous theory in the world of integrated circuits saying that the integration density quadruples every three years. It has already become an axiom that is accepted worldwide. NEC challenged this saying and attempted to increase the density by 32 times over three years, assembling 50 highly experienced engineers to develop a chip that can accommodate 32 LSIs and also by improving overall performance.

After about a year had elapsed from the start of the program and just as the engineers were about to gain the summit, they encountered a precipice of Moore's Law. It was a most difficult obstruction, preventing them absolutely from reaching their goal. The team of 50 engineers tried hard, studying alternative routes to the summit daily, repeating computer simulations, and continuing daring attacks day and night. Eventually, four months after their scheduled completion date, their efforts were rewarded and they reached the summit.

4. Global Strategy

The computer manufacturing industry is dominated by top manufacturers that include IBM, HP and Sun Microsystems, and it is extremely hard for Japanese manufacturers to compete against them on an equal footing. Nevertheless, NEC is determined to advance and gain global success by their endeavor and technical ability, which can outclass Moore's Law, just as Samsung Electronic did. From this viewpoint, the collaboration agreements with UNISYS and Stratus agreed in 2005 are expected to offer a major opportunity for making such advancement possible.

(1) Collaboration with UNISYS

Previously, NEC has been developing and producing three types of servers independently. These include mainframes, UNIX servers and PC servers. But such a production system could not achieve the requisite mass-production effects or cost competitiveness due to the high cost and low production volume per model.

To solve the above problem, NEC studied the possibility of creating a common server for the three types of applications by developing an LSI as described above using Intel processors and thus succeeded in developing a common server containing the mainframe. This strategy made it possible to unify the three previous types of servers into one unit. As this development has enabled a simplification of the previous development operations that dealt with three models, NEC has succeeded in a threefold increase in the production volume per model and has thereby achieved a significant reduction in costs.

On the other hand, UNISYS which is a manufacturer with a 120 year history has also been struggling with an independent development of three server types. Knowing the success of NEC, they were conscious of the high technical abilities of NEC and decided to contact us. As a result, the two firms agreed to a technical collaboration program, in which the two firms will jointly develop a common platform to cover their high-end server products, producing all of the server models at the NEC Computertechno Plant (Kofu, Japan) and supplying the market with products of both NEC and UNISYS.

UNISYS has developed a global computer business by selling 50% of their products in North America, 40% in Europe and 10% in other areas. Allowing all of these servers to be produced using a common server to be produced by NEC, this tie-up will bring the benefits of increasing the production volume per model for UNISYS and of providing a means of global advancement for NEC.

(2) Collaboration with Stratus

The fault-tolerant server is an remarkable high-tech server that has been developed in pursuit of non-stop operation. The applications of servers are expanding widely in fields where even a momentary shutdown is absolutely impermissible,

such as in the case of communications or process control environments in the manufacturing industries.
The fault-tolerant server market worldwide is dominated by two firms, these are NEC and Stratus. Previously, NEC and Stratus have developed server models jointly, by introducing Stratus technology and have allotted production between them. As NEC has succeeded in developing a new server technology, the two firms decided on a new form of collaboration, in which all the models are developed and produced by NEC and marketed through the sales networks of NEC and Stratus in order to achieve a complete supremacy of the global market.

NEC is planning to expand the overseas ratio of its computer business in the near future based on and including the above described collaborative ventures.

5. New Service Applications of Servers

Two of the new service applications of high-performance servers that are being developed and provided by NEC are described in the following.

(1) Remote Conferencing for Easy Information Communications
A new type of remote conferencing system that features an enhanced feeling of presence is enabled by connecting remotely located conference rooms through a network and using the conference server, PCs and projectors developed by NEC. This system can be implemented using the following new technologies.
❶ High-speed document distribution technology
While previous remote conferencing has been conducted by faxing documents so that the participants can talk while reading the printouts of the documents, the new system replaces the above operations by displaying documents on the projector screen. Thanks to NEC's new image processing technology, the time required for the transmission of document data to remote PCs is reduced from about ten sheets/sec, with the previous 100M communications, to twenty sheets/sec. with the new system.
❷ Electronic pen
The electronic pen can be used to write characters, etc. on the projected screen. The traces of the electronic pen are identified completely by means of infrared rays and ultrasonic signals, and the reception device outputs the signals to the projector and PCs to reproduce the same traces on them. In addition, the same traces are also reproduced and displayed on the projectors in the remote locations connected via the network.
❸ New short-focus projector
Previous projectors had to be installed at a distance of 190cm from the screen, so that the projected image was often obstructed by the shadow of a person standing in front of the screen. NEC has solved this problem by the first time development of a projector capable of focal adjustment at the short distance of 26cm. With this projector, the projected image will not be obstructed by a lecturer etc. standing near to the screen or by a human shadow.
These are the technologies that enable all of the participants of the new type of remote conference to view the same images regardless of location and to improve the efficiency of the conferencing system by being able to perform simultaneous checks. NEC expects that this improvement in the convenience of remote conferencing will expand its applications to cover university lectures, etc. The system is already being marketed in Asia.

(2) Automatic Interpretation of Communications via a Server
NEC has been continuing R&D for automatic interpretation for about 20 years. This system facilitates conversations involving the Japanese and English languages and ensures clear communications between non-Japanese speaking and non-English speaking persons. The system automatically interprets messages spoken in English into Japanese and those spoken in Japanese into English and transmits the interpreted messages to the other party. The possibility of lively discussions without interruptions is surely one of the advantages made possible in the Ubiquitous world. We are continuing to vigorously promote R&D in this area, in order to enable the benefits of a broader field in the future.

6. NEC's Product Developments in the Ubiquitous Age

The original contributions of Japanese people and Japanese culture (animations, games, pop music and movies) are now accepted worldwide. As is already well known, two years ago, TIME magazine featured the catchphrase of a Japanese pop singer 'Shiina Ringo' "Japanese rule, OK?" on its cover. This warned the people that in the future they should be prepared for a possible replacement of the American standards that have been leading the world by the Japanese ones.

(1) Examples of NEC's "Japanese Cool" Challenge – an Ultraslim Cellular Phone

NEC is developing cellular phone products both from the aspect of technology and design, and these efforts have led to the launch of the world's slimmest cellular phone in the Chinese market (**Fig. 2**). The joint work of the engineering team who are improving their skills every day and the designer team who are refining their expertise by serious discussions etc. or "collaboration in the world of craftsmanship" endeavors to launch cool products that cannot be imitated by our global competitors.

One of the technology innovations thus achieved may be seen in the development of the ultra slim packaging technology. Traditional cellular phones adopted a cabinet with a width of 23mm that contained much space inside because large components were needed. On the other hand, to develop the world's slimmest cellular phone, they conducted R&D into a slim format construction that could reduce the now unnecessary space and improve the functional efficiency, and have succeeded in packaging equivalent components and functions in a reduced cabinet thickness of 11.9mm.

The development encountered a problem in the strength of the slim cabinet. Namely, the thin cabinet was found to be very weak against external forces. The NEC staff solved this problem by implementing a composite cabinet of metallic and reinforced plastic materials, and realized a very strong case material with a thickness of 0.3mm.

These efforts in technical and product development enabled a product that is a typical example manifesting "Japanese Cool" in an admirable manner.

(2) NEC's Concept on Future Terminal Designs

It is expected that in the future LCD materials will become thinner and capable of displaying various information even if they are stressed. The LSIs will also decrease in size considerably. Recently, I personally asked designers to design a terminal by showing them virtual images of my conception of cellular phone and PCs five years hence. This terminal can usefully be put in a pocket, but pressing a button changes its size and turns it into either a cellular phone or a PC. It also has a keyboard and can show moving images. We hope to realize such a device in the coming five to ten years.

(3) Determination for Future Endeavors

Our ex-NEC Chairman Sekimoto used to say, "Jidai no kaze wo kata de shiru." It is difficult to translate this directly into English, but it is not enough for engineers to sit and work at their desk; they should visit the sites of fabrication, customers and overseas engineers and hold thorough discussions. Positive actions by themselves produce a wind of change, and it is in this wind that opportunities for the future are hiding. He meant that the engineers should feel thus and implement their ideas in their products.

At NEC, all members of the corporate staff should take these words to heart, continually feel the wind of the times and connect it to the products of the future.

*The corporate and product names mentioned in this article are the trademarks or registered trademarks of their respective owners.

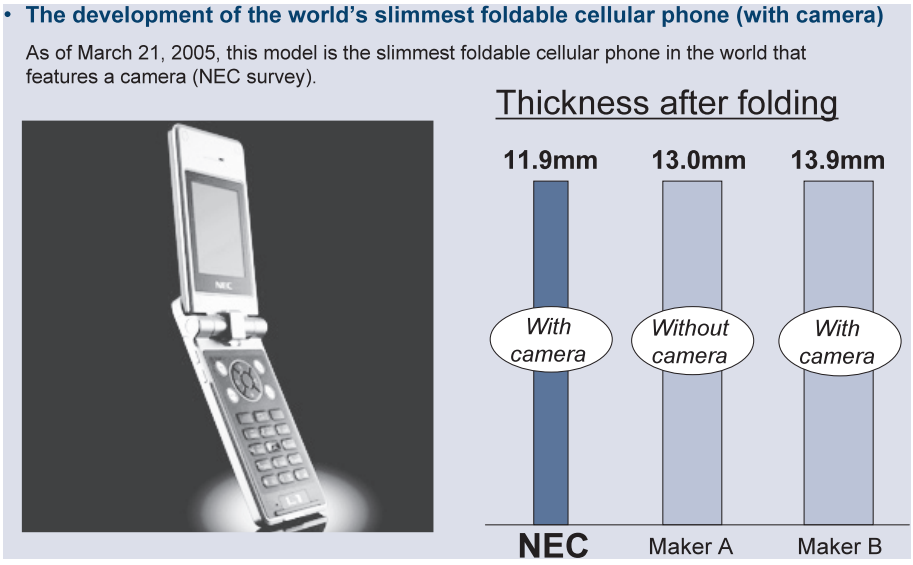

Fig. 2 The world's Slimmest foldable cellular phone