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From the Editor

The 1970s saw a shift from batch processing to online processing. That is, as we entered the '70s, we witnessed, in Japan as elsewhere, the rapid diffusion of centralized processing, especially among large companies, through the connection of regionally distributed terminals to a large host computer located in the center. At that time terminals were mere input/output devices. Later, terminals came to have some capabilities of their own as a result of technological innovations. And the growing use of distributed processing systems by businesses was observed in Japan, as in the United States and Europe. But most of the instances of distributed processing in this country have been of what is called the hierarchical type in which the whole system is managed by the central host computer. We see few cases of the horizontal type of distribution, which is common in the United States and Europe. The primary reason for this difference lies in the differences in organizational structure between Japanese businesses, including city banks, and their counterparts in Western industrial countries. In those days, the terminals installed in distributed business bases were referred to as "intelligent terminals." The word "intelligent" essentially means to have intelligence on the ability to understand. But the intelligent terminals of those days had only front-end processing or stand-alone processing capabilities. They did not have any intelligence in the true sense of the word. Computer people prefer to use colorful terms like these, and Japanese computer people also use this term as it is, writing it in Katakana the way it is pronounced, instead of translating it into Japanese. But such a term tends to be misunderstood unless it is clearly defined in advance. Later, the workstation was developed. But the workstation is essentially an extended form of the terminal. In other words, the workstation is a functionally more advanced form of the intelligent terminal. The workstation can be regarded as a kind of terminal designed to meet the user's needs as much as possible. Certainly, workstations were intended primarily for sophisticated scientific and technical processing such as CAD, CAM and CAE in the beginning. That is why they featured a variety of additional facilities. Today, however, workstations are coming to be used in many other fields, like business administration and finance. These workstations are called "office workstations" as opposed to the engineering workstations, that are used for technological purposes. More recently we have seen the advent of super-workstations. These are virtually the same as general purpose computers, or rather, they may be considered to be computers that have a greatly improved human interface.

Computers have been becoming smaller in size and higher in performance. Now even a personal computer is as powerful as a large computer of old. This trend toward downsizing is expected to continue. Furthermore, the advances in the communication facilities of PCs are making them fully serviceable as terminals in distributed processing. These developments indicate that PCs are moving toward the terminals side away from computer side. In the meantime, terminals are becoming more and more like computers as a result of improvements in capability.

Today we have minicomputers, office computers and personal computers as well as very small low-end computers, which are classified as general purpose computers in Japan. Besides these, we have engineering workstations and office workstations. Each of these machines is defined in some way or other. But it is not possible to make their boundaries clear. Users need not be too conscious of the definitions of the respective machines, because they are partly chosen as part of the manufacturers' marketing strategy.

System integration (SI) and strategic information system (SIS) are key issues in end user computing these days. The trends toward globalization and networking among businesses are increasing the need for open systems. Materializing open systems is an important government policy in Japan, too. In this sense, much is expected of workstations. But there are still some issues yet to be addressed, such as standardization and security.

Here, we will provide feature articles on workstation conditions in Japan. This editor expresses gratitude to those persons who extended us their cooperation. We will be very happy if the feature articles prove helpful to the readers.

Yuji Yamadori
Director
Research & International Affairs

Current Status of Workstations in Japan

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1. Background

With the development of today's advanced information society, the cost of information processing (the total cost of purchasing the information handling equipment plus the personnel expenses incurred in information input) has been increasing greatly very rapidly. Moreover, a sharp increase in the amount being spent for information processing is evident in general industries, other than broadcasting, telecommunications, etc., of the information industry. It is no exaggeration to say that, for an enterprise, the most important strategic step today is to arm itself with information.

At first, an enterprise used its computer primarily to centrally control and analyze data. The idea was to use the computer to automate data handling for administration, sales management, and other related activities. This was what shaped the centrally controlled system, which mainly used a general-purpose computer with online terminals operating as inlets for data collection connected to it. Such a system, however, requires both time and energy for data collection and is not a speedy decision-making tool for an end user. Since data was collected and processed at one place in this system, there was no distinction between data needed immediately and data for which a user could wait a few days. This led to the concept of "distributed processing" of data in a system close to the end user.

Introducing large general-purpose systems calls for a substantially large investment, and they cannot be run without the maker's support. Package software for these computers is expensive. In addition, it is not easy for an enterprise to develop application software geared to its own activities, so it has to rely on the maker or a system developer for its software needs. Installing a system of this type lies outside the reach of small-to-medium companies. On the other hand, however, a downsizing phenomenon is perceived now in the computer world: new units, coming up in quick succession, are compact and inexpensive and in no way inferior to the large machines.

Side by side with the advances in distributed processing and downsizing, attention of the computer circles all over the world seems to be concentrating on workstations (WS), a product replacing general-purpose computers, minicomputers, and office computers.

Workstations are similar in appearance to personal computers as far as the size is concerned, but compare functionally with general-purpose equipment. In addition, they are moderately priced. The most attractive feature of a workstation, therefore, is its high cost-effectiveness.

Workstations — in particular, engineering workstations (EWS) which are used in research and development activities — use UNIX as their standard operating system (OS). Standardized operating systems make it relatively easy for an enterprise to modify a program that it has developed and transplant it in machines of other makers. This is very convenient for both users and application developers.

Finally, the fact that workstations are drawing so much attention may be attributed to their excellent operating environment. Use of workstations presupposes that of networks. This makes it possible to interconnect workstations or use them as terminals connected to large machines. Also, even by themselves workstations are capable of a high level of processing which is why they help in creating networks of various configurations.

Initially, workstations found wide use in research and development because of their high competence in handling scientific and engineering calculations. However, since then they are being used in other areas also, such as manufacturing, administration, or financial data processing. Indeed, the trends in these areas serve as a key factor in estimating the market for the workstation industry.

2. Technical Trends

Since 1986, the Japanese language processing specialist committee (headed by Jiro Iimura) under the Japan Electronic Industry Development Association (JEIDA) has been studying technological trends in the field of workstations. While continuing with its surveys on basic engineering trends and application trends, the committee in 1990 — the fifth year since its start — focused on an analysis of the gap between the makers' technical trend and trend seen among users in workstation applications. The makers targeted a total of 45 enterprises selected by JEIDA. Out of these, 23 responded, representing 30 models. For the survey on users, the committee mailed its questionnaire to 3,000 addresses picked randomly from an annual public report on workstation users. Responses came from 354 organizations covering 642 models. Here, we will take up part of the survey report based on these responses.

2.1 Results of the survey of makers

The 23 enterprises that responded to this survey and the 30 machines represented by them are listed in Table 1. As the table shows, office workstations (OWS) totaled 11 models, engineering workstations (EWS) totaled 18 models, and workstation models (WS) of other types totaled one only.

2.1.1 Definition of workstations

Figures 1 and 2 detail the results of a survey on the essential hardware and software conditions that distinguish a workstation. The object of this survey was to determine how the respective makers defined their term, "workstation."

Results of the survey reflect an emphasis on "network functions", "high-processing capability", and "cost performance" as the hardware conditions that workstations are expected to satisfy. For engineering workstations, "high-resolution bit map display" is an especially important condition. Among software characteristics, "window systems", "use of UNIX as an operating system", and "multitask processing" seem to be essential. Especially,

Table 1. Respondents to the maker survey and their models

Maker	OWS	EWS	Others
Hitachi	2050/32E+		
NEC	N5300 AD II	EWS4800 Series	
Canon	EZPS3500		
Sanyo Electric	MPS-020-3		
Sharp	OA220		
Mitsubishi Electric	M3307-E108	MELCOM ME350	
NTT Data	WS/32ex		
Fuji Xerox	Argoss5230		
Matsushita Electric Industrial	CV-B3801		
Oki Electric Industry	OKIstation7300		
Toshiba	J-3300 Series		
Sun Microsystems Japan		SPARCstation1+	
Fujitsu		401FG83 (S Family) 447GH20F (S Family)	
Sumitomo Electric Industries		S-P300-GCX II	
Omron		LUNA	
Seiko Electronics		SN-4300GRX	
Kubota Computer		TITAN500 TITAN3000V RS3230	
Silicon Graphics Japan		IRIS-4D/25TG	
IBM Japan		POWER Station	
Yokogawa Hewlett-Packard		HP9000series400	
PFU		Astation200/300	
Matsushita Computer System		Series5/600 Sorbourne S3000	
Unisys Japan			NW 2 Family B39
Total 23 makers	11 models	18 models	1 model
	Total 30 models		

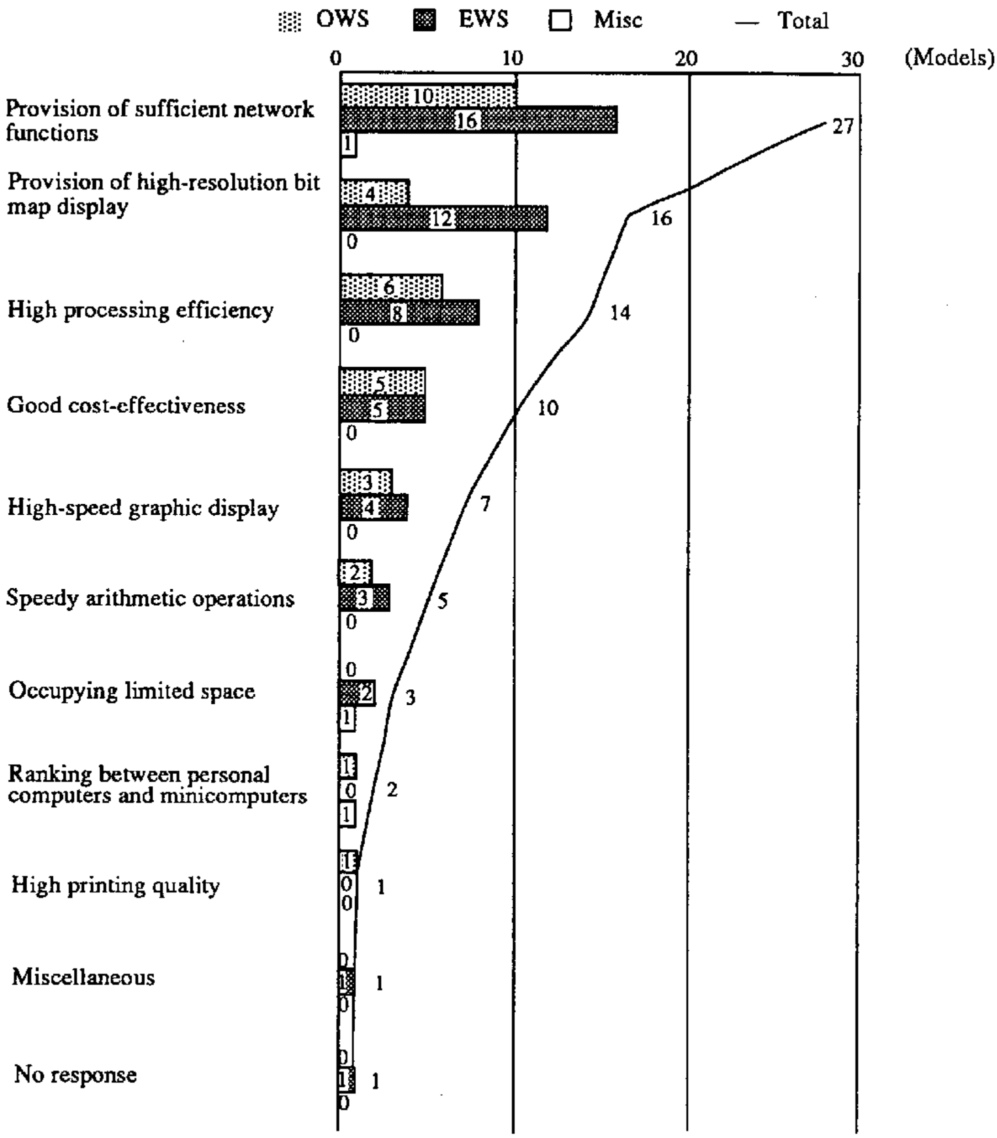

Figure 1. Essential hardware conditions for makers

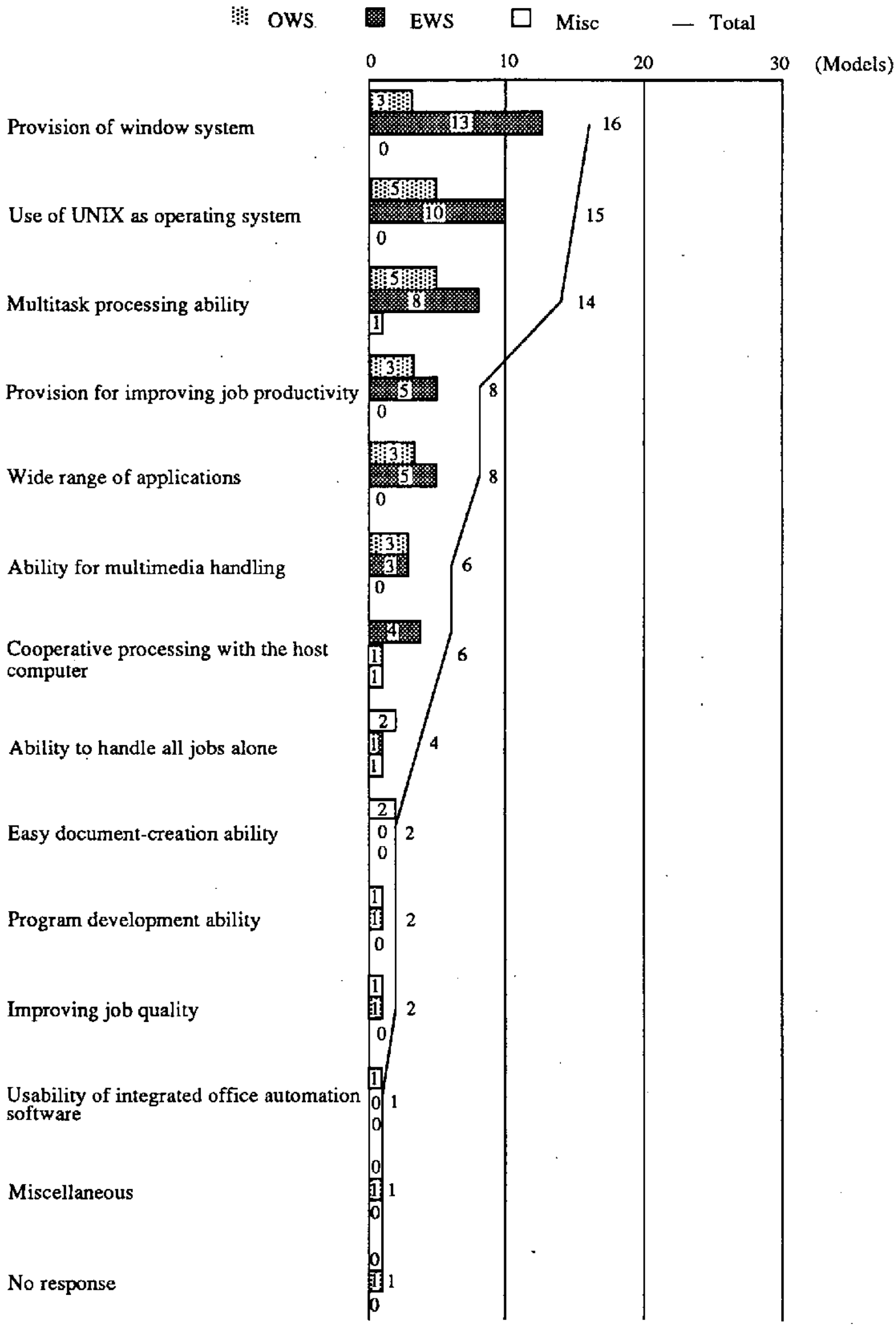

Figure 2. Essential software conditions for makers

for office workstations, "cooperative processing with the host" is considered to be an important condition.

2.1.2 Current hardware status

The survey revealed the following details on the status of the hardware technologies.

As the distribution of display resolutions in Figure 3 shows, 1,100 to 1,200 dots in the horizontal direction and 700 to 800 dots in the vertical direction represent the main trend for office workstations and 1,200 to 1,300 dots in the horizontal direction and 1,000 to 1,100 dots in the vertical direction represent that for engineering workstations. As for color display, 17 models can display color only, three models can display monochromatic only, and 10 models can display both monochromatic and color. As Table 2 shows, most of the 30 models (27) can display color. Among mono-

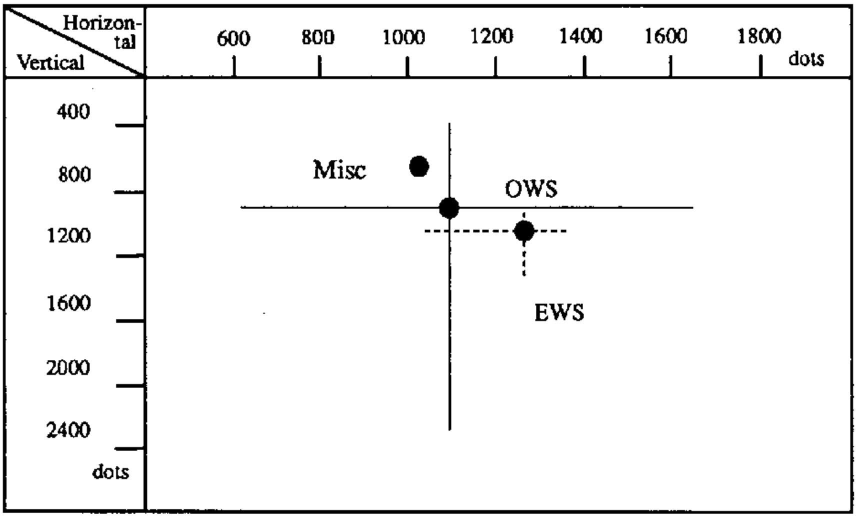

Figure 3. Average display resolution distribution

Table 2. Display colors

	Total	OWS	EWS	Others
Total number of models	30	11	18	1
Color	27	9	17	1
Monochromatic	13	8	5	–
Paper white	7	6	1	–
White	3	1	2	–
Shades of green	2	1	1	–
Shades of yellow	–	–	–	–
Miscellaneous	3	2	1	–

Table 3. Communication functions

			OWS		EWS		Others	
Total number of models			11		18		1	
LAN Interface	Standard devices		3		16		–	
	Options		8		2		1	
Public telephone line interface	Present	Public telephone network		8		10		1
		DDX packet network		5		10		1
		DDX line switching network	8	3	13	6	1	1
		ISDN		2		4		1
		Miscellaneous		–		1		–
	Absent		3		4		–	
	No response		–		1		–	
Host communication functions	Present		8		16		1	
	Absent		3		2		–	
Personal computer communication functions	Present	JUST PC	5		2		–	
		Miscellaneous	1		4		–	
	Absent		5		10		1	
	No response		–		3		–	

chromatic displays, white and paper white predominate in office workstations.

Communication functions are supported as shown in Table 3. Local area network (LAN) interfaces are supported by 19 out of 30 models as a standard feature, in particular for EWS, where 16 out of 18 models supported them. Thus, it can be said that LAN interfaces are essential for EWS. Twenty-two models support the public-network interface, of which 19 models can use the public telephone network.

Figure 4 shows the general-purpose interfaces used by the workstations. The RS232 C interface is used by almost all of the 30 workstations (29) covered in the survey. Models that use SCSI and Centronics are also quite large in number. In all EWS, RS232 C and SCSI are standard features: they are essential features for the EWS.

2.1.3 Current software status

The survey revealed the following details on the status of software.

Most of the workstations — 27 (90%) out of the 30 — employ UNIX as their operating system (OS). In particular, all the 18 EWS represented in the survey support UNIX. Figure 5 compares OS trends seen in OWS and EWS over past three years.

Applications which are attracting attention were investigated with respect to the keywords. As Table 4 shows, most of the OWS

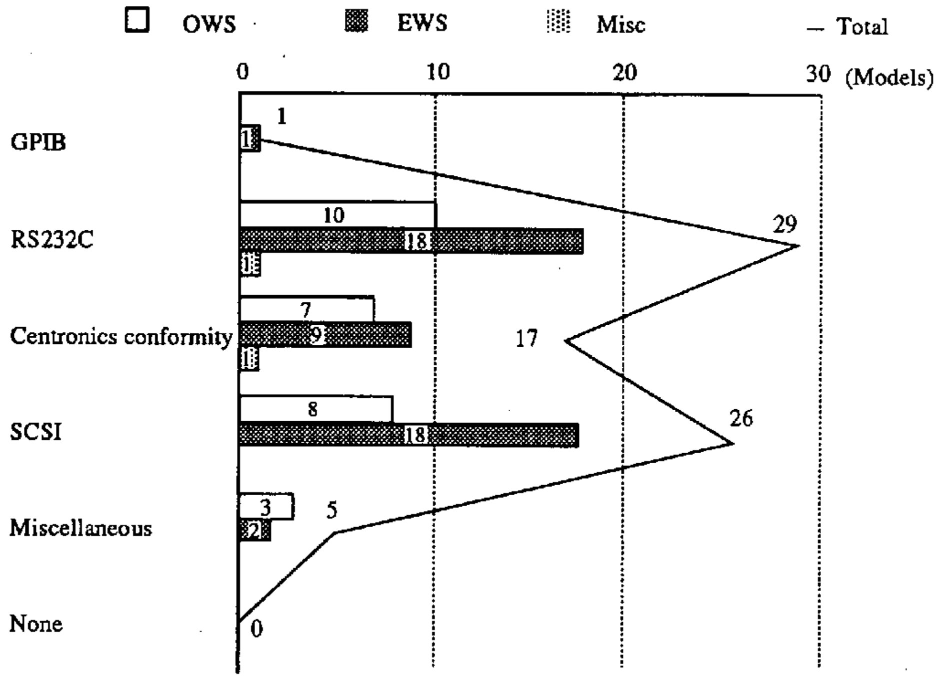

Figure 4. Standard general-purpose interfaces

Table 4. Application keywords

	Total	OWS	EWS	Misc
Total number of models	30	11	18	1
Multimedia	14	7	7	–
DTP	14	7	7	–
Groupware	9	5	3	1
CAD/CAM	8	2	6	–
CASE	8	3	5	–
DTPR	8	3	5	–
Hypertext	7	3	4	–
SIS	7	6	1	–
CIM	4	1	3	–
CAI	2	2	–	–
PIM	–	–	–	–
Miscellaneous	2	–	2	–
No response	8	2	–	–

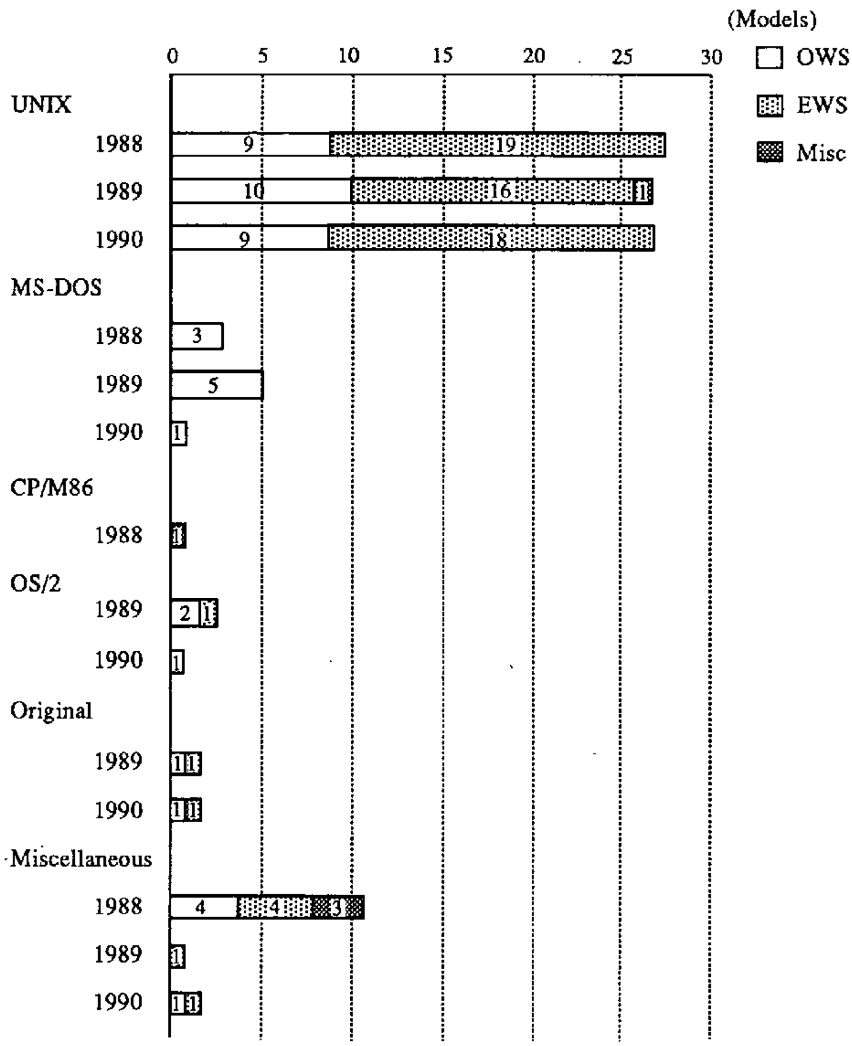

Figure 5. Operating systems

and EWS models placed emphasis on multimedia and DTP.

2.1.4 Future technical trends

A survey of the makers' views on future technical trends revealed the following:

Technical trend of hardware (OWS, EWS)

- Increase in processing speed by RISC or multiprocessor .... 22 cases (9, 13)
- Increase in network processing speed and implementation of advanced function by FDDI or ISDN .... 17 cases (8, 9)
- Reduction of size, weight, and price .... 15 cases (7, 8)
- Implementation of large-capacity memory and disk .... 13 cases (5, 8)

- Increase in graphic and image processing speed .... 10 cases (4, 6)
- Support of multimedia processing function .... 8 cases (4, 4)
- Support of high resolution display .... 5 cases (2, 3)
- Standardization (interface board, open system) .... 4 cases (1, 3)

Technical trend of software (OWS, EWS)

- Standardization of GUI .... 16 cases (6, 10)
- Introduction of distributed environment and parallel processing .... 11 cases (5, 6)
- Support of multimedia data processing function .... 8 cases (3, 5)
- Improvement of operability .... 6 cases (0, 6)
- Increase of number of package software .... 5 cases (3, 2)
- Improvement of image processing .... 4 cases (2, 2)
- Improvement of security control .... 4 cases (1, 3)

No big difference was seen between EWS and OWS in the predicted hardware and software trends. All makers are trying now to increase the speeds of the CPU, the network, and the peripheral equipment and to improve their functional levels. At the same time, efforts are under way to reduce the size, the weight, and the price of the machines. In the software area, most makers are showing great interest in the standardization of GUI.

For wider diffusion of OWS in business-related applications, one will possibly seek further development in integrating techniques such as multitask and multiuser technologies which distinguish workstations from personal computers. As for the EWS, further standardization of hardware and software will be sought besides a coexistence of technologies in an open environment. This will make it possible for the engineers to use their machines in a wide range of applications.

2.2 Results of the user survey

The purpose of this survey, targeting 3,000 user companies, was to collect data on user use of workstations for reference in trying to open or to cultivate new markets. In all 354 responded, representing 642 models.

2.2.1 Factors for introduction

A survey on the period of WS introduction indicated that the number increased from 1987 onwards, approximately 70% of the total having been introduced between 1987 and 1990. In particular, 45% of the total are the units introduced from 1989 onwards, reflecting a sharp expansion of the market and the possibility of further growth in the coming years.

A similar survey on the use of these machines revealed that applications of OWS are concentrated mainly around document-creation or tabulation, plotting graphs, administration of personnel affairs, computing salaries, financial computations, accounting, and sales or inventory data processing. Similarly, EWS find widest use in scientific and engineering calculations, computer-aided design or other engineering activities, and in software development. A user buys a workstation best suited for the job in view and uses it for related specialized applications. Rarely is a workstation used in general applications.

Table 5 shows the average number of workstations introduced by companies. The number of models introduced tends to vary in the fixed range of two to three irrespective of the number of employees. However, the number of units tends to increase more or less in proportion with the number of employees.

Table 5. Overall average number of models and units introduced and in use according to the number of employees

	Overall	Not more than 49 employees	Not more than 99 employees	Not more than 299 employees	Not more than 499 employees	Not more than 799 employees	Not more than 999 employees	Not more than 1,999 employees	2,000 employees or more	No response
Overall average numbers of models	2.5 models	1.8 models	2.4 models	2.6 models	2.4 models	2.8 models	2.5 models	3.2 models	2.3 models	2.5 models
Overall average numbers of units introduced	28.0 units	14.8 units	20.1 units	16.1 units	26.8 units	36.0 units	37.1 units	38.9 units	64.0 units	27.6 units
Overall average numbers of models currently in use	2.1 models	1.4 models	2.1 models	2.1 models	2.0 models	2.5 models	2.3 models	2.3 models	2.1 models	2.1 models
Overall average numbers of units currently in use	24.6 units	11.1 units	16.1 units	12.4 units	25.0 units	29.6 units	31.1 units	34.7 units	66.1 units	29.2 units

2.2.2 Purpose of WS introduction and model selection factors

The main reasons for introducing workstations are listed in Table 6. On the whole, most of the choices were guided by considerations such as "the workstation maker being the same as the host maker" and "the possibilities of simplifying routine work". The enterprises mainly introducing EWS selected the machines because of their "superior processing capability", thereby "improving software productivity" and "cost-effectiveness". The trend here seems to differ from the overall pattern registered by workstations as a whole or that shown by OWS.

Factors influencing the choice of specific models are listed in Table 7. Many of the main factors are the same as those influencing the installation of workstations. Although most users purchase their workstations from "the same maker as their host computer", in purchasing their EWS, they tend to place greater emphasis on "good cost-effectiveness" and on "an abundance of distribution software packages".

2.2.3 Results of introduction and points for future introduction

Figure 6 lists users' ratings of the results of introducing workstations. Of the total, approximately 80% of the users rated the results to be as "expected or above expectation". Compared to around 70% in the preceding

Table 6. Main reasons for installation

(%)

	Total (354 models)	OWS (281 models)	EWS (72 models)	Others (1)
Produced by the same maker as that of the host	37	44	8	–
Higher software development/maintenance productivity	26	24	31	100
Work expansion	22	25	13	–
Possibility of trimming routine work	22	24	15	100
Increase in job volume	22	25	11	–
Excellent processing ability	20	17	32	–
Easier data input	16	19	7	100
Processing capability of machines already introduced is low	16	15	19	–
Availability of a means of communication	13	13	13	–
Good cost effectiveness	12	9	26	–
Shared use of resources	12	12	14	–
Graphic data processing	10	4	31	–
Good operability	9	8	11	–
Abundance of distribution software packages	7	4	17	–
Product of a reliable maker	6	5	8	–
Support of management analyses and planning	6	7	–	–
Possibility of detailed customer service	6	6	6	–
Reducing paper consumption	4	5	1	–
Availability of job analysis method	4	5	1	–
Low price	3	3	4	–
Good after-sale service by maker	3	3	3	–
Effective utilization of work space	1	1	–	–
Suitable size	1	1	–	–
Compactness	0.3	0.4	–	–
Miscellaneous	9	8	14	–
No response	1	–	3	–

Table 7. Reasons for models selection

(%)

	Total (354 models)	OWS (281 models)	EWS (72 models)	Others (1)
Produced by the same maker as that of the host	46	55	14	–
Excellent processing capability	24	21	36	–
Higher software development/maintenance productivity	18	17	22	100
Processing capability of machines already introduced is low	16	17	14	–
Work expansion	16	17	10	–
Good cost-effectiveness	15	11	33	–
Increase in work volume	14	16	8	–
Good operability	13	13	11	–
Possibility of trimming routine work	12	13	8	100
Abundance of distribution software packages	12	8	28	–
Product of a reliable maker	10	10	13	–
Shared use of resources	10	10	8	–
Easier data input	10	11	4	–
Availability of a means of communication	8	8	8	100
Low price	7	6	11	–
Graphic processing	7	3	21	–
Good after-sales service by maker	6	6	4	–
Provision of detailed customer service	5	5	6	–
Availability of job analysis method	3	3	1	–
Compactness	3	3	3	–
Reducing paper consumption	3	3	3	–
Support of management analyses and planning	3	3	–	–
Effective utilization of work space	2	2	–	–
Suitable size	1	1	1	–
Miscellaneous	1	9	17	–
No response	25	28	15	–

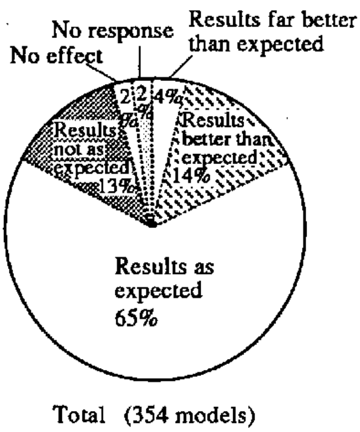

Figure 6. Evaluation of introduction

year, this indicates a substantial increase. The number of those who said that the effects of introducing workstations were "not as expected" seems to have dropped to around half of the previous year's level; consequently, it seems that more workstation are satisfying the users' expectations.

Table 8 lists the factors that will likely influence future introduction of workstations. On the whole, "better operational features", "facilities for linked operation with other computers", "cost", and "easy-to-use input functions" are likely to be important factors. Other responses from prospective EWS users include "maintenance system", "high-speed graphic display", and "high-speed arithmetic functions". Apparently, greater importance is given to maintenance and high-speed.

2.2.4 System configuration

The basic general hardware for a workstation system includes a 32 bit CPU, a 10MB memory, a 200MB hard disk drive, a flexible disk drive, and a LAN. The system is expected to operate in a multiuser, multitask, and distributed processing environment, have virtual memory, and partition client and server functions.

Desktop models make up 77% of the workstations purchased by users. This indicates a trend in favor of high performance, small size, and light weight. Over the past few years, however, desk-side machines have accounted for 40% of the EWS in use, indicating a strong inclination towards high-class models.

Figure 7 shows that 70% of the workstation users are linked to some network. Networks serve as an effective linkage in project teams and group jobs, and the number of machines connected to them will increase in the coming years.

The machines connected to the same networks are not necessarily of the same type. Figure 8 shows that 27% of the OWS connected to a network are of different types and that for the EWS, the proportion is 49%. Most EWS use the UNIX operating system. They all have an open architecture and the software used by them is compatible at the source level. As a result, EWS of different types are easily connectable. On the other hand, instances of connections between OWS of different types have sharply increased from last year's 8.3%. An even larger number of OWS of different types is likely to be connected as the range of their applications widen in the coming years.

2.2.5 Software development

Including the software ordered outside, more than half of the software currently in use has been developed by the users themselves. Instances of use of makers' standards do appear

Table 8. Factors for future introduction

(%)

	Total (354 models)	OWS (281 models)	EWS (72 models)	Others (1)
Good operability	39	42	25	–
Possibility of linked operation with other computers	37	39	32	–
Low equipment cost	28	26	33	–
Easy usability of input functions	26	30	14	–
High processing efficiency	25	26	24	–
Low space requirement	24	26	15	–
Steady maintenance system	22	19	38	–
Usability in multimedia environment	21	19	25	100
Easy file management	21	21	21	–
Higher work productivity	20	21	13	–
Good operation manuals available	19	19	22	–
Communication functions	19	20	14	–
Speedy file input/output	18	17	21	–
Absence of need for specially trained operators	16	16	14	–
Low running cost	15	17	10	–
Program development functions	15	15	15	–
Speedy printing	14	16	3	100
Speedy arithmetic processing	12	8	29	100
Better visibility of display	12	13	11	–
High-speed graphic display	11	5	33	–
Better work quality	11	11	7	–
Speedy input	9	9	8	–
Low noise	8	8	7	–
Operator training facilities	8	8	7	–
Good printing quality	7	7	3	100
File access	5	5	6	100
Good curtailment effect	5	6	4	–
High-speed arithmetic function	4	1	14	–
Multicolored high-precision display	4	2	10	–
Long service life and durability	4	4	3	–
Graphic display function	4	4	3	–
Input into and output from special devices	1	1	1	–
Miscellaneous	2	1	3	–
No response	1	1	1	–

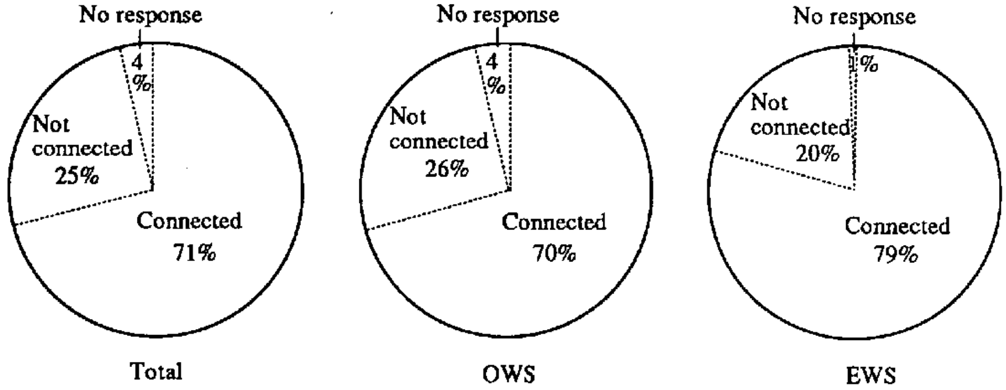

Figure 7. Network connections

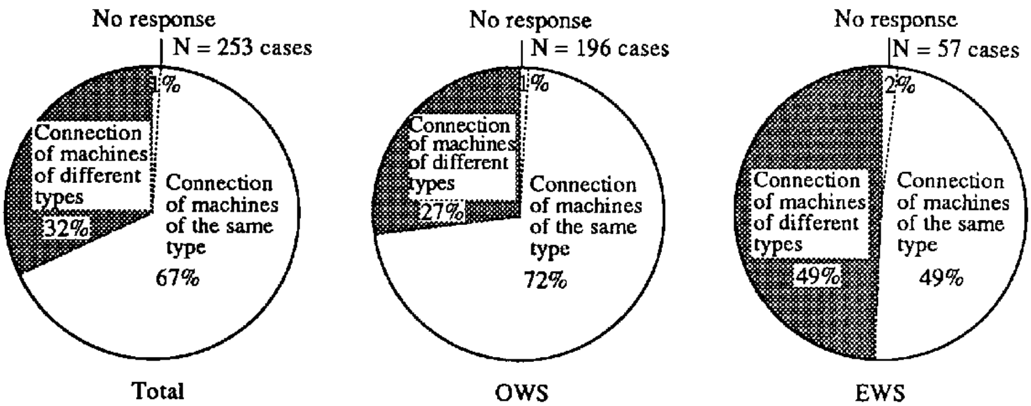

Figure 8. Connections between different types of machines

to be on the increase from the surveys on both the current status and future development. On the whole, however, enterprises may continue to prefer developing their own software, tailored specifically to their job requirements, rather than following the makers' standards or using packages available in the market (See Figure 9).

3. Conclusion

This survey covered machines that were developed as workstations by their makers, as well as those that users considered to be workstations; consequently, it is difficult to lay down a definition of a workstation from the pattern of its uses. From the perspective of functions and performances, however, it seems that a machine must satisfy the following conditions to qualify as a workstation:

- Provision of sufficient communication functions
- No restrictions on the type of application; it can be used for any purpose
- Data exchange possible with host or workstations of different types
- High-performance and high-speed machine

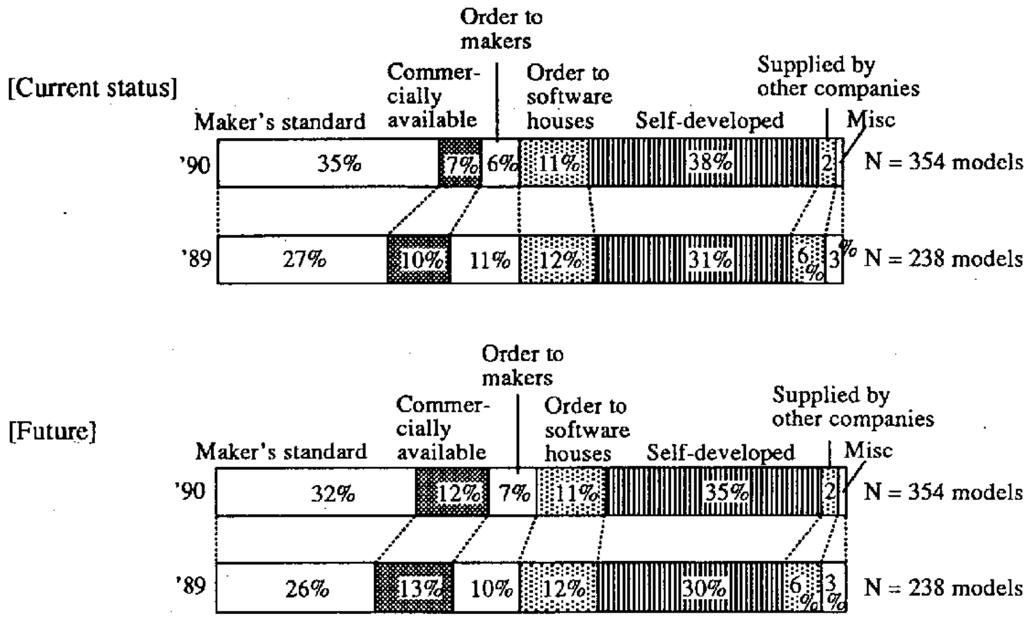

Figure 9. Software development

that can handle multitask and multiwindow operations

- Provision of high resolution and high-quality printing functions
- Ability to process completely by itself
- Business-work, document-creation, tabulation, etc., operations can be performed easily (OWS)
- Program developing machine

Both OS in an open-license environment (such as UNIX) and high-speed digital network (LAN or WAN) technologies are indispensable for these functional and performance requirements.

Again, conceptually a workstation may be defined as a machine satisfying the following requirements:

- All business work can be handled by one machine
- Can be placed on a desk
- Individual-use machine

As far as can be seen from the results of this survey, the image of workstations held by users comes quite close to the image held by makers. However, such images are amenable to changes with technological advances in hardware and software.

Based on the results of surveys launched hitherto, JEIDA also forecasted steady growth of the workstation market over the coming years. Therefore, in 1991, it inaugurated a workstation study committee. It has taken up a ten-year plan to study workstation market trends and targets a more quantitative appraisal of market movements specially for machines operating in the UNIX and server/client environment.

Introduction of Workstations in Omron

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1. Company profile

Omron Corp. was established in 1933, mainly to manufacture and sell elecronic parts. In the fifties, the company widened its range of activities by launching the production and marketing of microswitches, relays, timers and other automation-related components, and eventually emerged as the leader in this line of business in Japan.

In the sixties, we entered the information industry and has since been producing roadway traffic control, banking, and retail systems. In 1984, we moved into the engineering workstation (EWS) market where we are currently trying to expand our share.

In 1991, we acquired Nippon Data General, further demonstrating an avid interest in workstation-related activities. Figure 1 provides a profile of the company.

2. Computers' role in Omron's research and development activities

In 1980, we drew up a basic conception to underlie our use of large computers in research, development and design activities. The company's idea was to introduce computers into all areas of design support, with large IBM computers as a nucleus. Besides supporting software development and electrical and mechanical design, computers were to help manage development projects and retrieve technical data.

The system that we developed is illustrated in Figure 2. Based on this concept, we built the necessary environment and, by 1985, our system included 140 software development terminals, and 96 computer aided design (CAD) terminals on the mechanical side and 12 on the electrical side. In addition there were 47 development support terminals.

We had already started investigating on the possibilities of creating a workstation-based development environment by 1980. The object was mainly to support software development. At that time, most of our software development activities for developing such products as electronic money recorders, bank cash dispensers, and programmable controllers relied on the use of microcomputers. We used contemporary assembler language for software development. The increase in volume of software development plus the shortage in development personnel which resulted in delays, became a crucial problem for us around that time. We foresaw that this problem would only become greater with time and decided to standardize the use of C as the high-level language for efficient software development. At the same time, we selected Unix-based computer as the platform for future software development.

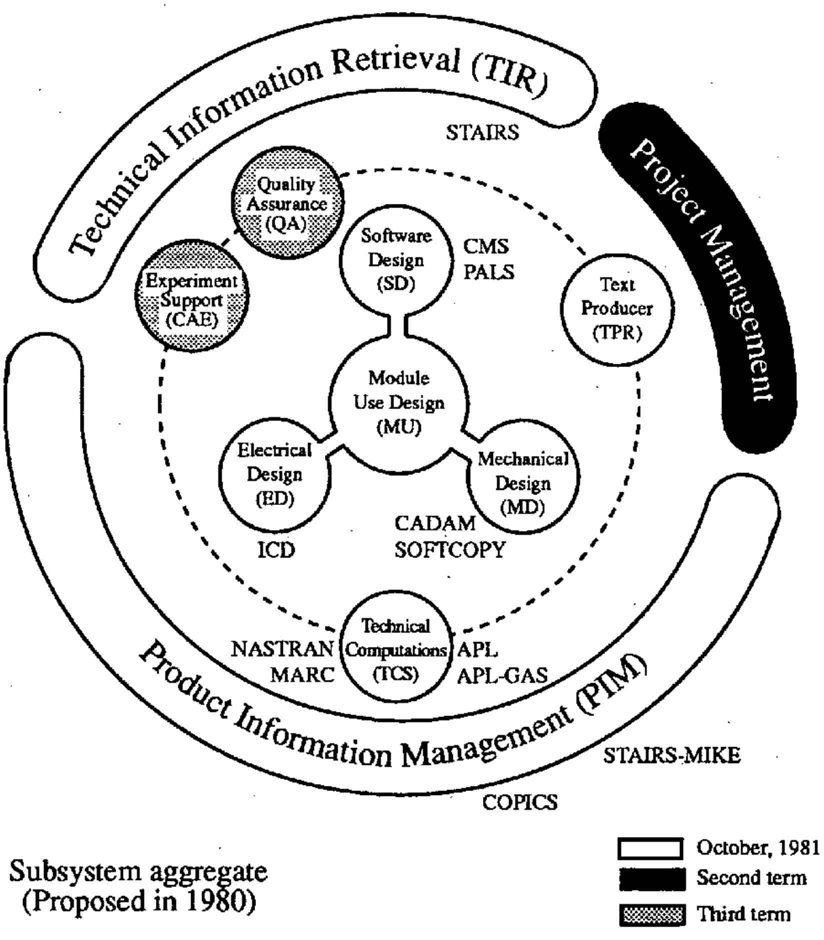
Figure 1 Company Profile

Established in	: 1933
Capital	: 38.6 billion yen
Sales	: 376.5 billion yen
Number of employees	: 6,800

Activities for production and marketing of:

- Control system devices including switches, timing control devices and programmable controllers
- Electronic fund transfer systems including banking systems, retail systems and public service systems
- Office automation systems including EWS, peripheral equipment
- Health and medical equipment
- Social systems including traffic control systems

Figure 2 Omron's Development Support System Using Large Computers



To realize the creation of this development environment, we bought a Unix-based microcomputer, VAX 11-780 in 1981 and researched on Unix technologies in addition to developing a C language cross-compiler for Motorola Inc.'s 8-bit microcomputer MC6809.

These activities led in 1984 to the creation of the "Super Mate" Unix workstation using the MC68000 CPU. We put it in use in our own software development environment and made it commercially available. In the same year the company joined the Ministry of International Trade and Industry's Sigma Project for the industrialization of software development. At the same time in 1987, we developed the Sigma WS and began building a S/W development environment on the very platform which provided every engineer with his/her own workstation. (Figure 3).

The new environment marked a break from the past with respect to computer use. Until then, using a computer had meant doing paper work on one's desk, followed by input for which one had to move to the terminal room. The computer output, which took the form of program lists or data stored on floppy disks, was available only at the computer room counter.

Separate workstations available to each individual made it possible for him to attend to computer-related jobs without leaving his desk. In addition we have installed a powerful network facility which made engineers walking towards the laboratory with floppy disks and program lists in hand, obsolete. The enhancement we made on workstation-based development environment also introduced such by-products as electronic mail and electronic bulletin board systems which provided user's with comfortable environment that was beyond our expectations.

Workstations and networks have not only made computer use more convenient but have also proved very economical. In 1985, the annual running cost worked out to around 2 million yen per terminal when large computers were used, whereas the cost dropped to one tenths as workstations. As a result, a switchover to workstations took place not only in software development but also in computer-aided electrical or mechanical design. We had transferred all its computer-aided electrical design to workstations by 1986. By 1988, our computer-aided mechanical design had also been transferred to workstations.

Computer-aided design differs significantly from environment of workstations to that of CAD terminals of large computers. In the former, the input windows make simultaneous text handling possible. As a result, the user can handle text generation, such as for specifications or design sheets, on his or her own desk. Again, because all the developers use it, electronic mail can dramatically reduce the volume of paper moving between designers for the exchange of information.

Our reliance on workstation support is increasing over the entire range of development activities. Today, we have 1000 workstations engaged in software development, 50 in computer aided electrical design, 200 in computer aided mechanical design, and 250 more in miscellaneous applications. The importance of large computers has steadily increased since 1985, but, starting from 1991, it will begin to show a decline (Figure 4).

Figure 3 Building of the Software Development Environment and Development of Workstations

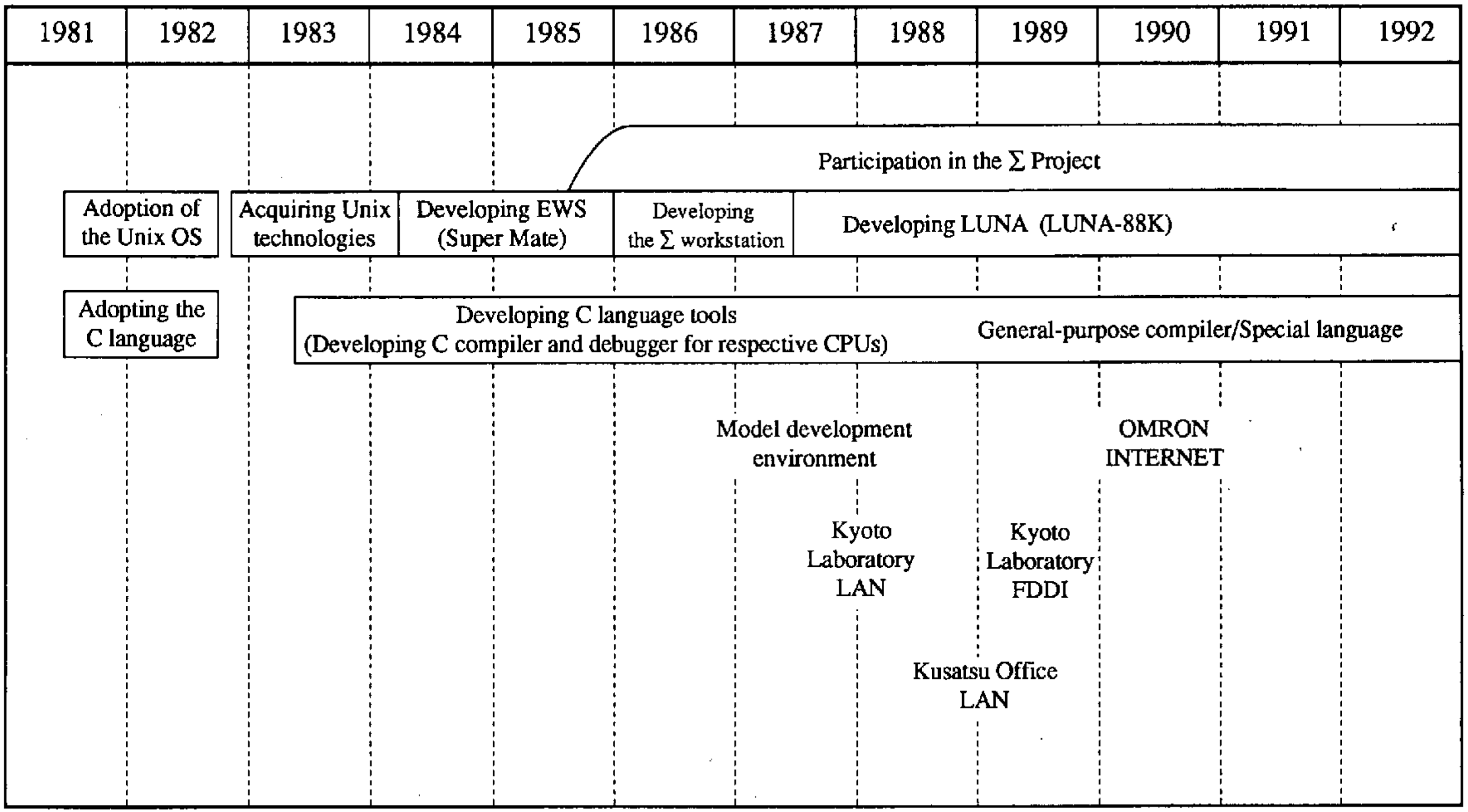
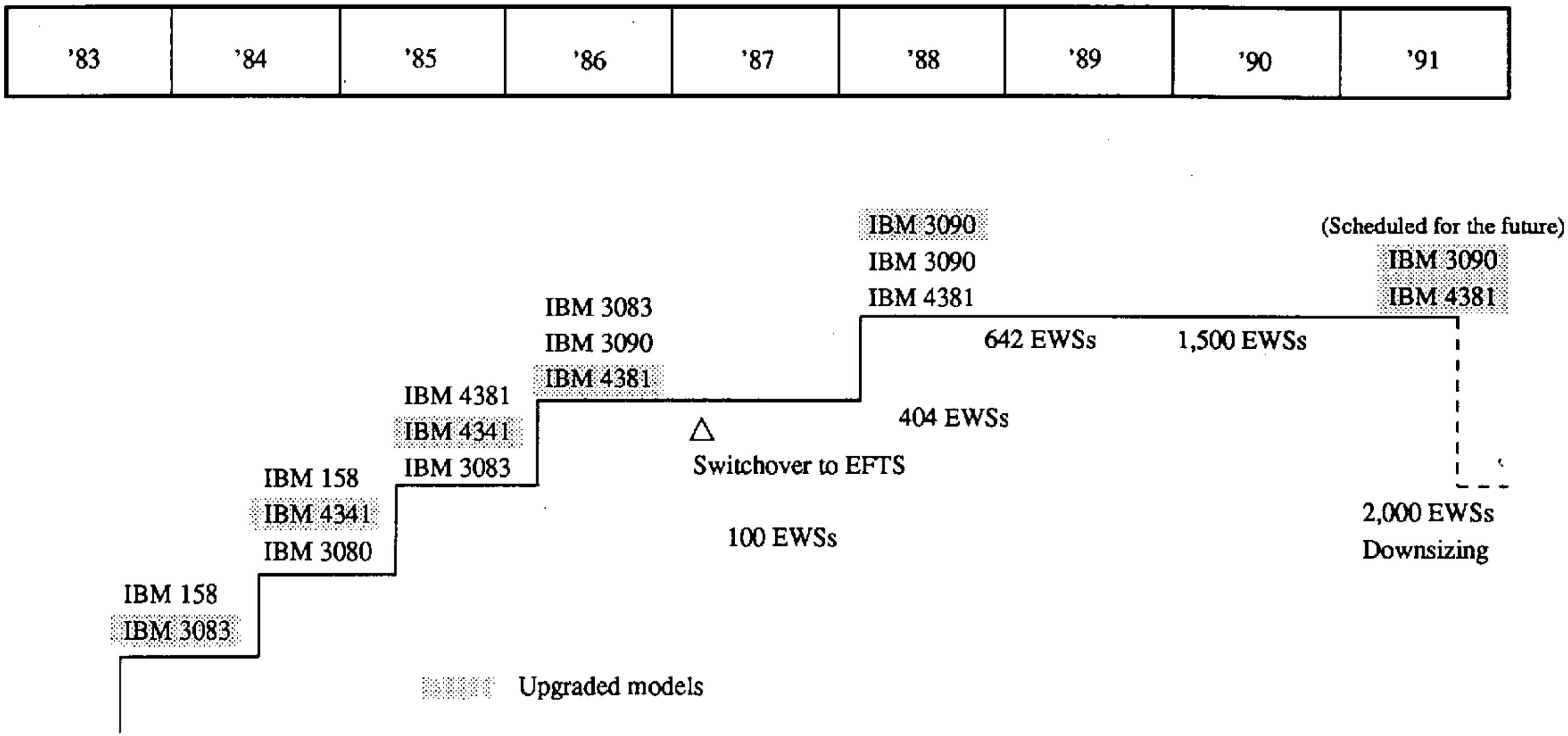


Figure 4 Introduction of Development Support Computer Systems
— from IBM to Omron's Luna Workstation —



Recently, the appearance of RISC-based workstations has increased the performance of the CPU. Further acceleration of this trend is expected. At our company, the Luna-88K was developed independently by using a multiprocessor Motorola RISC-88000 CPU with a Mach-OS. This is serving the company for internal use and is also being sold outside. At the present time, it is being used by Carnegie-Mellon University for the development of Mach-OS (Photo 1).

3. Workstation network configuration

In 1987, we started building a workstation network using Ethernet. We initially created a model software development environment targeted for 30 persons which was in operation for about a year. It was a software development environment that allotted a workstation per person. The results convinced us to lay Ethernet cable throughout the Kyoto Laboratory. At the same time, the model environment was expanded to accommodate up to 130 persons. By then, a large computer was connected to the network to make access from workstations. The range of use of the workstation network has widened and has encouraged those who had customarily used large computers to purchase and extensively use workstations (Figure 5). Starting from 1987, the network was extended to our offices that have engineering sections where currently 17 offices are interconnected (Figure 6).

Photo 1 Omron Luna-88K Workstation

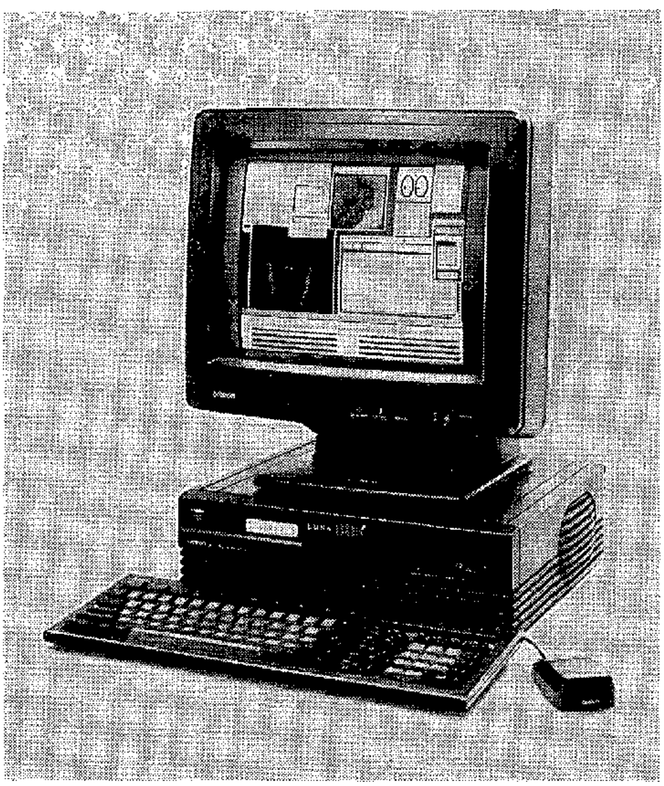


Figure 5 Network Environment at Omron's Kyoto Laboratory

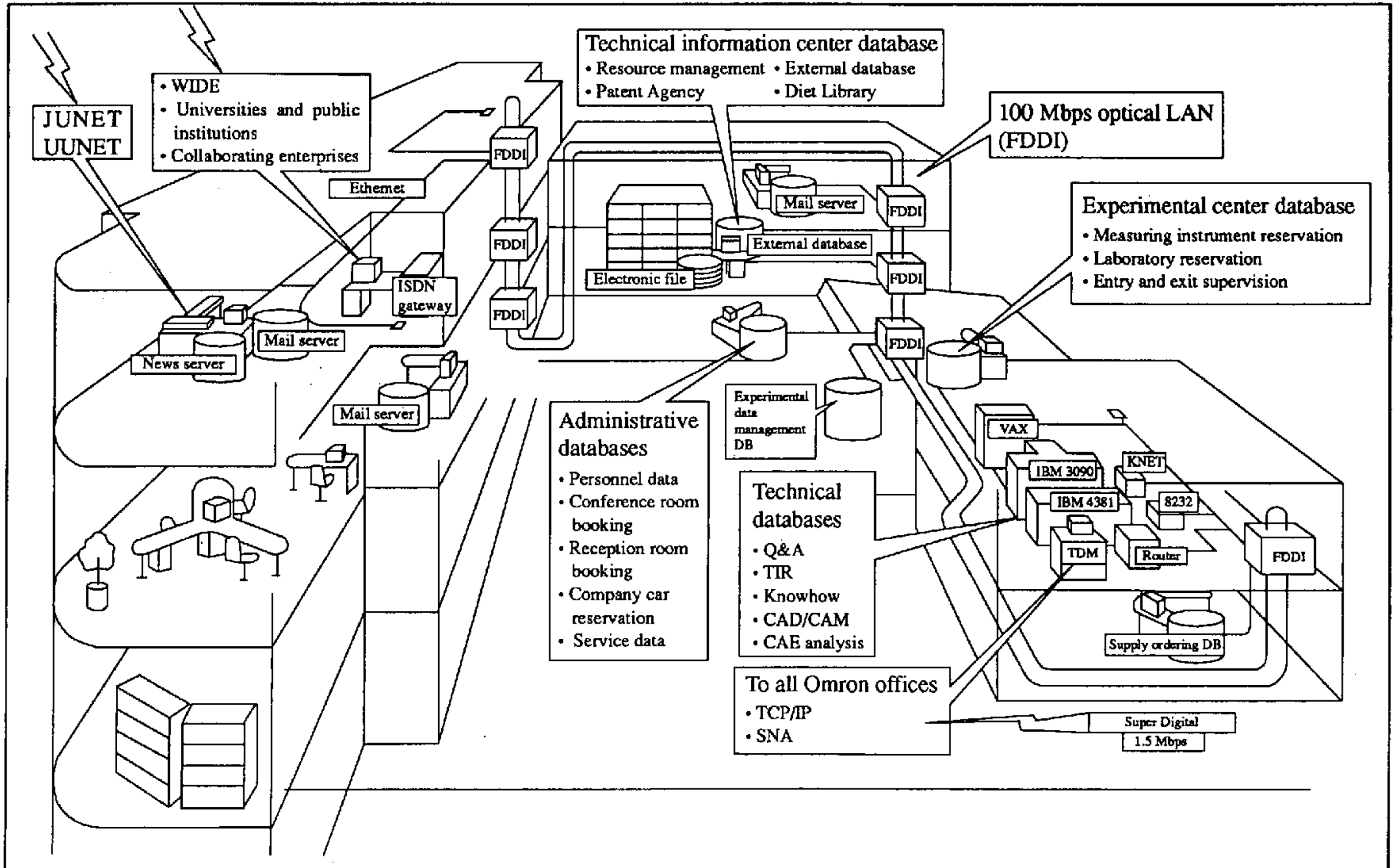
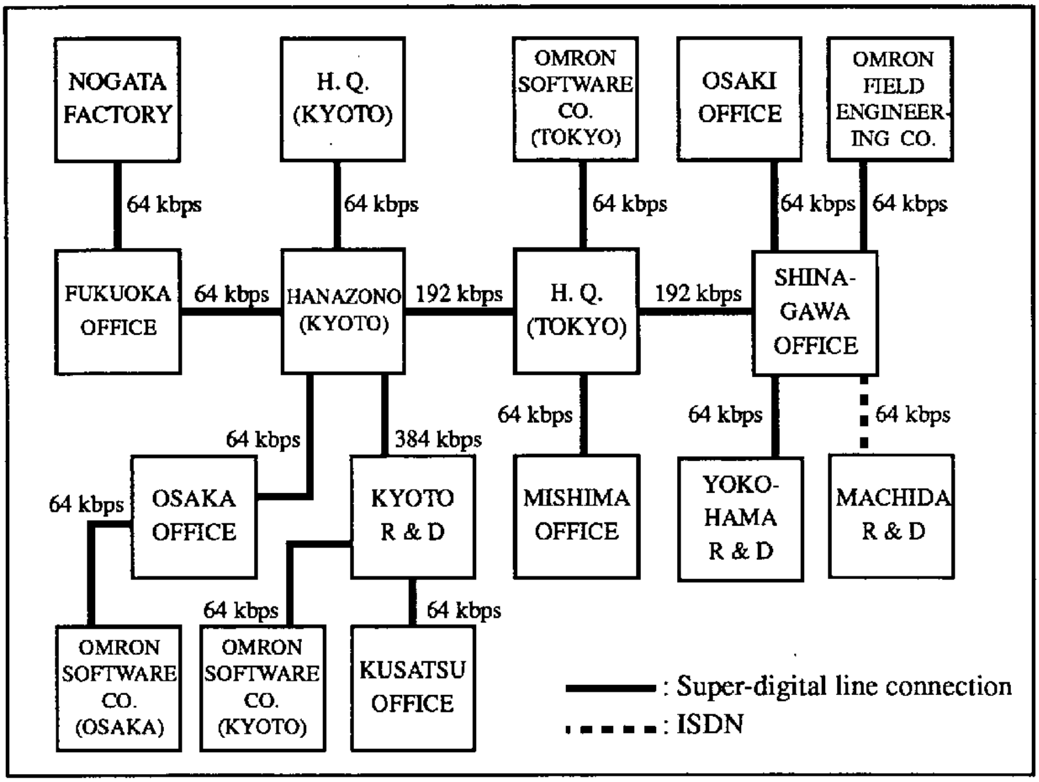


Figure 6 Omron's Engineering Workstation Network "Omron-Internet"



4. Omron's future R&D environment ideal

We hold that "point of development" (POD) is the ideal approach for a future network-reliant research and development (R&D) environment. The target in POD is to provide users, wherever they may be, with a working environment comparable to that of the laboratory -- a goal that will be achieved as workstations are reduced in size and gain in speed. It will be possible for these users to visit customers with handy terminals and perform on-the-spot design tailored to clients' needs. We foresee this possibility becoming a reality a few years from now. Accordingly, we attach great importance to the need to quickly build the infrastructure for this (Figures 7, 8, and 9).

The POD system concept moves the conventional large computer to the position of a database server, making it possible to use workstations for all calculations. Just a single workstation will be able to help not only in software design or electrical or mechanical design but also in administrative data processing such as when booking a conference or reception room and arranging the purchase of materials for experiments. The large computer server machines supervise and accumulate data related to commercialized products. All basic data on products commercialized by us will be collected here.

Subject to regular security checks, the resulting environment, which will connect the large computer and workstations, will allow access to our product design database from anywhere at any time.

Figure 7 Image of OMRON Unified R&D Support System

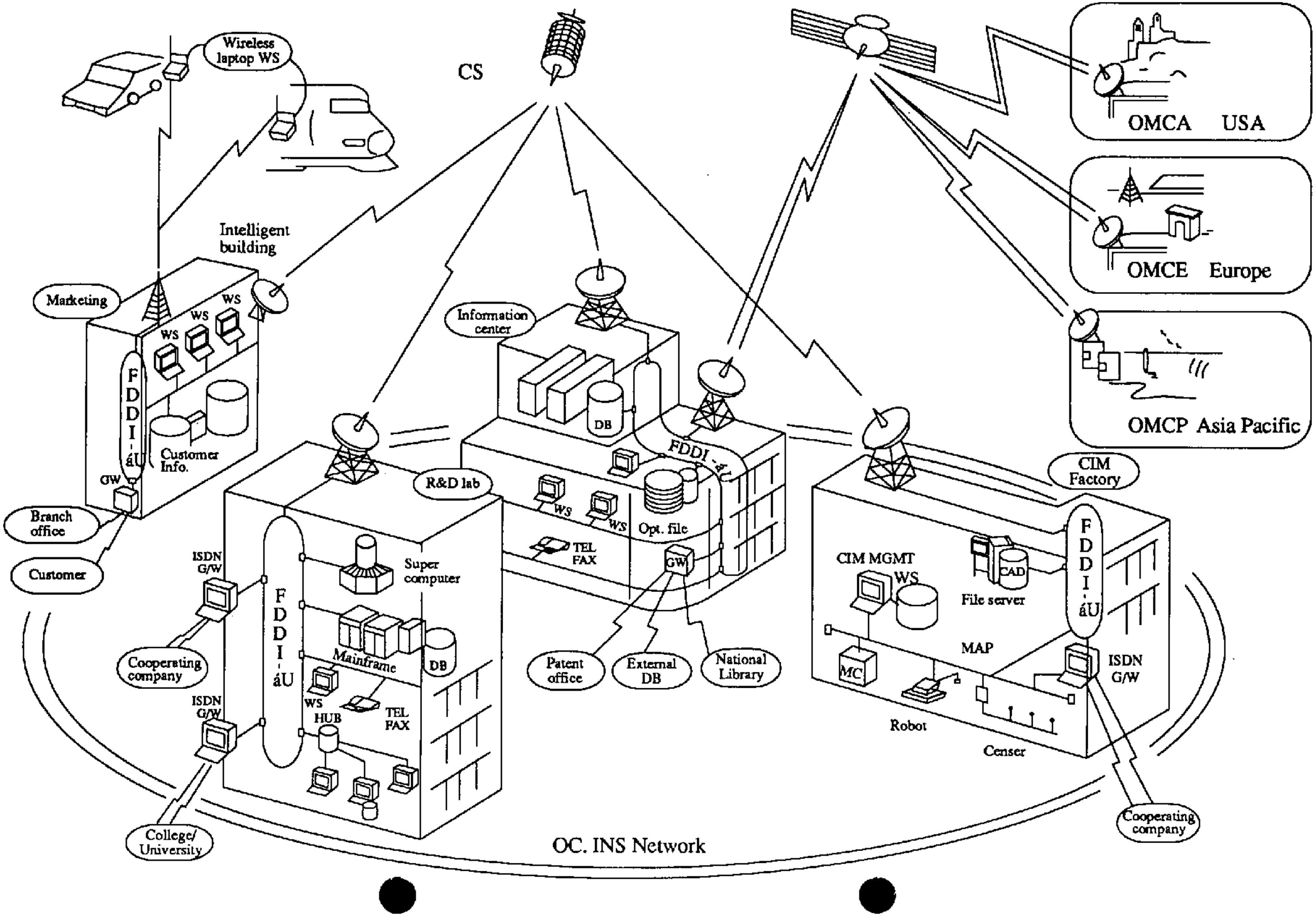


Figure 8 A Future of OMRON Integrated R&D Support System

— An Implementation of POD (Point of Development) —

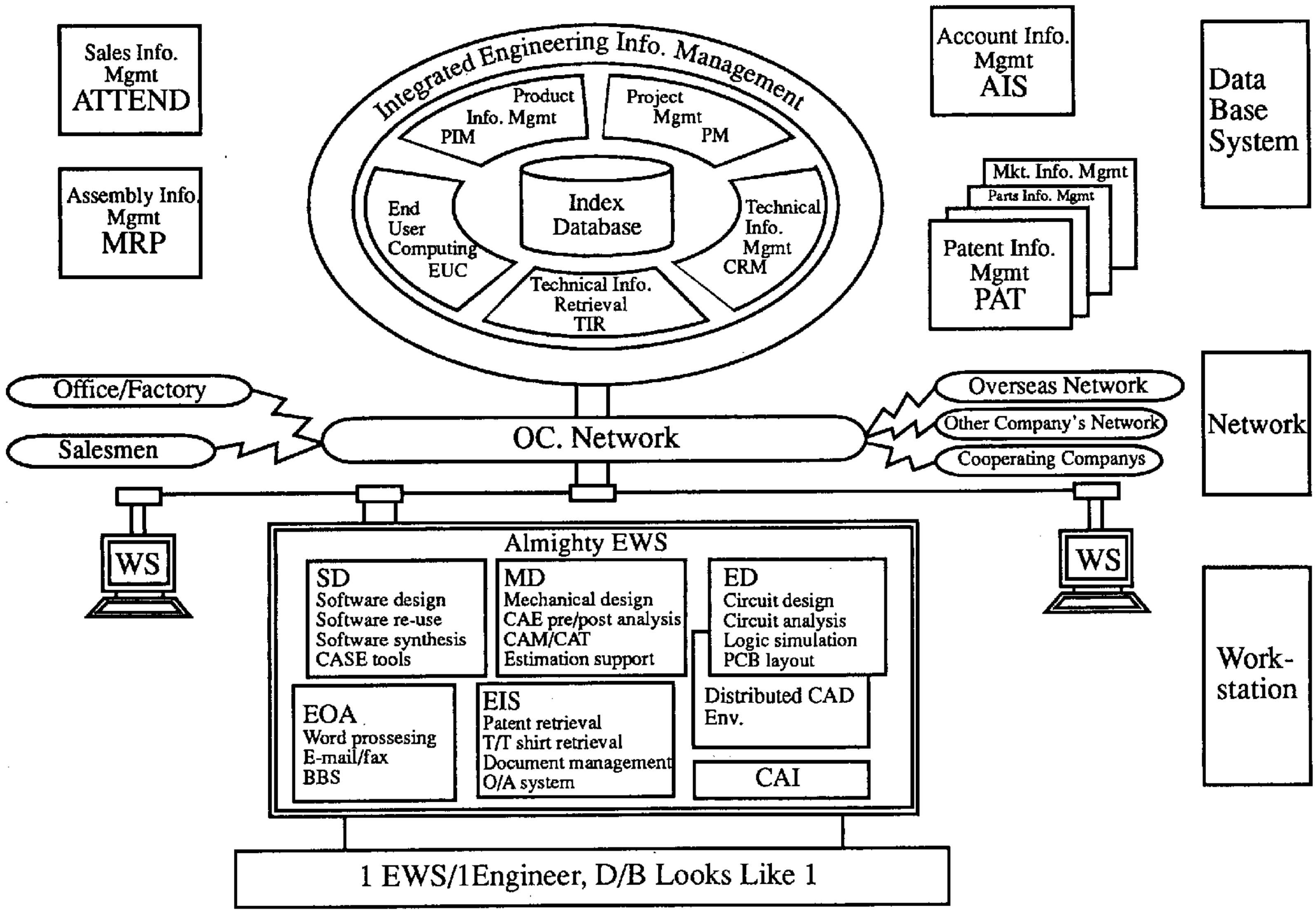
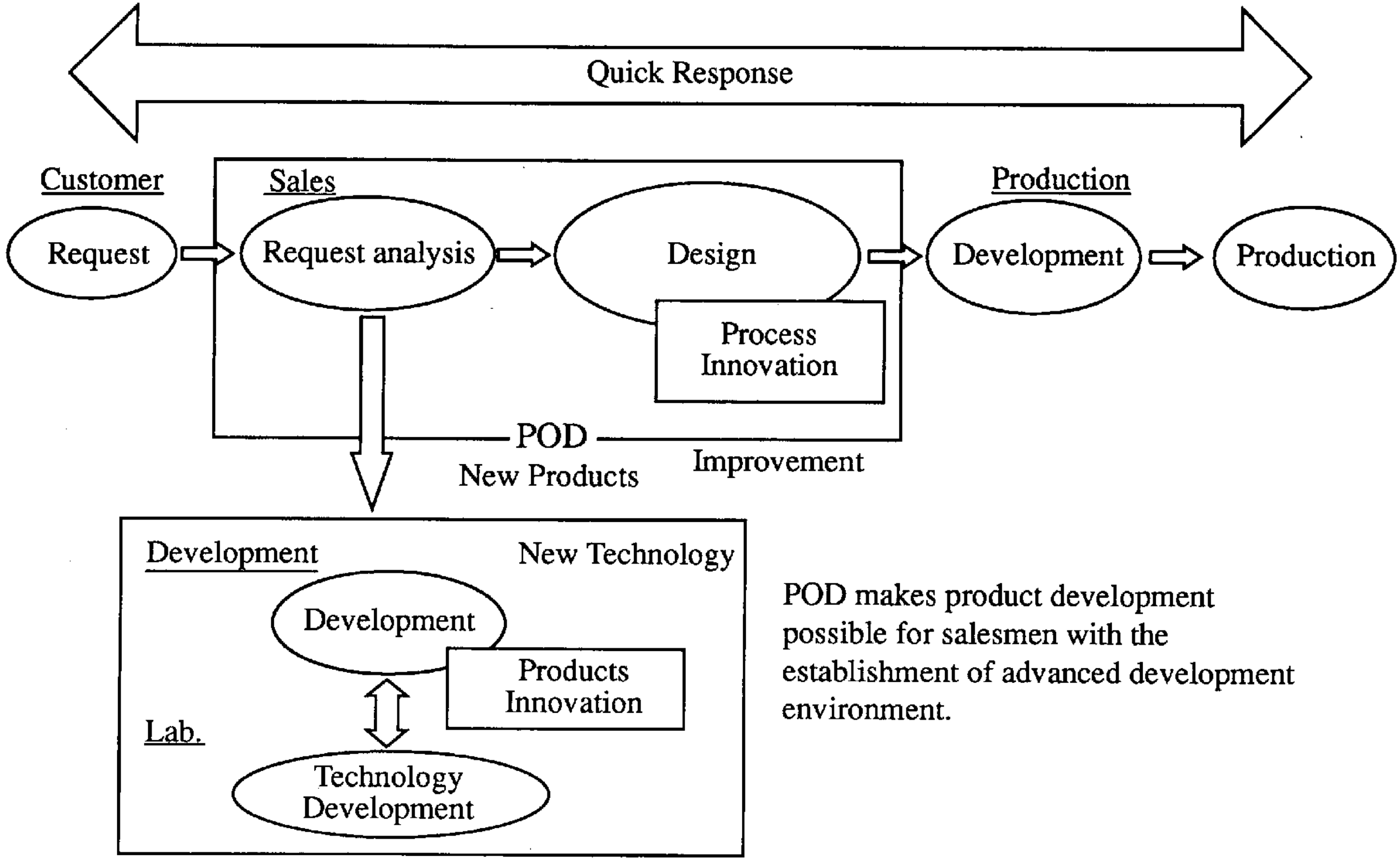


Figure 9 Image of POD (Point of Development) after Five Years



POD makes product development possible for salesmen with the establishment of advanced development environment.

5. Future tasks

Three tasks must be attended to before the POD environment can take shape:
(1) Spreading the workstation culture
(2) Effective distribution of jobs between the large computer and the workstations
(3) Enhancement of a security system.

Workstation culture has already penetrated fairly deeply into the research and development environment but it must now spread to sales activities as well. This calls for a proper training and education and a system of personnel rotation.

As already mentioned, general use of large computers are certain to find use as central servers. However, it remains to be seen how well the application software in use since the past will be utilized and how well distributed server machines can handle an unlimited increase in data.

A big problem that awaits solution in the domain of workstation utilization technology is the lack of adequate security for systems using workstations. The question is being investigated at present in the context of standardizing Unix.

We expect to produce workstation systems for both internal company applications and external supply. For this we will use the technological knowhow we have accumulated over the past 15 years in the use of Unix and in the development of workstations.

Introduction of Workstations in NTT's Research & Development Departments

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1. Introduction

ISDN service, which began in April 1988, is now being used full scale, and the "globalization of computer systems" has made wide progress. At the same time, the performance of personal computers (PCs) and workstations (WSs) has improved, and equipment prices have been on the decline in recent years. Furthermore, the propagation of LANs (Local Area Network) is being achieved. These trends have promoted the development of "personal system utilization environments." Because of the foregoing factors, the propagation of distributed systems centering on networks is expected to further accelerate. This means that work will be performed by utilizing a workstation-based personal environment in combination with various services provided by networks (and systems installed through networks around the globe) in a complex fashion. Under these circumstances, the role played by workstations will become more important.

In this paper, I would like to introduce the workstation user environment, as it is formed through networks in particular, and the forms for utilizing workstations in research and development departments, centering around the example of the installations at NTT Network Information Systems Laboratories.

2. Development of Systems and Networks in the Research and Development Environment

NTT's laboratories are scattered around in 6 locations: Musashino, Yokosuka, Ibaraki, Atsugi, Shinagawa and Kyoto. Network Information Systems Laboratories are located in 2 locations, Yokosuka and Musashino. All the laboratory locations are connected with high-speed lines and systematization of the research and development environment has been progressing. Representative network services that can be utilized through workstations at laboratories include the following:

(1) Network for R&D Engineer: NTT-INET

This is a network for information exchange between researchers in Japan and the rest of the world. Computers installed at NTT are used for the network. Also, the network is connected through gateways with JUNET, an academic research network in Japan, NEARnet (New England Academic and Research network) and other external networks.

(2) Network for Distributed Software Development: CAE (Computer Aided Engineering) – NET

This is a network that has been constructed for improving the efficiency of software development within NTT.[*1] A variety of services are provided to support the distributed development of software, connecting software development locations across Japan by network.

(3) Other Network User Environments

In addition to the above-mentioned networks (1) and (2), there is a network that is exclusive to the research and development departments. In this network, various types of services such as management support, administrative processing support, information supply support and communications support are provided to support office work in the R&D environment.[*2] Furthermore, joint utilization service for supercomputers is provided. The research staff can access supercomputers such as a CRAY through LAN using their workstations in the laboratory, and can receive various scientific and engineering computing services needed in research and development.

In the following, I would like to describe the CAE Network as an example of a system that can simultaneously utilize the global environment and the personal environment from among the above-mentioned network environments that can be used by the R&D department of NTT. I will describe the outline of the network configuration, protocols, its service content, and the utilization status at NTT Network Information Systems Laboratories, etc.

3. CAE Network and its Usage

3.1 Network Configuration

The configuration of the CAE Network is shown in Figure 1. The CAE Network is composed of "Departmental Networks" which are exclusive to each department within NTT and a "CAE Trunk Network" that connects the departmental networks on a nation-wide basis.

In the CAE Trunk Network, access points are

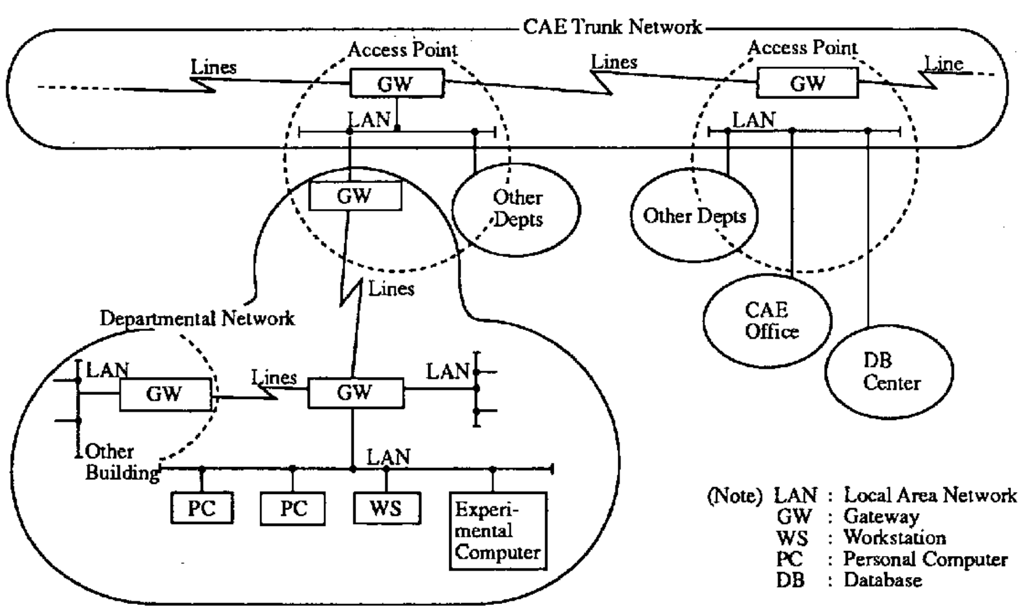

Figure 1. Network Configuration of CAE-NET

provided to connect the departmental networks for each geographical area. Trunk gateways are installed at each access point, and they are connected using either ISDN lines or super digital circuits (64 kb/s or 1.544 Mb/s). The departmental networks and access points are connected using gateways installed on both sides via super digital lines or switched lines.

The minimum unit in the network is a LAN. Workstations and personal computers for development environment, mainframes and minicomputers for execution environment are connected to LANs.

3.2 Protocols

The communications protocols used in CAE Network are the group of TCP/IP (Transmission Control Protocol/Internet Protocol) protocols that are the de facto standards for internet.

3.3 Services

The services commonly provided on CAE Network can be broadly grouped into the following three types. These services have made it possible to have speedy inter-departmental communications, and promote the distribution of technical information and various tools. The intent is to improve the efficiency of the software development performed at locations scattered across Japan and to facilitate maintenance.

(1) Communications Service

Communications Service provides a means to perform information exchange between departments. Electronic mail and news, and electronic bulletin boards are representative services.

Using this service, it is possible to construct value-added services for users or user groups, such as exchange of documents and programs for software design, information on conferences and conference proceedings, dispatch of comment slips, and knowledge about network operation status.

(2) Software Information Distribution Service

Useful information for software development is accumulated as data bases and provided to users. Users at all NTT locations can get this information through the network using workstations. Registration of information can also be done from workstations. This provides support for performing software development and maintenance work efficiently.

(3) Distributed Development Support Service

This provides services such as remote "login" high-speed file transfer, and multiple simultaneous transmissions, etc. With this service, a greater part of software development work can be performed on a workstation, since computer testing can be done from remote workstations. This service will promote the distributed development of software.

3.4 Network Management

With the CAE Network, we systematically perform construction and operation of the trunk and departmental networks, centralized control of IP addresses, supply of common services, network security management, etc.

3.5 Utilization Status at the Network Information Systems Laboratories

The CAE Network of the Network Information System Laboratories at our Yokosuka Location (hereafter called Yokosuka CAEnet) has been constructed as one of the sub-network for the company-wide CAE Network that I have described up until now.

(1) Network Configuration

The network configuration of Yokosuka CAE-net is shown in Figure 2.

Only the gateways to connect with the access points for the CAE trunk network, the routers to accommodate the segment LANs under the backbone LAN and LAN analyzers for monitoring are attached to the backbone LAN. Security management concerning informa-

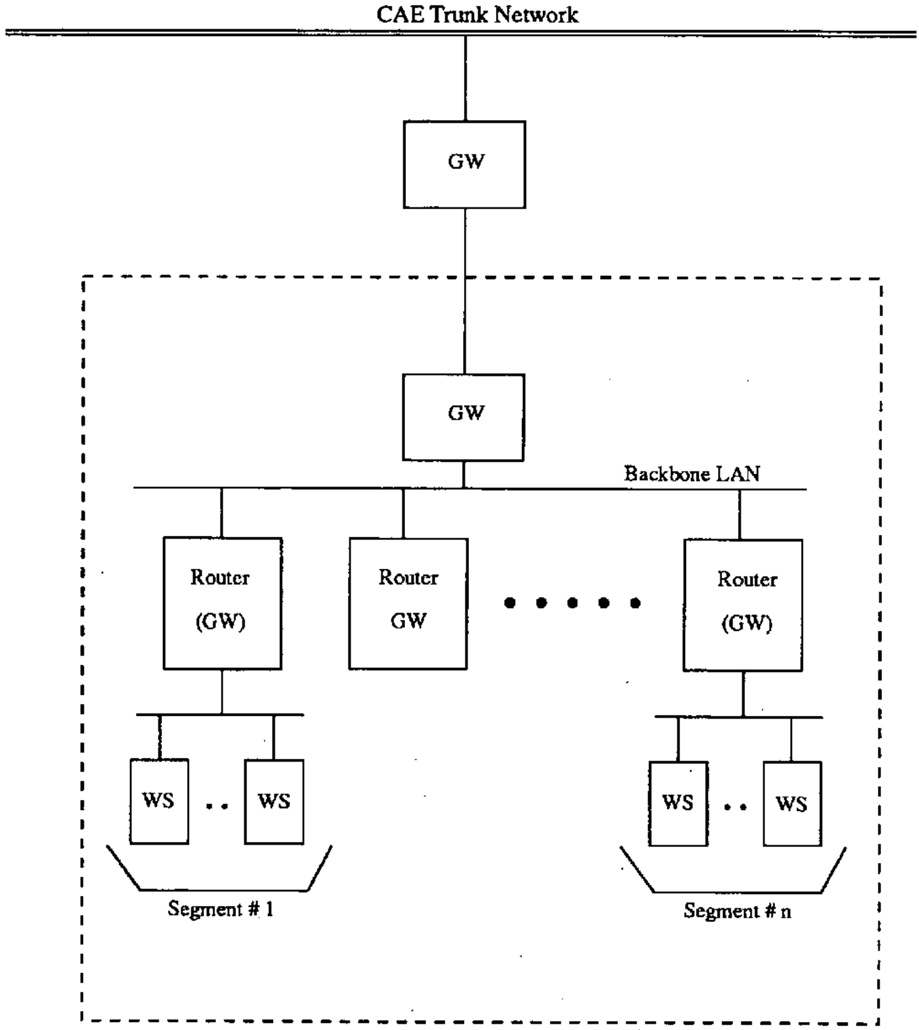

Figure 2. Configuration of Yokosuka CAEnet

tion exchange with each segment is performed by the router.

Business-use workstations and workstations for software development are attached to the segment LANs. The services shown below are used.

(2) Utilization Status

The utilization status of the Yokosuka CAEnet is shown in Table 1.

Table 1. Utilization Status of CAE Network

Type of Service	Services Provided • Example of Use	Network Utilization outside of Segment
Electronic Mail	• Use of electronic facilities for items that are communicated	Yokosuka CAEnet
	• Fax transfer service	
	• Information exchange (internal, external)	Yokosuka CAEnet, CAE-NET, External networks (via NTT- INET)
Electronic Bulletin Board	• Tool use methods	Yokosuka CAEnet
	• Address information, network operation information	CAE-NET
	• Various discussions	CAE-NET
	• Reference to external news	External networks (via NTT-INET)
Information Supply	• Software development facility information (Routing method chart, line accomodation table, etc.)	Yokosuka CAEnet
Computer Usage for Software Development	• Remote test	Yokosuka CAEnet, CAE-NET
	• Software development (Source code control, etc.)	Yokosuka CAEnet,
Connections outside of Department	• File delivery	CAE-NET
	• Software development management	CAE-NET
	• Reference to CAE data base	CAE-NET
Others	• Shared use of files through NFS • Location control • Document preparation using a workstation	

4. Conclusion

I have introduced a network user environment (CAE-NET) that supports the distributed development of software, using an example of the workstation installation at NTT Network Information Systems Laboratories.

At present, enhancement of network environments is making steady progress in Japan, and will become the basis for construction of information systems. In order to effectively use this network environment, our future task is to achieve high-level utilization of workstations.

[Reference Materials]

(1) Fukuyama, et al. "A New Development Environment via CAE Network," NTT Gijutsu Journal, pp23~27 (April, 1990).

(2) Terashima, et al. "Enhancement of OA Systems by Electronic Decision Making and Decision Making Support," NTT Gijutsu Journal, pp74~75 (May, 1991).

Introduction of Workstations in Mitsubishi Electric

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1. Introduction

The focus of this paper is on UNIX workstations and how these machines are being used at Mitsubishi Electric Corporation — even though what workstations actually are remains to be defined. The open UNIX environment has served to promote technological development and software accumulation, and this has drawn users to the UNIX world. Initially UNIX was thought to be suitable only for overly enthusiastic specialists, but today it has been found that office managers can familiarize themselves with the workstation environment and start using these machines in just a single day. However, within companies workstations find the widest use in departments seeking to develop engineering office automation. Systems built specifically with this aim in mind are referred to as engineering office systems. The object of this paper is to provide a simple description of a standard platform for engineering office automation and engineering office systems, along with representative tools, and to provide an example of a UNIX system.

2. Engineering Office System

The advent of the time sharing system (TSS) age finally made it possible for individual users to use computers freely. However, the main purposes served by computers at that stage were to perform calculations and develop programs. However, when workstations and local area networks made their debut, engineers started using the workstation environment for much of their work. Here, we will discuss the engineering office system developed by Mitsubishi Electric for its own internal use and the aims it is intended to serve. For a view of the origin and development of this system, refer to Figure 1.

The following targets were achieved by the electronic handling of technical information and jobs. The idea here is to reinforce the structure of the enterprise.

(1) Greater efficiency in technical document generation (allowing for reuse and a paperless approach)
(2) Greater communication efficiency through use of electronic mail and news (speed and accuracy)
(3) Construction of technical databases to accumulate technical data and knowhow and to use this information efficiently
(4) Consolidation of basic CAE, CAD, CAM, and EOA functions, integration of jobs, and improving their efficiency
(5) Extension of office automation to cover planning, estimation, preparations, project management, and other operations
(6) More efficient management and higher management standards

(7) Creation of a shared working environment (groupware) based on engineering office automation, both for in-house and inter-company applications.

Note that engineering office automation represents a more abstract image that encompasses engineering office systems.

3. The Standard EOS Platform (the ME family)

The ME family is the generic name given to the ME CISC and the ME RISC Series. Specifications follow general and specific industrial standards for the individual components of these two series, which makes it easy to include third party products or public domain software in the system and also makes it easy to operate in a multivendor system environment. Figure 2 provides an image of job details, application patterns, and functions in the use of the standard engineering office system platform.

3.1 ME family models

The main types of machines that have been in use so far belong to the CISC Series. The advantages of this series have included continued usability — without any change — of the abundant software resources that have been built up over the years. As for the RISC Series, it holds out the prospect of even brighter performance possibilities. Conceivably, this series will make way for new applications.

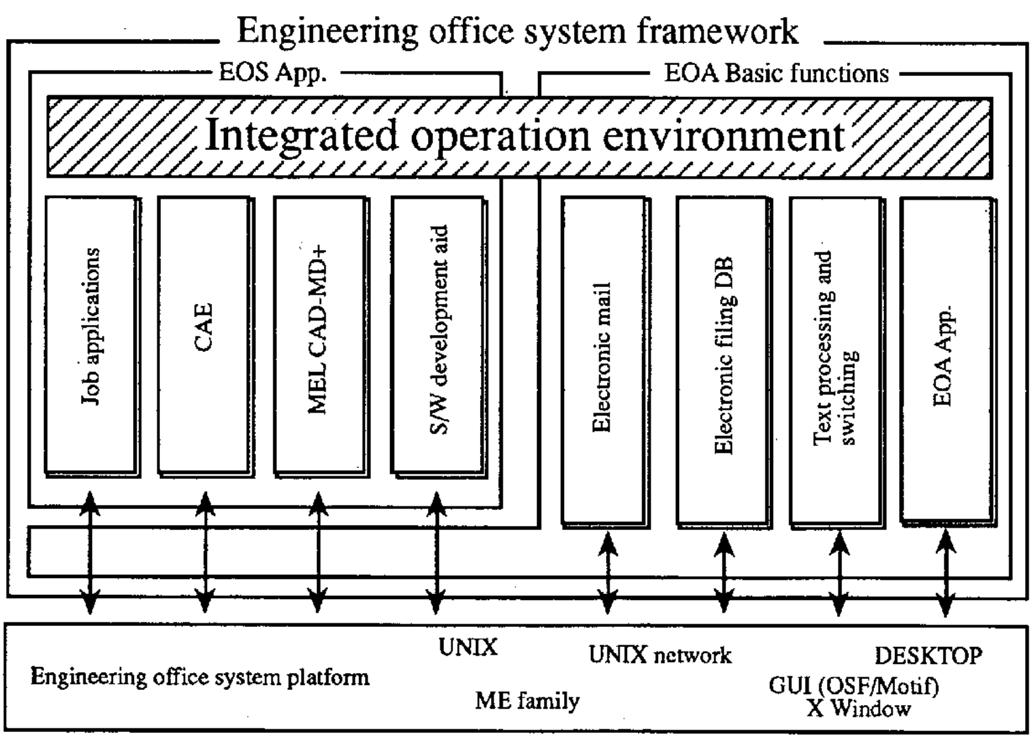

Figure 1 Configuration of the Engineering Office System

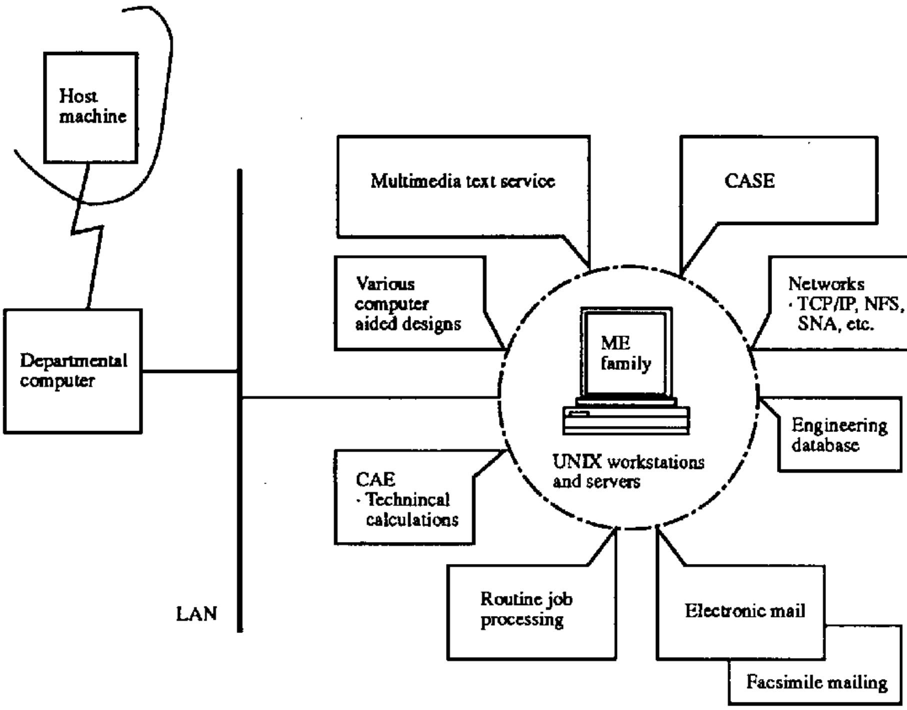

Figure 2 EOS Standard Platform Application Image

Table 1. Examples of Hardware Models

	ME250	ME400	ME550	ME/R7200	ME/R7300	ME/S7500
Performance	5.5MIPS	7MIPS	20MIPS	57MIPS	76MIPS	
CPU	68030		68040	PA-RISC		
Main memory (max)	16MB	32MB	128MB	64MB		192MB
CRT size	16 inch/20inch			19 inch		
Resolution	1280×1024					
Simultaneously displayed colors	256 colors (optional colors offered)					—
Built-in FXD (max)	3.5 inch 200MB	5 inch 320MB	5 inch 670MB	3.5 inch 420MB×2		5 inch 660MB×2
FDD/DAT	FDD			DAT		
Basic I/O interface	SCSI, RS-232C Centronics, LAN					
I/O slot	—	VME Double long × 3 Single long × 1		EISA 1		EISA 4
Option	Cassette MT	Cassette MT FXD extention I/O and communica-tion control	Cassette MT FXD extension Full-color graphic engine	FXD extension→max 10GB Floppy disks Graphic system (GRX, CRX, PVRX, TVRX)		FXD extension →max 40GB

3.2 Basic ME family software

Use of the standard UNIX workstations and servers in the ME family makes the related operating system a base for the use of software that is highly evaluated in industry and used widely all over the world. The main products that are used centering on the basic software appear in Figure 3.

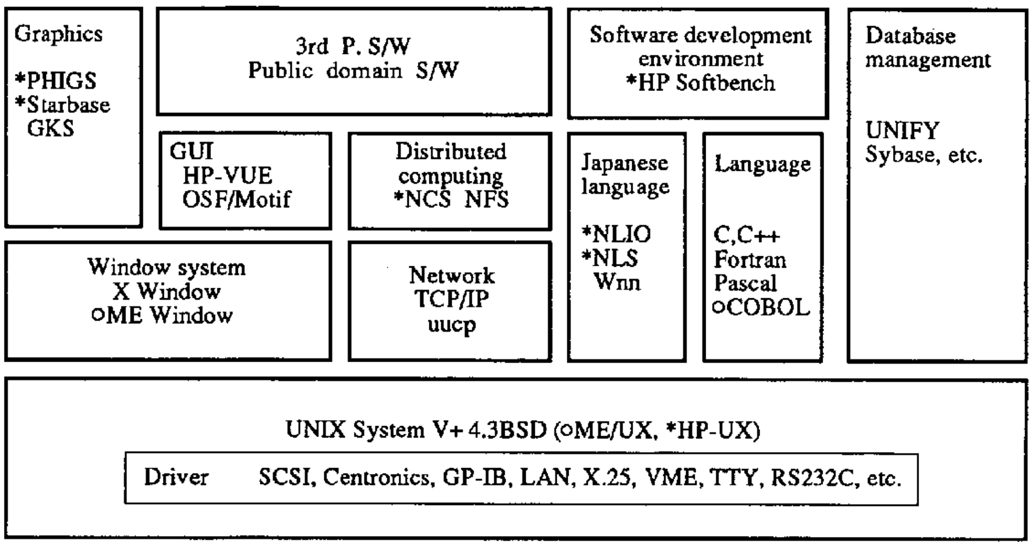

Figure 3 Software Configuration

*: For the ME RISC Series   o: For the ME CISC Series   No symbol: Common functions

4. Representative Tools for EOA

Next, let us consider some of the commonly used basic tools used in engineering office automation.

4.1 Multimedia text processing

This system embodies the functions engineers have always desired. Representative functions are as follows:

(1) Text editing

The function makes simple mouse or icon based operations possible for Japanese language word-processing, tabulating, production of geometric patterns, image input (monochromatic screen), editing, and graphic data handling.

(2) Input of CAD drawings

Input of drawings produced through computer aided design via the GKS metafile, CAD drawings can be fed in and inserted within and edited along with texts. This function is particularly helpful in the production of proposals or technical manuals.

(3) Mathematical expressions

With this function, mathematical expressions involving integration, differentiation, summation, or other common operations for scientific or engineering calculations can be inserted into texts and printed.

(4) Text data conversion

The function uses Sony Co., Ltd.'s common document file format (CDFF) and makes the inclusion of texts produced by word-processing programs run on personal computers or other workstations possible.

The system can handle B5 (182 x 257mm), B4 (257 x 364mm), A4 (210 x 297mm), and A3 (297 x 420mm) papersizes, and print operations can be easily executed in the desk-top environment through the print server.

4.2 Electronic cabinet

This refers to a service allowing use of the host computer electronic cabinet from terminals such as workstations or personal computers. The cabinet, binders, and documents, are hierarchically organized and are managed and maintained on the host side. The following are the features of the cabinet:

(1) Centralized control of documents and sharing of documents with other terminals

(2) User-friendly man-machine interface services in the form of a desk-top environment, with icons, and multi-window facilities

(3) Simultaneous accessing of the electronic cabinet from two or more host computers.

4.3 UNIX electronic mail

Use of electronic mail in the UNIX world presents various user-interface related problems. For this reason, Mitsubishi Electric has developed a graphic user interface for multiple-addressing, confirmation of incoming calls, confidential treatment, address-retrieval, and various other functions that can be manipulated by using a mouse. Mail contents are prepared by applying the multimedia text processing functions or by using a Mitsubishi Electric personal computer (MAXY Series) or word-processor. Documents thus prepared can be sent or received via the UNIX electronic mail system.

4.4 Electronic conference room booking

From a workstation or personal computer, one can find out the booking status of conference rooms of various sizes within the factory. This saves a great deal of time that would otherwise be required to search for an unoccupied conference room. Representative functions include:

(1) Booking, cancellation, changing
(2) Listing of booking status
(3) Security function (setting up passwords for specific conference rooms)
(4) Display of conference room data (names, accommodations, locations) and user data.

4.5 FAX application system

Files and data generated and managed by the workstations can be directly transmitted to the FAX system.

5. The System: An Example

Here we shall discuss an example of an engineering office system using workstations or servers and tools.

5.1 A typical engineering office system

Figure 4 provides a typical example of the systems used in Mitsubishi Electric's plants and research stations.

5.2 Electronic document storage

Electronic document storage is a system that treats design drawings as electronic data and exercises central control of such data. Accordingly, with this type of system, the conventional document management operations of storing, supervising and lending drawings (on paper) are computerized. This makes the entire process paperless and facilitates better design efficiency and quality control. The main features and functions of the system are:

(1) The storage facility is made up of a drawings ledger and a CAD drawings database that stores drawings data.
(2) The storage facility registers drawing information and actual drawings data (CAD data).
(3) Keyword facilities are provided for data retrieval from the drawings ledger
(4) Specified drawings are displayed on LAN-connected workstations by using monitor system.
(5) Drawings can be obtained from specified workstation(s) connected to the LAN.
(6) Drawings ledger contents and CAD drawings data can be changed.

5.3 Equipment assets management system

The system, known as FASTPLAN creates databases that inter-relate building, office, and plant drawings (diagrams showing equipment layouts) and ledger data relating to the attributes of the equipment elements. This widens the scope of equipment and asset management. The system utilizes diagram data processing and layout design/conversion support functions to efficiently handle factory site plans for maintenance purposes, to supervise fixed assets, to manage machine contracts and maintenance, and to plan equipment

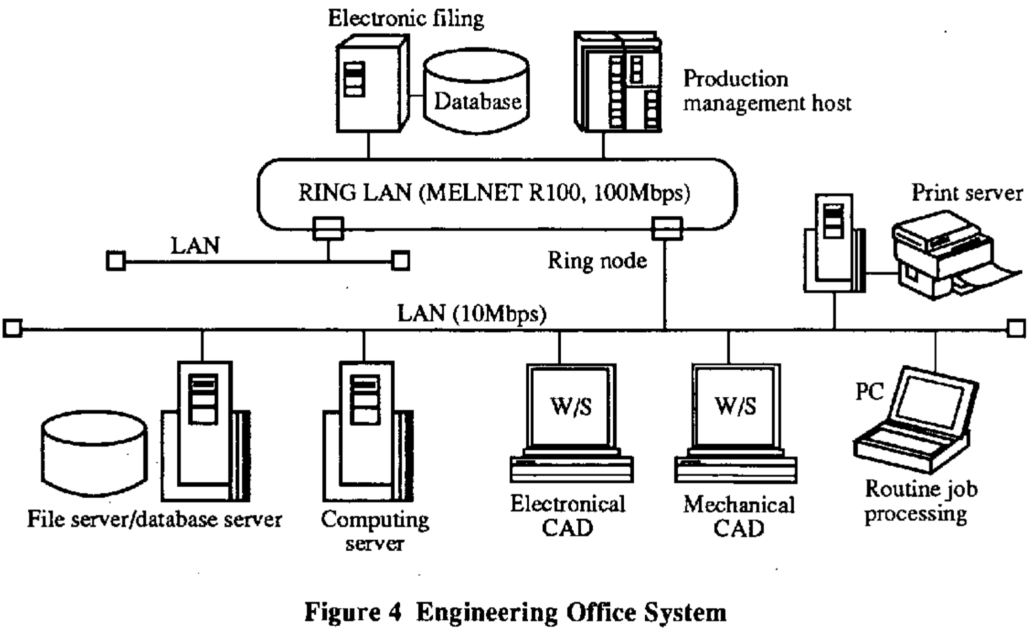

Figure 4 Engineering Office System

layout.

5.4 Estimate preparation system

One of the most important duties performed by Mitsubishi Electric's system engineers is to prepare estimates for computer systems in accordance with user requirements, and to offer proposals. This system performs all the operations related to estimates from producing drawings, to drawing up specifications and responses. In addition, via a network, the system can develop the data for the production process. It can therefore serve as an effective SIS/CIM system. The main functions of this system are:

(1) Preparation of drawings and estimates
(2) Checking estimates
(3) Preparing product information database
(4) Automatic estimate related calculations
(5) Preparation of specifications
(6) Transmitting estimate related data to lower steps in the process.

5.5 EOA for research stations

The studies conducted at our research stations make use of tools that match their various research objectives. These are run on workstations or super-computers. However, researchers also need a common environment. Apart from the tools described in Section 4, there are also a number of services developed by the research stations for their own use. The following are three such services:

(1) Routine text generation system
This system helps produce, in excellent formats, the routine texts that researchers have to write so frequently through an easy-to-use interface. No particular attention is needed for formatting the texts, and coding is simple and based on logical items. Furthermore, use of TEX, a text editing system makes detailed text output possible. Also, the same data can be simultaneously edited into different formats.

(2) Technical data service
This service uses a high-speed database machine as a server. From workstations or personal computers connected to the local area network, data may be retrieved from company technical materials and research documents by using titles or the name of the document issuer.

(3) Instrument data retrieval system
The object of this system is to make effective use of the instruments within the research station. Accordingly, it centrally controls instrument ownership, instrument performance information, and information on loaning of instruments. All information on instruments can be instantaneously retrieved from workstations or personal computers connected to the local area network.

6. Conclusion

For some time, UNIX workstations have been the main machines Mitsubishi Electric has been using to promote engineering office automation. Initially, use of the machines was restricted to experts only. These days, however, the opportunity has been created to use software for different applications across graphical user interfaces or in a desktop environment. As a result, workstations are now required for each individual employee. It is difficult to discontinue use of UNIX workstations once one starts to work with them, since they soon become indispensable for one's daily work.

As the scale of engineering office systems expands hereafter and when full-scale multimedia processing begins, demand for better and more sophisticated performance for LANs and communication systems will rise. Standardization of security measures will also become a necessity for supervision of the resources that are transmitted across networks.

Current News

* **NTT Develops New TV Conference System**

NTT has developed an innovative TV Conference System that can connect many different locations for simultaneous discussion with one another on screen. The system includes a functional workstation with which the same screen can display persons in 11 locations. Since each voice can be heard coming from the spot where the picture of the person with voice is, users will be able to have the feeling of being gathered around a table as in a live situation. In addition, users can choose to speak only to specific persons in the session. Services will start in 1995.

The system utilizes a 19-inch TV screen. While displaying information needed for the conference on the screen, up to 11 members of the conference can also be displayed on part of the screen for simultaneous discussion. Furthermore, the user can turn down the volume or shut off the conversation itself, if there is someone the user doesn't want to converse with.

Moreover users can change how the screen is arranged to display the 11 persons on the screen using only the simplest operations. While watching the screen during a session, users can also make outside phone calls in order to acquire necessary information, and then join in the debate again.

The system assumes the use of broadband integrated services digital networks (ISDN).

* **Fujitsu, AT&T Group receives order to lay optical submarine cable between Singapore and Japan**

A US-Japan consortium, led by Fujitsu and including AT&T, NEC and Japanese Ocean Submarine Cable, has accepted an order to lay an optical submarine cable [the APC System] that will connect 5 different countries or areas between Singapore and Japan. The total cost will be 46.4 billion yen and the cables overall length will be 7,500 km. Operations are to begin at the end of July, 1993.

The APC System is to be a communications trunk line between Japan, Taiwan, Hong Kong, Malaysia and Singapore connected by optical fibers with a transmission capacity of 560 megabit/sec, corresponding to 7,560 telephone lines. In Japan, the trunk line of the APC System will be connected to the Miura cable center of International Digital Communication (IDC) and the Miyazaki cable center of KDD.

Conventional submarine cables link connections between each area and the next area in turn. In contrast, the cable of the APC System will have 4 branch points on the ocean floor connected to branches to each area and will be the first of its type in the Pacific region.

For ordering and management of the APC system the consortium will involve AT&T, KDD, IDC, ITDC and 9 other telecommunications providers in Hong Kong, Singapore and Malaysia. After its completion, 29 more corporations that will use the cable plan to sign the maintenance agreement, so that a total of 38 telecom providers and corporations from 23 countries and regions will jointly own the APC System. The cable of the APC System is to be connected to "SEA-ME-WE2", which will extend from Singapore to France and start operations at almost the same time as the APC System, thus forming part of a round-the-world optical submarine cable network.

* Europeans to join in the development of four-dimensional computer

A number of EC research institutions and corporations are announcing their participation in the project to develop the new "four-dimensional computer" information processing system that the Ministry of International Trade and Industry (MITI) is to launch in 1992.

The "Four-dimensional computer" will employ remarkable functions that conventional computers have not had, such as human-like intuition and the ability to recognize figures and graphics. Starting in fiscal year 1992 MITI will invest approximately 100 billion yen in this international project for new computer development and is appealed to European and American countries to participate in the project. Many European countries have decided to attend to the Tokyo International Workshop in October, 1991 to examine and discuss a wide variety of aspects of project research. ERCIM (European Information Science and Mathematics Consortium), which plays an important role in research and development (R&D) in the field of information science in Europe, has displayed a special interest in the project. ERCIM comprises 5 primary research organizations dealing with information science in the UK, France, Germany, and other countries. Approximately 10 ERCIM staff members will attend to the Tokyo International Workshop. From France, the Optical Research Center of CNRS (The National Scientific Research Center) also wishes to attend the Workshop.

* Fujitsu Laboratories develop new type of chips for optical signal reception

Fujitsu Laboratories have developed a new type of chip for optical signal reception that may find practical use in coherent optical communications, the next generation very high-speed optical communications. Conventionally four chips with light intercepting elements have been used together as a set, but with the new type these elements are successfully integrated into one chip. In addition, the substrates of the elements are processed into a condenser lens layer so that the elements are unified with the lenses on the chip.

The size of the new chip is 500 microns by 400 microns. 4 spots on one side of the chip are processed into lenses with a diameter of 80 microns. Since these parts are made from indium and phosphorus, they have the nature of transparent glass with regard to the 1.55 micron wave length light band that is used for optical communications.

Photodiodes made of gallium, indium and

arsenic form the light interception elements in the interior beneath the lenses. The control circuitry and connection terminals are formed on the opposite side from the lenses, if the chip is mounted on a signal processing IC chip, their circuits can be directly connected.

Coherent optical communications is a system with which a great deal of information can be transmitted using the operating wave length, frequency of light and delicate changes of phase. It is expected that its information operating speed will be 15 times to 60 times faster than of previous optical communication systems, which expresses information using flashes of light.

* Mitsubishi Electric Central Laboratories develops very high speed neural network

Mitsubishi Electric Central Laboratories has developed a new type of very high speed neural network that is 10 million times faster than previous networks. The neural network, which performs information processing that virtually imitates biological nervous systems, acquires the information processing capacity to solve specific problems by modifying its internal organization through learning. Therefore, the Laboratories call the developed system "self-organizing neuro theory."

For example, when wiring together a large number of semiconductor elements in LSI design in the way that will minimize the overall length of the electrical wiring, the elements are first appropriately arranged within specific limits. Then one of the elements is moved a specific distance toward a specified position. The more wires that are connected to that device, the greater the distance that the other devices move in the same direction. This operation is repeated for each device, returning to the first device when they have all been completed.

This means that the devices are moved according to the principle that the devices with a large number of connecting wires are made contiguous, while those with few connecting wires become separated off. By repeating this simple operation, the positional relationships of the devices approaches the optimal arrangement.

To find the optimal arrangement by computer, every allocation pattern must be inspected. When a conventional neural network is used, if there are 10,000 devices, it would take approximately 20,000 years (in the case of a supercomputer). Since the new system does not investigate every allocation pattern but merely repeats the same simple operation, it would only take approximately 15 hours for the computation (one ten millionth of 20,000 years). Moreover, the memory capacity which is required for the computation is only one hundred billionth of that needed by previous computers.

Thus, the focus of this new type of neural network theory will be to use simple operations in place of large quantities of calculations, by more successfully extracting the quality that neural networks inherently possess to approach a stable configuration.

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