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MICRO-ELECTRONICS MONITOR

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The *Microelectronics Monitor* proposes to accept industry-related advertisements from companies interested in reaching planners and policy-makers as well as entrepreneurs and members of the scientific community in some sixty developing countries throughout the world and inform them about their products and services.

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I. NEWS AND EVENTS

Silicon Valley hit by slowdown as big firms falter

Prophecies of a general slowdown in the semiconductor sector made by industry observers last year seem to be coming true with a series of bad news reports from Silicon Valley's big manufacturers.

The slowdown comes as a result of problems among personal computer manufacturers and a polarization in the industry that is pushing out the smaller companies.

Advanced Micro Devices (AMD) was the first with the bad news revealing it lost almost $37 million in its fourth quarter. About $17 million of the loss was due to closing a plant in Sunnyvale. The loss shocked industry analysts who were not expecting such a big loss.

National Semiconductor has said it will fire 2,000 workers, around 5 per cent of its workforce, as it tries to cut operating expenses. Analysts expect National to report a third quarter loss as it takes a write-off of about $12 million in redundancy pay. The company will attempt to return to its semiconductor business by selling off its mainframe business and point of sale division.

Intel, which has done very well on the back of the PC industry upturn over the last two years, has also reported a major drop in income. Profit fell by 10 per cent in the fourth quarter, in spite of high sales to $86 million.

The lower earnings are attributed to slower sales of the 80386 microprocessor. (Source: Electronics Weekly, 1 February 1989)

US processor giants line up 32-bit launches

Motorola and Intel will announce powerful new versions of their industry standard microprocessors later this year.

Intel will produce its next-generation 80486 microprocessor by the end of May offering a tripling in performance on the 80386.

The Intel chip has been five years in preparation and has cost about $300 million in development costs. It will have about one million transistors and will include many features that up to now have had to be provided by buying expensive co-processors. The 80486 will have on-board cache memory, and a math co-processor. Some of the microcode has been hardwired to increase performance. It will interface with digital video interactive chips, a technology for multimedia systems acquired by Intel from General Electric.

Samples of the 80486 will be available in the second half of the year with volume production by the third quarter. It will cost around $1,500, according to industry sources. The company has already told its biggest customers about the chip. IBM, reported to be one of its first users, will announce an 80486 system by the end of 1989.

Intel expects the 80486 initially to find applications in file servers and data base servers. A reduced instruction set computing architecture co-processor can be used with the 80486 to boost its performance further.

Motorola is preparing to introduce its 68040 microprocessor later this year. It offers a fourfold performance over the company's top-of-the-line 68030 microprocessor and features 1.2 million transistors, compared with 300,000 on the 68030. (Source: Electronics Weekly, 25 January 1989)

Sun clones to hit market

Cheap clones of Sun Microsystems' workstations will be appearing this year.

This will force down the price of computers and wreak havoc among established computer makers, whose share prices are already tumbling in the face of sharply reduced profit forecasts.

At least two firms, one in Taiwan and one in Hong Kong, are promising cheap Sun clones by the end of the year; while US-based Solbourne Computer unveiled its second Sun-compatible offering last week. Sun is actively encouraging the cloning process by licensing companies to make its Sparc processor, which is at the heart of its reduced instruction set computing machines.

Complete chip-sets for Sun-clone makers will be available from a number of sources such as Californian chip start-up Via Technologies, which recently got backing from Japanese giant Fujitsu.

Sun is expecting the clones and, according to one observer, "plans to cut them off at the pass" by slashing its own prices and unveiling much more powerful machines based on fast Bipolar versions of the Sparc processor. Such a machine could put more than 50 million instructions per second (MIPS) on the desktop.

Worst hit will be US computer giants such as IBM, DEC and Unisys who are already suffering as desktop machines eat into markets once dominated by their high-margin big computers. These companies are currently wading into the workstation market to protect their flanks but will be hard pressed to compete with Asian prices.

Top-end PC makers such as Compaq and Tandon may also run into problems as the prices of workstations delivering 15 MIPS start to compete with PCs delivering 5 MIPS. Workstation makers such as Apollo and Mips Computer Systems will also have to cut prices.

Sun-clone makers will target the US market first where share prices of big computer makers are already sliding as sales of minicomputers and mainframes stagnate. (Source: Electronics Weekly, 29 March 1989)

US plans next electronics war

The US electronics industry has shaken off its lethargy and taken the first strides in a race with Japan and Europe to develop high-definition television (HDTV), a technology that may revolutionize not only television but also the computer and telecommunications industries. American Telephone and Telegraph (AT&T) and Zenith Electronics Corporation, the only remaining US-owned television manufacturer, agreed to jointly develop an HDTV system. They have jointly applied to the Defense Advanced Research Projects Agency (DARPA) for support.

Although the United States is late in joining the HDTV race, many in US industry and universities are confident they can leapfrog Europe and Japan.

HDTV, which Japan's National Broadcasting Corporation (NHK) began developing in the early 1970s, has twice as many lines on the screen as conventional television, and thus offers pictures with greater clarity and resolution. HDTV also has applications in the movie industry, military imaging systems (whence DARPA's interest), still photography, printing, computer graphics and microscopic imaging. And supporters of HDTV talk of linking it with personal computers to create new information media.

If HDTV takes off, it will create a huge market for the semiconductor industry because of its dependence on computer chips. But present versions of HDTV receivers have drawbacks likely to deter consumers. They are heavy, bulky and expensive, while the high quality of the picture is apparent only when the screen is large. This is where US researchers see an opportunity to enter the market. (Source: Nature, Vol. 338, 9 March 1989)

Electronics industry in front line

Representatives of the US electronics industry, faced with the prospect of an enforced phase-out of the CFC solvents used as cleaning and drying agents in manufacturing, met CFC producers to try to speed up the search for alternatives.

While the use of CFCs in aerosol propellants and refrigeration has been given most attention in the assessments of the threat to stratospheric ozone, attention has only more recently focused on CFC-113, a solvent used in more than 100 specialized applications in electronics manufacturing. Not only has the electronics industry started late in the race to develop alternatives, but it is unlikely that one or even several substitutes will be adequate replacements in all applications.

The electronics industry seems nevertheless reconciled to a complete ban on CFC use by the year 2000. The US administration lined up with the European Community in recommending a complete phase-out by the year 2000.

If the recommendation is not formally endorsed by the signatories of the protocol at the meeting planned for Helsinki in May, the US Congress could decide to act unilaterally on behalf of the United States.

While most industry representatives at the conference accepted that a CFC phase-out is necessary to minimize ozone destruction, they fear that the regulatory axe will fall before they have safe economical substitutes in place. Hasty decisions on replacements, they say, could themselves create problems in the future, should the new chemicals prove toxic or otherwise hazardous, for example.

Some CFC suppliers complained that the electronics industry is reluctant to consider alternatives that will require costly changes in equipment and manufacturing processes, and seems rather to be waiting for a "magic liquid" that can be used in a fashion identical with that of existing products. (Source: Nature, Vol. 338, 9 March 1989)

Assaults on the environment

Some models of high speed laser printers, commonly found in DP departments, are helping to destroy the Earth's ozone layer by releasing CFC gases into the atmosphere.

The machines in question are the Siemens ND2 and ND3, 103-page a minute printers. The ND2 is also supplied to Storage Technology and Unisys who re-badge them as the 6/100 and 0777 respectively.

The leaked gas is tri-chloro-tri-fluoro-ethane (CFC 113). It is a liquid solvent heated to a gaseous vapour in a process known as cold fusion that seals the toner to the paper.

The container where the printing takes place is not 100 per cent airtight because the paper moves continuously through it. This allows vapour to escape into the atmosphere.

Siemens was the first company to introduce the cold fusion process using a gas sealant and is the only company still using it. Most companies, including Fujitsu, use a Zenon lamp fusion method. This method uses a flash-heat temperature which seals the toner without using any gas.

Ironically, another environmental hazard with laser printers is that they emit ozone, which at ground level is harmful to humans continually exposed to it. The ozone is created as a by-product of the electrostatic field used to transfer toner to the printers' photo-conductive drum.

To prevent excessive emissions of ozone, printers are fitted with special carbon filters. These, like any other kind of filter, need to be regularly replaced. (Source: Computer Weekly, 23 March 1989)

Mastering micros for development

Microprocessor technology is rapidly changing the economies of the industrialized nations - and at the same time is reinforcing their traditional scientific and technological advantage over the developing countries. As the foundation of key industries, microelectronics now plays the basic economic role that steel and chemicals technology did in bringing about the industrial revolution of the past century.

Expertise in computerized information systems tends to be concentrated in a few centres in the industrialized countries, and state-of-the art technology is mainly being developed there. This threatens to "lock out" the third world even further from such benefits at the very moment that microprocessor technology is increasingly being heralded as an essential of economic growth. The systems that support modern society are more and more computer-based - and this, in turn, affects the ways in which societies are evolving. There is thus urgent need for the third world to build up its own capabilities in this field.

The United Nations University is attempting to answer this challenge with training and research involving scientists from developing countries in microprocessor technology at centres of excellence in various parts of the world. The aim is to build up institutional capabilities in third world countries for mastering this technology and applying it in innovative fashion to their own particular problems.

The concept of "mastering" is fundamental. It does not mean "push-button" training for microcomputer users but raising scientific and technological knowledge to the level necessary for understanding the technology, using it and innovating with it.

The impact of the new information technologies is certain to be far-reaching and pervasive for all communities, rich and poor. It could have particularly serious consequences, however, in third world countries, unless their institutional capabilities can be reinforced to be able to absorb and utilize the new technologies for the benefit of their peoples. Some foresee a scenario in which the present global society of "haves" and "have-nots" could become one of "knows" and "know-nots", with the latter falling ever more hopelessly behind.

The study of the myriad and complex ways in which information is produced, how it flows, how it is processed and utilized and, finally, how it can influence the socio-cultural bedrock of society itself is a field that has come to be known as "informatics". The UNU, with the co-operation of the Systems Development Programme at Trinity College, Dublin, Ireland, has embarked on a long-term research study into the processes of innovation in this field. (Source: Development Forum, January-February 1989)

Optical interface standard in the pipeline

A world-wide optical interface standard which promises easy interworking for computer networks is entering its final stages of preparation. Known as SONET (Synchronous Optical Network), the project to develop the standard was started by a USA-based group, the Exchange Carriers Standards Association (ECSA).

A vital step towards SONET implementation was the international agreement reached in 1988 at the International Telegraph and Telephone Consultative Committee (CCITT) Study Group XVIII meeting in Seoul, Republic of Korea. The CCITT is one of the permanent organs of the International Telecommunication Union (ITU). CCITT had, prior to the meeting, been working towards the definition of a Network Node Interface (NNI), based on techniques similar to those used in the SONET specification. Once the impact of this was realized by ECSA, the SONET specification was introduced to the CCITT as soon as it was ready.

At the time of its introduction to CCITT, the SONET specification was based on a signal of approximately 50 megabits per second, and could effectively carry all North American digital signals. Modifications since made to the specification would allow SONET to work in other countries as well.

What has been created is an international interface which can be used in existing networks all over the world, and which allows easy interworking between networks of different types. Agreement on the SONET interface has, moreover, been reached within a creditably short period of time.

SONET, when finalized, may also have a common interface for broadband ISDN (B-ISDN) services, although the future B-ISDN interface has not yet been well defined. (Source: Telecommunications international edition, Vol. 22, No. 3)

International food aid information system

The World Food Programme (WFP) is developing an International Food Aid Information System (INTERFAIS) as a network for information sharing, linking all organizations and services interested in food aid operations and statistics. Its main purposes are:

- To provide a central depository of information on all food aid pledges and shipments, port and internal transport capacities, and opportunities for local purchases and triangular transactions, in order to help donors, recipient Governments, WFP units and the Global Information and Early Warning System of the Food and Agriculture Organization of the United Nations (FAO) in monitoring food aid supply and in planning and co-ordinating food aid policies and programmes;

- To combine information routinely requested from various intergovernmental organizations and committees into one consolidated data base, in order to reduce the time and costs incurred by aid administrations in reporting on their food aid programmes;

- To develop, promote and maintain the use of uniform data collection and reporting formats, procedures, and codes and classifications, in order to improve the timeliness, accuracy and consistency of data and their overall utility for food aid management.

Closely linked to the Programme's Management Information System (MIS), with which it shares the same codes and mainframe computer facilities, the system has been designed to incorporate all relevant MIS data on WFP food aid and other food aid handled by WFP. Data is automatically transferred to INTERFAIS, avoiding duplication of the data collection and entry processes.

The success of INTERFAIS, WFP expects, will rely heavily upon the voluntary co-operation of donor and recipient governments, intergovernmental organizations and non-governmental organizations in providing information to the system in a timely and uniform manner.

Subsequent phases of development will concentrate on translating the mainframe computer program into standard commercial software, producing a manual to facilitate the installation and use of the system by recipient and donor administrations and WFP country offices, and improving communications with various offices through regular exchange of diskettes and the transfer of data via electronic mail. Attention will also be directed towards reaching international agreement on a set of guidelines to be applied to food aid information sharing. (Source: United Nations Economic and Social Council (ECOSOC). Operational activities for development: Report of the Committee on Food Aid Policies and Programmes. E/1988/77)

ILO population packages

The International Labour Office (ILO) has produced, on diskette, two microcomputer-based software packages in connection with its training activities in the area of population, human resources and development planning:

- POPILO - Population and Labour Force Projections - is a population projection program which could be used in labour market analysis, and which takes the form of a Lotus 1-2-3 spreadsheet. POPILO can be used on a PC-compatible microcomputer with a minimum of 256 kilobytes of main memory and Lotus 1-2-3 software (Version 1 or above).

- TM1 - Population and Development Training Module 1 - is an interactive training program, designed for use in self-study or group sessions. It examines interactions between fertility, mortality and other elements of population dynamics, on the one hand, and labour force, health and education needs, on the other. TM1 runs on PC-compatible microcomputers equipped with the DOS operating system.

Both programs, and accompanying documentation, are available free of charge from the ILO. Requests should be addressed to: Mr. Ghazi M. Farooq, Co-ordinator, Population Activities, Employment Planning and Population Branch, Employment and Development Department, ILO, 4 route des Morillons, 1211 Geneva 22, Switzerland. (TP + 41 22 799 64 57.) (Source: ACCIS Newsletter 6(6), March 1989)

Budget for JESSI programme

The Joint European Submicron Silicon Initiative (JESSI) would have a $7.6 billion budget featuring a 34:29:22:15 split among applications, chip technology, new processes, and materials and equipment, respectively. The new process segment addresses improved design methods, process integration, new manufacturing techniques, modelling and simulation. The applications segment would concentrate on computer-aided design tools; chip-technology on CMOS memories, logic circuits and production engineering; materials and equipment on lithographic apparatus, ion implanters, testing and clean-room process. The budget was developed by 60 experts from 30 companies and institutions in Belgium, France, Italy, the Netherlands, the UK and the FRG. (Extracted from Electronics, February 1989)

When is a chip not a Eurochip?

The European Commission has announced that integrated circuits for computers shall only be considered to be "products of the EEC" if the process of diffusion, during which microcircuits are deposited onto silicon wafers, occurs within the EEC. Diffusion is the most troublesome stage in chip manufacture, and "requires the biggest investment in research," explained the Commission.

The aim of the ruling is to force chip makers to build production and research facilities in the EEC as well as assembly plants. Chips from outside the EEC face 5 per cent import duties, increasing costs for companies that assemble and market electronic devices in Europe. Companies that produce within the EEC, however, will have a marketing edge in 1992, when trade barriers in Europe disappear.

The ruling means that manufacturers are likely to spend between $100 million and $300 million building more fabrication plants in Europe for silicon wafers. Texas Instruments, an American manufacturer, recently announced plans to build its third European fabrication plant, in Italy. NEC of Japan plans a wafer plant in Scotland and Fujitsu is expected to build one in England. Hitachi and Toshiba are expected to announce their own plans soon for building more chip factories in Europe. (This first appeared in New Scientist, London, 18 February 1989, the weekly review of science and technology.)

Centre for quantized electronic structures set up

The Center for Quantized Electronic Structures, which will be involved in microelectronics research, is being set up at the University of California (Santa Barbara, California). The National Science Foundation, which will supply $2.1 million in initial year funding, picked the university as an initial science and technology centre. The centre's purpose is to examine microelectronics via making semiconductors that have quantum structure characteristics. The structures' small layers, "wires" and "boxes" cause electrons to behave differently in usual materials. NSF said it hopes to attain a reduced timespan from actual discovery to use, noting that the rapid transfer of knowledge is vital to the US' capability to compete globally. (Extracted from Ceramic SB, March 1989)

OAU contributes to RASCOM study

The Organization for African Unity (OAU) has donated US$200,000 towards the financing of a feasibility study for the Regional African Satellite Communications System (RASCOM).

The RASCOM feasibility study, co-ordinated by the International Telecommunication Union (ITU) and commissioned by the African Ministers of Planning, Transport and Communication, is intended to ascertain the requirements for an efficient telecommunications network for the African continent. The major goal of RASCOM is to promote economic and social development by improving African telecommunications facilities. Since the majority of Africans live in rural areas, rural telecommunications improvement is emphasized in the RASCOM study.

The OAU contribution was made during a ceremony held in Addis Ababa, Ethiopia, on 24 October 1988. The ceremony preceded a three-day meeting held from 24 to 26 October in Addis Ababa of the African Telecommunications Experts charged with the responsibility of collectively monitoring the project on behalf of the Ministers.

Other contributions have come from the following organizations: the African Development Bank, the United Nations Development Programme (UNDP), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and ITU. (Source: ITU press release, 16 November 1988; Africa telecommunications report, December 1988) (ACCIS Newsletter, Vol. 6, No. 5, January 1989)

Training in geographic information systems technology for managers of natural resources from developing countries

Since 1986, the European Office of the United Nations Institute for Training and Research (UNITAR) organizes and co ordinates a training programme in remote sensing and geographic information systems for managers of natural resources from developing countries. This training programme was launched at the request of the United Nations Environment Programme (UNEP) in close co ordination with UNEP's Global Resource Information Database

(GRID). GRID, based in Nairobi, and with regional nodes in Geneva and Bangkok, assembles, collates, compares and analyses environmental data for global, regional and national use. The training programme, designed by UNITAR and funded by the Swiss Government, provides yearly training in Switzerland for 10 managers of natural resources from developing countries. Scientific backing for the programme is provided by the Environmental and Agricultural Institute of the Swiss Federal Polytechnic in Lausanne (EPFL) and GRID staff in Geneva. As of this date, 30 scientists from developing countries have participated in the Swiss programme.

Following the success of the initial two years, and research conducted by UNITAR in other scientific institutions active in this field, similar training programmes are being planned through GRID regional nodes throughout the world. Concurrently, UNEP and UNITAR are joining efforts to seek follow up for trainees' projects and their implementation through various United Nations, international and national agencies.

For further information on this programme, please contact the Director, UNITAR European Office, Palais des Nations, 1211 Geneva 10, Switzerland. (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

Long distance support for UN system meetings

Holding a major international conference is an exercise which places a heavy burden on an organization's overstretched budget, and one of the biggest cost components is travel. Efforts by a number of United Nations system organizations to reduce the entourage of support staff (editors, translators, typists, etc.) needed on the spot at conference sites have come to our attention during the past few months.

The new methods now being used to produce conference documents are not just a way of cutting travel budgets, however; the use of computer and facsimile technology also means that better quality documents can be distributed at the conference in a shorter time.

The International Telecommunication Union (ITU) held two major conferences in Melbourne, Australia, in late 1988; the Plenary Assembly of its International Telegraph and Telephone Consultative Committee (CCITT) from 14 to 25 November, and the World Administrative Telegraph and Telephone Conference (WATTC), from 28 November to 9 December. The organization's Local Area Network, known as TELnet, was extended to support the conference, with 30 workstations installed in two sites in Melbourne. Converted in this way into a Wide Area Network, TELnet provided a direct link with ITU headquarters in Geneva, via Swiss and Australian public data networks. In case of breakdowns in the public data networks, a backup link using a modem and normal telephone lines was installed. Staff at the conference sent documents to Geneva via facsimile, where they were typed and or translated, then put into the TELnet system. Staff in Melbourne were then able to access and print the documents from their local workstations.

In December 1988 the General Agreement on Tariffs and Trade (GATT) held the Mid Term Review of the Uruguay Round of multilateral trade negotiations in Montreal, Canada. During the course of the meeting, some 70 ministers delivered speeches which, due to GATT's new system for document transmission, were able to be translated, typed and distributed to participants on the day of delivery. When the text of a speech was received from a country's delegation, it was faxed immediately to the GATT secretariat in Geneva for translation and typing, then transmitted back to Montreal via a modem connection. The system required two microcomputers and two facsimile machines in both Geneva and Montreal.

A number of United Nations system organizations, including the United Nations and the United Nations Educational, Scientific and Cultural Organization (UNESCO), in addition to ITU and GATT, have in the past few years carried out experiments with long-distance servicing of important meetings using two-way facsimile transmission. The new system, using both facsimile and computerized document transmission, has the major advantage that copies can be made at the conference site from an original document, rather than a facsimile.

If other organizations have had experiences in this field, ACCIS would very much like to hear about them. (Source: ITU Computer Department newsletter, Random bits, November 1988) (ACCIS Newsletter, Vol. 6, No. 5, January 1989)

Treaty on integrated telecommunications signed at WATTC-88

On 9 December 1988, an historical landmark occurred in the fields of telecommunications and international law, as representatives from 113 nations adopted the world's first treaty for integrated international telecommunication services and networks. The International Telecommunications Regulations, which take effect on 1 July 1990, will provide the basic foundation of norms and administrative mechanisms required not only for implementing the networks of the 1990s, but also for assuring the continued availability of traditional existing telecommunications services throughout the world.

The new treaty was drafted by the 1988 World Administrative Telegraph and Telephone Conference (WATTC 88), a legislative organ of the International Telecommunication Union (ITU). WATTC 88, which was held in Melbourne, Australia, was expressly convened by ITU's member countries to provide a broad, basic framework for telecommunications today and tomorrow. The conference was particularly notable for its embarkation on a new telecommunication framework to enable harmonious and innovative growth of international telecommunications world wide.

WATTC 88 focused on how international economic progress and the interests of a vast array of telecommunications service providers could best be fostered to their satisfaction and that of the ever increasing groups of users. The regulations were framed with a number of flexible provisions which mean that, while they arrange for the future establishment and operation of all types of telecommunication services, each member country will be able to adopt the policy and technological approach it considers suitable.

An important issue was the balancing of national sovereignty and the evolution of a vast range of telecommunication service providers through the common global telecommunication network. A number of provisions explicitly recognize the importance of national sovereignty (i.e. the application of

national law and its continued exercise under agreed conditions) between the parties concerned.

Emphasis was placed by the conference on interconnection interconnectivity, an unprecedented level of which has been made possible by recent technological advances. The new regulations support interconnection in provisions emphasizing the appropriate use of technology and operational recommendations (i.e. standards) developed through the ITU's International Telegraph and Telephone Consultative Committee (CCITT).

The conference was mindful of the Report of the Independent Commission for World-wide Telecommunications Development (The Missing Link), and the recommendation to set aside accounting revenues for the development of national networks of developing countries. The conference invited all administrations to co-operate with cost studies being carried out by the Secretary-General of ITU on the cost of services and the potential benefits that could result from a change in the apportionment of international accounting revenues. If the studies lead to variation in the traditional 50/50 basis of revenue-sharing with developing countries, the additional revenue could be used for improving developing country telecommunications, and possibly as contributions to the Centre for Telecommunications Development.

In the resolutions, recommendations and opinion adopted by the Conference, the ITU Plenipotentiary Conference, meeting in Nice, France, in May 1989, has been asked to consider the impact of the changing telecommunication environment and the consequence of diverse policies, as well as the opportunities offered by new technologies and new types of services, keeping in mind the importance of ensuring their appropriate and harmonious introduction world wide. (Source: ITU press release, 23 December 1988. ACCIS Newsletter, Vol. 6, No. 5, January 1989)

Security of computer installations

The security of computer installations was one of the major issues of 1988. The virus - a previously unknown hazard - arrived in the spring, and has been making news in the national media ever since.

Worst affected were a British university, which had to stop all PC usage until a virus called Brain had been tracked down and rendered harmless; software supplier Aldus, which had to recall all copies of a program called Freehand that had been corrupted by a virus; and the Pentagon, which saw its Arpanet research establishment network grind to a halt one weekend.

These were the cases that made the biggest headlines, but countless other users also suffered. Anti-virus books and programs became a major growth industry.

All of this focused attention on the problem of hacking in general. The law provides no remedies against hackers unless they do specific harm. Hackers can cause problems other than direct damage such as amending data or fraudulently altering programs. The British Computer Society (BCS) quoted as an example of quite legal but dangerous and undesirable hacking the blocking of urgent calls to a medical system.

This line of thought has led the BCS to call for hacking to be made a criminal offence in itself.

The society prepared a statement outlining its reasons in November, and has sent it to both the Government and the European Commission. (Source: Computer Weekly, 5 January 1989)

Trade data sought

ACCIS focal points are now collecting data within their organizations for inclusion in the ACCIS guide to United Nations information sources on international trade and development finance. Readers within the United Nations system who know of any data bases, data collections, publications or information systems containing information on these subjects are requested to inform the ACCIS focal point for their organization (listed in the March 1987 and May 1988 issues of the ACCIS Newsletter), or to notify the ACCIS Secretariat. The trade guide, scheduled for publication in late spring 1989, is the third in a series of ACCIS guides to sources of information within the United Nations system. (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

II. NEW DEVELOPMENTS

Cold cathode tips mark dawn of new era

"Field emitting" microelectronic valves have been researched for a few years now, but until recently the way that they were made did not lend itself to mass production. The new valve generation consists of an array of minute cones, or cathodes, with pointed tips only a few tens of angstroms across. In a vacuum, these cold-cathode tips emit electrons into a field built up at the top of the hole in which the cathodes sit.

It is relatively easy to make cathode tips from silicon but more difficult to fabricate tips made from metals such as molybdenum or niobium which allow higher current density and work much better.

So far, most of the groundwork on microelectronic valves has been done at SRI International in America. There, Dr. Charles Spind has made many breakthroughs in his experiments with molybdenum-cathode tips, but the process he has been using to make them involves complex thin-film depositing and electron-beam lithography.

Spindt says that arrays of vacuum devices could be integrated on the very same scale as semiconductor circuits, with fewer process steps and with less sophisticated materials. According to the SRI Journal, field emitting "Spindt cathodes" are on the threshold of commercial applications.

Spindt and his team are currently working on flat panel "valve" displays for avionics.

In such a display, which would be bright, efficient, light and thin, the minute valve cathodes form electron sources for thousands of conventional phosphor surfaces in the form of pixels.

Thin visual displays are an obvious application of the new valves, but GEC is already heavily involved with flat screen cockpit type displays using liquid crystals combined with thin film transistor technology.

Any application that currently involves hot cathodes could benefit from field emitting valves. Some of the uses already suggested include high brightness cathodes for free electron lasers, low cost guns for travelling wave tubes and high resolution sources for electron microscopy. Longer term applications could be high-speed integrated circuits.

Since the new valve can work at high temperatures and is resistant to radiation, it is likely to find applications in aerospace and reactor environments, perhaps even as a rotation sensor for jet turbine blades. But whether it appears in domestic applications depends on whether or not it can be produced efficiently in large volumes.

Eventually, microelectronic valve arrays could have 107 hole tip combinations in a square centimetre, each handling around 100 mA with good current sharing. Like the old valve, the new device is capable of handling high current surges and expected lifetimes in excess of 50,000 hours at current densities of more than 50A sm^2 have already been reported. (Source: Electronics Weekly, 22 February 1989)

Quantum dots represent different state of matter

Studies of tiny dots of matter only a few nanometres across have allowed AT&T scientists to speculate on just how much detail can be crammed onto silicon chips but it may not be as much as chip makers hope.

These small clusters of atoms may also have important implications for the development of computers which run on light beams and also for making semiconductor materials, according to Dr. Louis Brus of AT&T's Bell Laboratories in New Jersey.

The Bell Laboratories team has achieved a world first by creating stable clusters of atoms ranging in size from only seven atoms to more than 10,000. To do this they had to overcome the tendency of such clusters to merge and form larger structures. That meant carefully growing each cluster within its own microscopic water droplet and then wrapping it in a protective coat of organic molecules to prevent it fusing with other clusters. The end result is a powder of thousands of separate clusters whose electronic, chemical and optical properties, including colour, vary with size.

The optical properties may one day be useful for making fast computers that run on light.

These quantum dots, as the clusters are sometimes called, represent a new state of matter. They occupy an interesting and unexplored region of size where the apparently chaotic and random behaviour of individual atoms and particles, such as electrons, gives way to the much more predictable behaviour of crystals and bulk solids. It is this predictable behaviour in the case of semiconducting materials that allows chips to function.

Semiconductors only exist because the behaviour of electrons in large groups of semiconductor atoms is different to the behaviour of electrons around individual atoms. Electrons which are usually strongly bonded to lone atoms can roam freely around the crystal lattice formed when many atoms of a semiconducting material come together.

The Bell Laboratories team tried to find out how many atoms must be clustered together before electrons are able to break free of the shackles of their individual parent atoms. They analysed the semiconductor properties found in clusters with different numbers of atoms and found that clusters with around 5,000 atoms, some 4nm across, showed signs of semiconductor behaviour.

As more and more atoms are brought together, the electron energy levels that characterize isolated atoms develop into broad bands separated by a large gap. It is the existence of this band structure that makes semiconductors possible.

The number of atoms necessary to produce the band gap sets an effective limit to the minimum size of features that can be shrunk onto silicon. And it turns out that this limit is not that far away: perhaps even the turn of the century.

The Bell Laboratories team identified an embryonic band structure in clusters of cadmium selenide containing around 5,000 atoms which are about 6nm across. So the minimum size of features on semiconductors will not be less than 6nm. But real devices will need a more defined band structure which is only found when even larger numbers of atoms are grouped together.

The quantum dots made by the Bell Laboratories researchers contained atoms which were arranged in a regular crystalline pattern and this may mean that silicon crystals grown for chip makers may be made in the future at low temperatures by fusing lots of atomic clusters rather than in high temperature furnaces. (Source: Electronics Weekly, 22 February 1989)

Personal video offers the truly private view

A company in Cambridge, Massachusetts, has developed a gadget that generates a full size video image at high resolution from a unit roughly the same size as a packet of chewing gum. The gadget, called Private Eye, is made by Reflection Technology (RTI), backed by individual investors working at the Massachusetts Institute of Technology in Boston.

Working prototypes of Private Eye already exist, and RTI believes that a manufacturer could mass produce the units for a few tens of dollars each. Private Eye measures about 8 centimetres by 3 centimetres, with a window 2.5 centimetres wide in the middle. A user who holds this window up to one eye sees an image of a 30 centimetre television screen half a metre away. This is superimposed on the normal field of view, which the user sees with the other eye.

At the moment, Private Eye, fixed to a pair of headphones, works only as a display for monochrome computer images, with red text or graphics on a black background. RTI believes that Private Eye could eventually display television images in full colour.

The prototype Private Eye demonstrated recently had a resolution of 720 pixels by 280, which can display 24 lines of computer text 80 characters long. The device consumes very little power and runs at only 5 volts. It can work on batteries, which eliminates the chance of an electric shock - an important consideration for anything worn on the head. The tiny projector has a mechanical focus

which users can adjust to suit their eyes. The system will not break if someone drops it, and it is very light - it weighs just [illegible] grams.

The first units should be available within the next year. They will provide displays for portable computers, video games, toys and portable fax receivers. It will take longer to perfect colour displays for television images. RTI will make Private Eye itself, and will license other companies to mass-produce the units. Sharp, the Japanese electronics company, is believed to have signed a licence deal already.

In the future, RTI says it may produce a double unit with two displays, one for each eye, to create three-dimensional images. It may also combine Private Eye with hi fi headphones to provide "the ultimate in personal entertainment". (This first appeared in New Scientist, London, 14 January 1989, the weekly review of science and technology)

Harnessing the trouble

A new class of semiconductor device may arise from the harnessing of troublesome interference and reflection effects, caused by high speed electrons behaving more like waves than particles, through the work of researchers at the Georgia Institute of Technology based at Atlanta in the United States. Work has been going on there to develop ballistic transistors. These depend on fast moving electronics, but the wave effects encountered have been causing problems. The belief now is that electron wave guides might be built into chips which would be smaller and faster than existing semiconductor devices. This might lead to optical like processing. Research work on the topic is proceeding at Atlanta. (Source: AMT, March 1989)

New technique permits reproduction of the colours on computer screens

A new method for reproducing exact colour nuances on computer screens has been developed at the Royal Institute of Technology in Stockholm by Associate Professor Gunnar Tonnquist, assisted by Chinese guest researcher Li Heng. The method presents colour stimuli on the monitor corresponding to the notations given by the Natural Colour System (NCS).

With the new technique, programmes are made to reproduce the various constant hue pages contained in the NCS atlas, even with an increased number of colours. Other programmes present combinations of colours along with other parameters, such as colours of constant chromaticness or blackness from different hue planes. This is said to enable designers for the first time to select their palettes in both a personal and strictly logical way according to purely visual parameters.

The new technique has aroused great interest among architects and designers in Sweden who want it included in their CAD programmes. Another application would be the generation of colour stimuli for basic colour vision research, Professor Tonnquist says.

The computer software uses an ordinary PC AT computer with a Tektronix PC4100 Graphics Coprocessor and a PCD13 colour monitor, producing 256 simultaneous colour stimuli out of a possible total of 16 million. (Source: SIP, March 1989)

Fast bipolar transistor

AT&T Bell Laboratories has developed a bipolar transistor 11 times faster than conventional bipolar transistors employed in today's supercomputers. The new bipolar transistor can switch on and off 140 billion times a second. It consists of indium phosphide and gallium indium arsenide. Some of the possible applications of the new transistor include analog and digital integrated circuits and in ultra high speed electronics for gigabit lightwave communication systems. (Extracted from Japan Industries, January 1989)

Electronic material using quantum wire superlattice developed

An electronic material using a "quantum wire superlattice", an area in a semiconductor chip that includes millions of ultrafine wires, has been developed at the University of California (Santa Barbara, CA). Via measuring the material's response to polarized laser light, it was shown that the wires are so tiny that they make electrons behave in a different manner compared to usual materials. Commercial lasers and transistors previously have incorporated materials using a quantum well structure, but the university researchers believe it is simpler than the superlattice structure. Semiconductors using the superlattice material may allow great strides in computer power and miniaturization. (Extracted from Metalworking News, [illegible] February 1989)

Smallest ever microchip

Hitachi (Japan) has developed a 1M bit SRAM with a 9 ns access time, the fastest ever. The device is based on CMOS technology and is reportedly the smallest microchip of its kind. Possible applications include 32 byte workstations, communications equipment and supercomputers. (Extracted from Japan Economic Journal, 25 February 1989)

Liquid film material developed

A liquid crystal film material, 1,000 times thinner than conventional films, made of commercially available materials has been developed by researchers at Kyushu University. The new material can be made in any size or shape in thicknesses as low as 10 nanometres. It responds to applied voltages in 0.5 seconds, which will allow its use in extra large TV screens, curtainless windows, etc. The film is a polymethyl methacrylate polymer mesh with entrained polycarbonate cyanobiphenyl liquid crystals. Article gives details of process and advantages of the material over conventional liquid crystal films. (Extracted from New Technology Japan, January 1989)

New superconductor discovered

University of Tokyo researchers discovered a superconductor that carries its current via electrons instead of by spaces between them as in other copper oxide superconductors. The discovery is not likely to have any immediate commercial value, but it does indicate the huge effort Japan is putting into high temperature superconductors. According to the journal Nature, the Japanese material is chemically related to the original IBM superconductor discovered in 1986. Like the original and its variants, the Japanese version is based on a copper oxide compound and when chilled carries electrical current without the resistance of copper wire and other electrical

conductors. The Japanese material, however, includes a grey metallic element called cerium. The material, along with a special production method, gives the Japanese material a big surplus of electrons in its copper-oxide sheets, suggesting that the electrons themselves are carrying the superconducting current. The discovery adds to the body of knowledge about how superconductors work and could give the Japanese an edge over the US and Europe in eventual commercialization of the technology. (Extracted from Wall Street Journal, 26 January 1989)

RTP that reduces contact failures

Peak Systems (Fremont, CA) has achieved a breakthrough in Rapid Thermal Processing (RTP) that reduces junction spiking and contact failures in MOS devices. Specifically, Peak Systems discovered that a diffusion barrier that prevents diffusion of silicon and aluminium can be created through the rapid thermal nitridation of titanium. Essentially, the TiN layer that is produced reduces the aluminium spiking and contact failures. Peak indicated that its RTP technique can be applied to MOS fabrication lines to significantly upgrade device speed. (Extracted from Solid State, January 1989)

High-temperature superconductive transistor

Fujitsu has developed a high-temperature superconductive transistor by creating a superconductor/semiconductor junction. Fujitsu's accomplishment will make it possible to construct semiconductor and superconductor regions on a ceramic thin film. Fujitsu created both parts on the same thin film by exposing the superconductive part to plasma oxygen. Essentially, the device is a diode in a superconductive film that has a substrate of dispersed silicon. The device's energy gap has a peak power of 12 to 13-mV. Fujitsu's scientists still need to determine which superconductive properties different diodes have. The ceramic thin-film substance was a yttrium-barium-copper-oxygen composition. Meanwhile, Hitachi has made a similar gain in superconductor microelectronics technology. Hitachi is working on low-temperature thin-film superconductive substrate fabrication. (Extracted from Electronic Engineering Times, 1 September 1989)

New semiconductor laser

Sandia National Laboratories has developed a new semiconductor laser with a high beam quality, making it suitable for applications in optical computers. Essentially, Sandia scientists achieved high-efficiency, continuous wave, surface-emitting laser operation at room temperature. Surface-emitting lasers are nothing new, but Sandia's device meets power efficiency requirements and high beam quality, which makes it unique. Although the device is currently pumped by a visible light laser, it will be pumped electrically in the future, according to P. Gourley, physicist, Sandia. (Extracted from Photo Spectrum, January 1989)

New optoelectronic device

Thomson-CSF (France) and collaborators have grown a buried ridge diode laser on silicon substrate, according to a report in Applied Physics Letters. Continuous wave room temperature operation of a GaInAsP/InP diode laser, grown by two-step low-pressure metallorganic chemical deposition, at 20 mW emitted with 16 per cent external quantum efficiency around 1.31 microns was reported by CNET, Kopin Inc. and Thomson. The goal of mounting III-V optoelectronic devices on Si substrates via superlattice structures has been brought closer to realization. (Extracted from Lasers and Optoelectronics, January 1989)

New optical memory device

NEC (Japan) has put a 1,024-bit optical memory on a 1-sq-mm die, and expects this to be the turning point of optoelectronic IC history as was the 1k dynamic RAM of 1970 to electronic ICs. The device integrates vertical-to-surface transmission electron-photonic (VSTEP) I/O elements in a 32x32 array on a GaAs substrate, in 25 per cent of the size of an 8x8-bit prototype produced in 1988. The pnpn structure of the VSTEP permits retention of data for 10 microseconds without refresh, reducing power drain for memory holding to 2 micro-Watts, or 0.01 per cent of the requirement for other optical memory devices, according to NEC. (Extracted from Electronic Engineering Times, 13 February 1989)

Tropics project

Philips International (Netherlands) is leading a pan-European effort to develop a transparent object-oriented 1 Gips (billion instructions per second) parallel computing system. The Tropics project will require five calendar years and 700 man-years to finish. Other participants include Nixdorf (Federal Republic of Germany), Thomson-CSF (France), and several universities and research organizations. The completed Tropics will incorporate hundreds of processors running in parallel and is intended as a server on LANs supporting intricate office tasks. (Extracted from Electronics, March 1989)

200M-bit memory chip technology developed

Fujitsu (Japan) and Anamartic (UK) have developed technology for a 200M-bit memory chip measuring 6 inches across. Their process, called wafer-scale integration, has been known for years, but has not been feasible because of its high defect rate. In wafer-scale integration semiconductor components are laid out across an entire wafer. Essentially, Fujitsu and Anamartic used Fujitsu's existing memory technology, and simply designed a single wafer containing 202 units of the Japanese company's 1M-bit memories. Logic circuits were then inserted between the 1M-bit chips to serve as switches and send signals around any chips that turn out to be defective. With all the 1M-bit chips on a single wafer, the memory takes up on 25 per cent as much space as 200 individually prackaged 1M-bit memories. Since chips are 1,000 times faster compared to disk drives, Fujitsu and Anamartic believe their 200M-bit memory could replace disk drives as external memory devices. (Extracted from Asian Wall Street Journal, 20 February 1989)

Analog neural processor chip

Fujitsu (Japan) has introduced an analog neural processor chip, which is the world's initial general-purpose calculating element that can execute 80,000 calculations per second. Fujitsu said the neurochip will be used in industrial robots needing real-time processing, intelligent sensors and support systems for learning uses. The chip will be used in a neurocomputer modelled similar to the human nervous system. Fujitsu is targeting the uniting of

200 elements into a system for linkups with engineering workstations by summer 1989. Sun Microsystems will produce the workstations that will be sold by Sun, Fujitsu and Toshiba. (Extracted from Metalworking News, 27 February 1989)

New type of superconductor

A superconducting material that contains copper oxide and rare earths has been developed by S. Uchida, a professor at the Engineering Research Institute of the University of Tokyo. This new type of superconductor may open up new potential for manufacturing superconductors from materials that were before thought to be difficult to work with or impossible to use. Uchida used the same idea used for semiconductors in the development of superconducting materials. However, in Uchida's technique, electronics were carried through electronic holes by particles with a negative electric charge, compared to traditional techniques that use a positive electric charge. The new superconductting material does not require oxygen in sintering and it can be sintered in an inert gas environment as well. (Extracted from American Materials Market, 8 March 1989)

Glass disk platters possibly suitable for hard disk drives

Glass disk platters may become suitable for hard disk drives in the 1990s, according to observers. J. Porter, an analyst at Disk/Trends remembers that in initial attempts 14-in glass platters spinning at 1,400 rpm broke and pieces went through the drive. The viability of glass has since improved. Porter notes that the outer velocity of a 3.5 in disk is much smaller than that of a 14 in disk when both are spinning at 3,600-rpm. The chemically hardened glass employed currently is not jeopardizing. Another analyst notes that glass offers a very flat surface. Heads can be flown very close to the disk, and a chemical step is passed over. Areal Technology is developing systems that will have a 4 microinch gap between disk platter and head. It can envision placing 400 or more megabytes of data on a 3.5 in disk. The company will soon deliver a glass disk drive that will offer 100 Mbytes, using two disk surfaces in a 3.5-in drive. (Extracted from Information World, 13 March 1989)

Carbon enhanced vapour etching developed

Researchers at the Center for Solid State Electronics Research, Arizona State University (Tempe, AZ) have developed carbon enhanced vapour etching (CEVE), a semiconductor etching process, that replaces wet or plasma etching of silicon dioxide films. The CEVE etcher is a gas tight Teflon chamber on a Teflon coated hotplate with temperature controlled bubblers. Carbon is used on the SiO_2 surface as a catalyst to speed hydrogen fluoride vapour etching and enables variable surface reliefs across a single surface with a single etching step. HF vapour can be supplied by bubbling N_2 through 49 per cent HF acid or anhydrous HF through H_2O. (Extracted from Semiconductor International, February 1989)

Laser-based process attaches gold wires to microchips

Microelectronics & Computer Technology developed a laser-based process to attach gold wires to any part of a microchip, not just its edges. The advance is important because silicon chips need an ever increasing number of links to the outside environment for sending and receiving data. Increasing the number of links has been hampered because the edges of chips are already crammed full of gold-wire endings (leads), and soldering them in other places poses a risk from heat damage. After three years of work, MCC has developed a technique that poses virtually no risk of heat damage. In the laboratory, the research consortium has made chips with 400 leads, or three times the number on any existing chip. A licence for the technology to build the new chip-bonding machines has been given to Electro Scientific Industries (Portland, OR), which expects to have a commercial version ready by the end of 1989. (Extracted from Business Week, 27 March 1989)

4 Mbit EEPROM memory chip

Toshiba has built a 4 Mbit EEPROM memory chip. Such a chip could eliminate the need for disc drives for storing programs. EEPROM (electrically erasable programmable read-only memory) can store data even if the power fails, unlike DRAMs, and unlike EPROMs, EEPROMs can be altered. Each EEPROM memory cell generally has a pair of transistors, one to store data and one to act as a switch, but the new Toshiba chip has only one switching transistor for each four memory transistors. (Extracted from New Scientist, 25 February 1989)

200 Mbit memory produced

Fujitsu has produced a 200 Mbit memory made with 200 memory microchips, based on technology developed by Anamartic (UK). The wafer-scale integration could cut the cost of electronic devices such as computer memories by eliminating the need for linking individual chips on boards. However etching wafer-scale integrations is very difficult, and some of the chips on a wafer will not function. The new wafer memory tolerates such faults. The 15 cm wafer has 202 1 Mbit DRAMs. Each is connected to a logic circuit, and each logic circuit is connected to four adjacent logic circuits. The logic circuits will have software to allow faulty parts of a wafer to be bypassed. The concept was developed by I. Catt, who attracted the attention of Anamartic founder Sir Clive Sinclair. (Extracted from New Scientist, 25 February 1989)

Toshiba develops multichip module

Engineers at Toshiba Corp., Japan developed a high density multichip module - the Digital Signal Processor module (DSP-module) - for image processing using chip-on-wafer technology.

The Japanese team used a 32 bit digital signal microprocessor (T9056), 24 64K SRAMs (TC55416) and 44 8-bit latches. To decrease the number of chips, one memory chip included two 64K SRAMs and one latch chip included 16 latches. Consequently, 16 LSI chips were mounted on a silicon wafer and connected with solder bumps. They contained the module in an aluminium nitride (AlN) ceramic package.

Toshiba engineers used a 50 x 64 mm silicon wafer for the module for three reasons: the matching thermal expansion coefficient of the substrate and ICs minimizes the thermal stress induced by solder bumps; the module can obtain high heat radiation through the silicon because of its thermal conductivity - 150 W/m.K; active or passive devices can be formed by standard IC techniques.

The scientists formed eight copper conductive layers that were separated by eight polyimide dielectric layers on the wafer. The conductive layers were evaporated Ti/Cu/Ti films. The eight conductive layers included three layers for signals, two for power supply, two for ground and one for bump connection. Also, the signal propagation velocity in the signal lines is high.

They attached the ICs to the silicon wafer electrically and mechanically using the flip-chip bonding method.

The Toshiba engineers electroplated copper-cored solder bumps on the IC bonding pads. First, they electroplated the copper core through viaholes made in the photoresist layer using photolithography. Then, they electroplated solder on the copper cores. The distance between the wafers and the LSI chips was kept constant by the copper core. The bump diameter was 150 μm and the minimum bump pitch was 180 μm.

The team attached and wire bonded the wafer to a 67 x 83 AIN package. The package contains 188 flat lead I/O pins on the four sides of the package. They chose AIN as the packaging material because it has a thermal expansion coefficient of 4.5×10^{-6}, which is close to that of silicon (3.4×10^{-6}). Thus warpage caused by the thermal expansion difference between the package and the wafer was minimal. With a thermal conductivity of 170 W/m.K, the AIN package provides the necessary heat radiation.

Chip-on-wafer technology can accommodate the speed and size requirements of next generation VLSI devices. (Reprinted with permission from Semiconductor International Magazine, March 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, IL, USA.)

"Tough" CMOS

Teledyne Semiconductor has developed a proprietary CMOS technology that is said to eliminate many of the possible failure modes of ICs. Dubbed "Tough CMOS" the process is being used immediately for power control MOSFET drivers - ICs used where the harsh environment within an electronic system is in the power supply.

The toughness of Tough CMOS is attributed to design features and extra process steps used during fabrication. For example, logic inputs can operate even when the input ground has voltage transients up to six volts below power ground; CMOS latch-up is virtually eliminated with the use of epitaxial silicon; and internal protection circuitry withstands electrostatic discharges up to 2 KV.

Tough CMOS also uses a proprietary moulding compound for plastic packaging. The compound improves the thermal coefficient of expansion compared to standard compounds and increases resistance to water vapour and humidity. It also has reduced ionic content and improved immunity to high voltage. (Reprinted with permission from Semiconductor International Magazine, March 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, IL, USA.)

Japanese companies unveil 16M Bit DRAMs

NEC Corp. and Mitsubishi Electric Corp. have separately developed 16 megabit dynamic random access memory (DRAM) chips.

The chip has a memory storage capacity 16 times greater than the popular one-megabit chip.

The two companies separately reported the achievements at the International Solid State Circuit Conference in New York.

Three other Japanese electronics manufacturers - Hitachi Ltd., Toshiba Corp. and Matsushita Electric Industrial Co. - announced their respective versions of the 16-megabit chip at the same conference a year ago.

Fujitsu Ltd. also has developed its own 16-megabit chip but has not disclosed technical details.

The 16-megabit chip is expected to become the mainstay of the very large-scale integration (VLSI) memory chip market in the early 1990s, replacing the four-megabit chip, whose mass production is scheduled to begin soon. (Source: The Japan Times, 17 February 1989)

Micro-machines may be commercialized within five years

Micron sized machines the size of computer chips will be commercial in five years, according to K. Gabriel of Bell Laboratories. These micro-machines are made of silicon using manufacturing techniques employed in silicon chip production and may eventually be made with processor control units in a single-step process. According to G. Hazelrigg of the US National Science Foundation, a commercial micromotor should cost roughly $0.001 initially and decline in price to $0.00001. Hazelrigg envisions miniature surgical instruments capable of removing scar tissue from the retina, for example. The US Department of Defense and 10 US corporations are backing research at the Sensor & Actuator Center (University of California - Berkeley), where the first working micro-turbine, a 60-120 micron 2-D unit, was made in June 1988. A micro-turbine capable of 24,000 rps with 110 micron blades, also 2-D, has been made at MIT and researchers at Karlsruhe Nuclear Research Centre (Federal Republic of Germany) are working on 3-dimensional machines. The micron-sized parts have the mechanical strength of steel and 1,400° C melting points. Work needs to be done in characterizing properties like elasticity, erosion resistance, heat conduction, resistance to torsion stresses, and interaction with cell-sized entities and molecular level magnetism effects. (Extracted from Technology Review, January 1989)

Microscopic semiconductor laser developed

A microscopic semiconductor laser has been developed at Sandia National Laboratories. The beam is generated by a gallium arsenide chip 10 microns thick. This is the first efficient surface emitting semiconductor laser, according to Sandia's P. Gourley. The beam spreads very little (perhaps 2.5 degrees), although most semiconductor lasers spread as much as 35 degrees. The new laser is well suited for use with optical fibres because of its circular shape. The new laser is a solid crystal that has been produced layer by layer to offer many mirrored surfaces with a 1-micron energizing region in between. This laser is one per cent as long as most semiconductor lasers, thanks to the high reflectivity of the internal mirrors. The laser must first be pumped with photons, but further development may allow the laser to work with just an electrical current. (Extracted from Science News, 17 December 1988)

Heterojunctions may revolutionize chip design techniques

Heterojunctions have set speed records for computers and other electronics, and promise to revolutionize chip design techniques in the future. However, widespread use of such chips is several years away, and is unlikely to spell the end of silicon, the mainstay of the electronics industry. At a recent International Electron Devices Meeting, Nippon Telegraph & Telephone (Japan) and Hughes Research Laboratories each reported new speed records using heterojunctions. NTT's transistor switched on and off in two picoseconds, against several hundreds of picoseconds for conventional silicon transistors.

Transistors have been made faster by making them smaller, giving the current less distance to travel, but engineers say that in a few years it will not be possible to shrink silicon circuits further to gain speed; improvements will come from new materials. Gallium arsenide, a faster material than silicon, is being used in applications necessitating speed. Scientists envision using combinations of materials - mainly gallium arsenide and related compounds (e.g. aluminium gallium arsenide and indium phosphide) - using molecular beam epitaxy, a technology that allows one material to be laid down on top of another in very thin sheets, atomic layer by atomic layer, in a form of high-technology spray painting. Using bandgap engineering, semiconductor designers can funnel electrons in certain directions and block them from moving in others.

Fujitsu's (Japan) high electron mobility transistors (HEMTs) are already in use in Japan as highly sensitive receivers for signals sent from satellites. More novel and potentially faster devices can be made by making the layers of different materials so thin that the laws of quantum mechanics are involved. Layers would have to be about 10 billionths of a metre thick, one-hundredth of the size of today's circuit elements. (Extracted from New York Times, 4 January 1989)

Neural computer network

Toshiba's (Japan) neural computer network gives the standard "left-brained" processor a "right hemisphere", in analogy with the functional specializations of the two human cerebral "sides". Beginning with a 16-fold parallel processor that was to perform up to 190 tasks, Toshiba found that the number of calculations needed to assign priorities was impossibly high for a conventional system. Resolving this with an ordinary neural-network system would have demanded too many components and consumed too much time. The new architecture embodies both types of processing, in analogy with the human brain. (Extracted from New Technology Japan, December 1988)

Genetic algorithms faster than AI programs

Genetic algorithms are faster and more adaptable than expert systems for artificial intelligence programs, according to C. Walbridge. Genetic algorithms, which function like the natural selection of species, hence the name, do not require expert systems, only a set of criteria to assess the suitability of a solution. The method has found applicability in truss design, production scheduling and improved pattern recognition, a crucial element in developing "smart" computing machines. The algorithms are easier to program and less susceptible to the "artificial stupidity" of expert systems. Due to intrinsic parallelism, the programs "learn" from previous computing and can derive solutions faster than most expert systems. Genetic algorithms enable machines to "think" and "create". (Extracted from Technology Review, January 1989)

Pinhole hologram holds hope for computing

A group of physicists at Imperial College of Science and Technology, London, has extended the simple principle of the pinhole camera to create "pinhole holograms". These may one day find applications in optical computing, to send data around a computer in the form of light, over optical fibres.

An ordinary hologram is recorded using a laser beam split into two. One of the two beams, known as the object beam, is directed onto the object, which reflects the light onto a photosensitive plate. The other beam is reflected directly onto the plate without being disturbed. This is known as the reference beam. When the two beams hit the recording plate, they interfere with each other so that the difference between them, a picture of the object, is recorded on the plate. When light shines on the finished hologram, it is altered in such a way that it appears to have been reflected off the object itself - so the object appears to be there before you.

The scientists at Imperial place a pinhole between the object and the recording plate, so that the pinhole becomes part of the object, and sits just in front of it. When the hologram is lit and reconstructed, all the light has to pass through this point in space, just as it did when the real pinhole was there. The beauty of using a pinhole is that the resulting image will have none of the distortion produced by using lenses to create the hologram. Also the real pinhole is not actually there, so the team can place optical devices in that space to manipulate the image.

One of the team's experiments is to create a number of holograms of different objects on the same holographic plate, moving the pinhole slightly each time. This way, the scientists can make a hologram with any number of different images on it, each with its own pinhole. If the researchers then place a row of shutters in the plane of the pinholes, they can produce any combination of the images. It would also be possible to replace the shutters with a liquid crystal which, instead of simply allowing an image to be "off" or "on", could introduce a scale of intensity, by changing the amount of light which hits the hologram. Using either the shutters or the liquid crystal researchers may one day be able to "program" the combination of holographic images into an optical computer.

Another experiment which the team is working on involves placing a diffraction grating in front of the pinhole. This creates a series of copies of the original placed side by side. If each point of light activates its own detector, then the combination of pinhole, hologram and shutter could act as the wiring in an optical computer. So far, the researchers have produced holograms that measure just a few millimetres across. This is only slightly larger than the requirements for an optical computer, and the researchers plan to scale down their work. (This first appeared in New Scientist, London, 4 February 1989, the weekly review of science and technology.)

Experimental model of optical neurocomputer

Mitsubishi Electric has built a futuristic, experimental model of an associative optical neurocomputer - a computer with internal processing modelled after biological neuron (nerve cell) behaviour - using a prototype optical neurochip that is reportedly the world's first such optical semiconductor. Mitsubishi's optical neurochip allows neural data processing to be achieved through optical interconnection technology and can be mounted alongside conventional electronic LSI chips. The development increases the likelihood of a true optical neurocomputer for the rapid processing of ambiguous information along the lines of human data-thought association. (Extracted from New Technology Japan, March 1989)

Novel computers

Electronic computers have two weak spots. First, their circuits carry only one piece of information at a time. No matter how small they are printed these circuits take up space. The more space they take up the longer it takes electrons to whizz around them, and the slower the computer can come out with its answers. Second, electrons interfere with one another because of the charge they carry. If circuits are squeezed too close together the result is a messy buzz of signals.

These are two reasons why computer designers are seeking to minimize the number of connections between components. The price they pay for this is commonly called a "bus", although it is more like a bus stop. It is a waiting room in which pieces of data wait while a processor deals with information further ahead in the queue. In this respect parallel-processing computers - which have several processors working on different parts of a problem at once - face an even worse difficulty. Ideally each processor would be connected to every other one. In practice a central controller keeps track of their work and assigns to the processors new parts of a problem as they finish each task. Result: lots more bottlenecks.

Optical computers should provide a way out of cramping and of bottlenecks. Not only do photons (particles of light) travel faster along optical fibres than electrons do along wires, but also more of them can fit into a smaller space. And because photons have no charge, they do not interfere with each other. Beams of laser light can pass straight through one another without turning a hair, so you can have more connections handling more data, and faster. Computers that use light also seem tailor made for parallel processing. Optical chips could handle many different beams of light simultaneously and each beam could do a different computing job.

On the other hand, the fact that photons have no charge makes it hard to make them affect one another. So how, for example, do you build the optical switches that would be the heart of an all-optical computer? The answer is that you probably do not. Most optical computer scientists convert their streams of photons back into electrons inside some parts of their computers to make a hybrid machine.

Most research into optical computers copies their silicon chip predecessors in other respects too. Their internal "architecture" is a close copy of traditional machines, with optical devices replacing electronic ones in a few places in order to pick up some speed. Dr. Alan Huang and his colleagues at AT&T Bell Laboratories in New Jersey have more revolutionary ideas. In a couple of months the team hopes to unveil a simple demonstration model of an electro-optical computer whose innards will baffle most computer scientists. Dr. Huang hopes that it will also intrigue them enough to go off and build more advanced machines along similar lines.

The machine will contain prisms, mirrors and lenses to channel the light, as well as gallium-arsenide chips that convert pulses of laser light into electrons in order to work as switches. For reasons of cheapness and simplicity, the optical paraphernalia must be kept to a minimum. So Dr. Huang's team has had to rethink the principles of computer architecture.

It has come up with two fresh ideas. The first is a novel approach to signal processing which Dr. Huang calls "symbolic substitution". This is a way of breaking problems down into components so that simple and symmetrical arrays of optical processors can solve them.

The idea is to build a uniform array of such switches to process light signals - a sort of loom in which the threads are beams of light. In effect, each switch works by combining the images from its inputs and creating a new one to pass on to the next.

The result is a computer with a simple, if unorthodox, layout. Dr. Huang's second innovation is a mathematical technique that he hopes will let him use the same regular set-up for a wide range of computational tasks. He calls it "computational origami", after the Japanese art of paper folding. The idea is to alter the configuration of the computer without moving any parts. This involves flipping the switches so that the data (in the form of light beams) are sent along different routes, depending on the type of problem to be solved.

One advantage of this is that instead of assigning each piece of information an "address" in the computer's memory, from which it can be retrieved when needed, origami will schedule its path so that it arrives at the right place at the right time. This obviates the need for short term random access memory. If an answer is to be used further along in a calculation, it is sent into a delay loop from which it will emerge just when it is needed. (Source: The Economist, 4 March 1989)

New superconductor may put theories to test

Researchers in Japan have prepared a new type of superconducting copper oxide in which the current is carried by electrons, rather than electron vacancies, or "holes", as is the case in all previous copper oxides.

Though not seen to be commercially applicable, the material has touched off new excitement for two reasons: it suggests another direction to look for high temperature superconductors. And it provides a different model with which to test the various theories of high temperature superconductivity.

The new materials are cerium-doped lanthanide copper oxides with the formula $Ln_{2-x}Ce_xCuO_{4-y}$, where Ln stands for praseodymium, neodymium, or samarium. They are described by Yoshi Tokura,

Hidenori Takagi, and Shinichi Uchida of the University of Tokyo. One of the samples they studied, $Nd_{1.85}Ce_{0.15}CuO_{3.93}$, begins showing signs of superconductivity at 24 K. (Extracted from Chemical and Engineering News, 30 January 1989)

Superchip hands computing power to scientists

Intel, the US chip manufacturer that supplies microprocessors for most of today's personal computers, announced a "superchip" that can turn an ordinary personal computer into a powerful graphics workstation. The 860 chip is the first 64-bit microchip to combine a central processor, a graphics unit and memory on a single piece of silicon.

The 860 chip is 30 times faster than Intel's current fastest chip and five times faster than the fastest chip offered by its main rival, Motorola. Computer makers plan to mount the new chip onto a board, so that users can plug it into the back of an ordinary personal computer to transform it into a scientific workstation capable of performing complex fluid dynamics or molecular modelling calculations. The 860 is perhaps the first processor that really can claim to bring the power of a supercomputer to people's desks.

At the moment sophisticated graphics functions are usually available only by sharing time on a large and very expensive supercomputer. The 860 chip, which costs $750, can perform as well as dedicated "graphics" supercomputers which cost around $100,000.

The 860 processor is not intended to replace Intel's current range of chips, the 286 and 386 microprocessors which provide the power behind personal computers such as IBM's PC and PS/2 machines.

Its most important role will be as an accelerator chip, working alongside a 386 processor or with the 486 chip for personal computers which Intel plans to launch before the middle of this year.

The 860 chip outperforms all others by using a combination of two technologies. The first is known as RISC: Reduced Instruction Set Computer technology. This breaks down complex and time-consuming instructions into a larger number of simple routines, which the hardware of the computer is designed to execute quickly. This particular RISC chip can carry out 80 million calculations every second.

The second technology is the physical process which allows Intel to pack in components just one micrometre apart, using technology known as Complementary Metal Oxide Silicon.

The 860 uses a form of operating system called Unix to control the functions of its microprocessor. As yet nobody has written applications software, or software to help programmers develop their own applications for the new chip.

IBM, however, has been working with Intel to produce an extra board for its PS/2 computers, so that it can take advantage of the power of the new chip. Microsoft, the software company that produces some of the most popular software for personal computers, is to develop software applications which can be run on the 860. This gives Intel a significant advantage over its competitors, all of whom have produced chips based on RISC technology.

Ian Wilson, Intel's technical marketing manager, says that Intel is also working with a group of computer companies including Compaq, Hewlett-Packard, Tandy and NEC which aim to produce a new architecture for 32-bit personal computers, called EISA (Extended Industry Standard Architecture).

This new design is intended to rival IBM's prioprietary "microchannel" design for the "bus" which controls the flow of data inside computers. This way the new processor could be used in the majority of the next generation of personal computers, those which opt either for IBM's microchannel architecture or for its alternative, EISA. Italy's Olivetti group also plans to base its latest range of minicomputers on the new chip. (This first appeared in New Scientist, London, 11 March 1989, the weekly review of science and technology)

Exotic semiconductors

Diamond may soon be used in exotic new semiconductors. Chemists and physicists in the US and Israel have developed a technique that enables them to grow a thin film of diamond epitaxially on silicon. Epitaxial growth is the layering of one material, atom by atom, onto the surface of another so that crystal lattices of the two materials align. The resulting material is effectively a single crystal that has interesting optical and electronic properties and can be used to develop advanced semiconducting compounds.

Electronics companies have used silicon in their integrated circuits for nearly 40 years. Although silicon has been immensely successful in that time, engineers have taken the performance of the material to its limits. The industry now needs better, faster semiconductors.

Throughout the 1980s, physicists and chemists responded by developing techniques to grow a wide range of so-called exotic semiconducting compounds that are faster than silicon and more suitable for optical telecommunications circuits. The pace of development in this field has been so rapid that electronics companies and computer manufacturers are already liberated from some of the limitations of silicon.

Until now, however, researchers have been able to use only the most stable form of an element or compound to design these new semiconductors. For example, anyone who tried to lay carbon atoms epitaxially on a surface found that a thin film of graphite, rather than diamond, grew. Wayne Rabalais, Yeshayahu Lifshitz and their colleagues at the University of Houston in Texas and the Soreq Nuclear Research Center at Yavne in Israel have now overcome this limitation, opening the door to a whole new range of exotic semiconductors.

Researchers have been able to grow diamond on the surface of materials for some time, using a technique known as chemical vapour deposition (CVD). The process involves heating a substrate to a very high temperature and introducing hydrocarbons and hydrogen to make diamond that forms a surface. This method, however, does not lead to epitaxial growth, because the carbon atoms can swim about on the surface of the film and end up in a jumbled arrangement of crystallites. At present, the diamond materials laid using CVD techniques cannot be used to build semiconductors.

Rabalais and Lifshitz have overcome this problem. Their technique punches atoms or molecules into the subsurface of a material, rather than laying them gently on top. The diamond crystals stay locked in place, rather like darts thrown into a dartboard.

The process occurs at room temperature, despite the fact that such temperatures usually cause graphite, not diamond, to form. Rabalais and Lifshitz encourage diamond to form at room temperature by exploiting the relative weakness of the bonds between the carbon atoms in graphite compared with those in diamonds. The researchers discourage the formation of graphite by giving the carbon atoms enough energy to shatter the bonds in graphite but leave the bonds in diamond intact.

Rabalais and his colleagues have recently announced that they had successfully grown diamonds on silicon epitaxially. Their achievement paves the way for the development of semiconductors containing diamonds. Electronics companies have wanted to do this for many years, because devices made from diamond will be resistant to radiation and would therefore be ideal for space communications, nuclear reactors and military applications.

Diamond devices would also operate at higher frequencies than present semiconductors, because the electrons in diamond move much faster than in other materials. They would also be able to work at higher power because electrical conduction in diamond breaks down at a much higher voltage than in other materials. Rabalais says that his work is at a very early stage and that much research is necessary before scientists will be able to produce films with the quality for technological applications.

Lifshitz suggests that researchers could use the technique to grow other materials that were previously impossible to grow epitaxially. He also claims that the technique will help researchers to understand how exotic materials work. (This first appeared in New Scientist, London, 18 March 1989, the weekly review of science and technology)

Superconductors have superstructure

Scientists in the US claim to have revealed a new feature in the structure of one of the high temperature superconductors which they believe could play an important role in determining the superconducting properties of these materials. The researchers claim to have observed the structure of the compound in more detail than ever before.

All crystals have a regular structure of small, identical groupings of atoms, called unit cells, that stack together like building blocks. For example, in gold, the unit cell is a cube with atoms of gold at each corner and in the centres of each face. These cubes then stack together to form a crystal of gold.

Researchers thought that the same was true for crystals of the high-temperature superconductors, except that their unit cells were much more complicated. However, scientists who have performed standard experiments - in which X rays are scattered from the crystals - have shown that in at least some of the high temperature superconductors, the unit cells do not stack in a precisely regular manner.

According to the American scientists, X-ray techniques can show only an average structure over many unit cells, so an observer cannot see the exact nature of this irregularity.

Now Michael Kirk and his colleagues, from the Department of Applied Physics at Stanford University in California, have used a scanning tunnelling microscope (STM), which they say can reveal the positions of individual atoms on the surface of a crystal. Using this instrument, they have studied the structure of a high-temperature superconductor based on bismuth, strontium, calcium, copper and oxygen, with the chemical formula $Bi_2Sr_2CaCu_2O_{8+}$.

The researchers say that a row of bismuth atoms is missing at every ninth or tenth unit, giving the crystal a larger-scale structure - a so-called superstructure. According to Kirk, the absence of the bismuth causes the nearby atoms of copper and oxygen to distort from their expected positions as the structure tries to fill the gaps. He says that the superconducting properties are "extremely sensitive to the positions of the copper and oxygen atoms". He could not say whether the missing bismuth atoms helped or hindered superconductivity but he was sure that they had an effect.

Kirk says that the team studied the bismuth-based material because the STM needs to look at a very flat surface. Such surfaces are usually difficult to prepare, but their attempts with the bismuth compound were successful. However, experiments using X-rays have indicated that similar superstructures may exist in other high-temperature superconductors, which leads the team to speculate that the effect may not be just an oddity of this compound but a general feature which affects the superconducting properties of all similar materials. The researchers now plan to study these other compounds. (This first appeared in New Scientist, London, 28 January 1989, the weekly review of science and technology)

Superconducting thin film coated with silver

Toshiba Corp. has developed a new technology for superconducting thin film.

Before, superconducting thin films were made using an annealing process, which reaches approximately 900°C and results in a rough surface that is difficult to join to other thin film materials. In addition, the superconducting properties of the surface of the film deteriorate due to contact with air and moisture.

Toshiba has developed a new fabrication method, called Multi Target Reactive Sputtering, which alleviates the need for annealing. In this method, yttrium, ceramic materials of barium and copper, and metallic copper are targets that are bombarded with an argon oxygen gas mixture. The argon ions are excited by electrical energy, which strikes atoms from the target and forms layers of thin film up to 700 nm onto substrates preheated to 560°C.

By controlling the energy of argon ions, the method can accurately control the amount of atoms of yttrium, barium and copper in proportion of 1:2:3 to form the optimum compound. Because of the optimum proportionality, the newly formed material requires no annealing to acquire superconductivity, and is thus preserved from the damage which frequently results during annealing. The material's surface is as flat as a mirror.

To prevent the surface of the thin film from losing its superconducting properties and thus making the junction with other materials possible, the researchers added a layer of silver to the surface for stability.

The silver layer was formed on the superconducting thin film through vacuum evaporation, after which it was annealed at 500°C while being supplied with oxygen. This creates an oxidized silver layer that prevents oxygen from escaping from the thin film and prevents the effect of water vapour in the air.

Moreover, Toshiba has discoverd that the silver layer on the film also exhibits superconductivity, although silver is not a superconductor itself. This effect is called proximity effect, and the two materials in conjunction can work as a single superconductor.

As the third breakthrough, using this superconducting thin film and lead (another superconducting material), Toshiba has successfully fabricated an experimental tunnel junction, which showed a superconducting tunnel effect.

Although the junction is still experimental, using lead, which is a low-temperature superconductor, and requiring liquid helium to obtain the necessary low temperature, the achievement will expand the prospects of superconductor application and contribute much to the overall progress of superconductor technology. (Source: JETRO, January 1989)

New systems to interact with computers

Scientists are developing new systems that would allow users to interact with computers in totally new ways. By wearing a specially designed helmet and gloves, people could enter into 3D computer-generated worlds and control the computer by using natural hand movements. For example, an architect could simulate the experience of walking through a building and moving columns and doors. Two people could play a simulated game of tennis without leaving their living room. These advanced simulation systems are called artificial realities, virtual realities or virtual environments. In computer industry jargon, "virtual" refers to something that appears to be present but really is not. Although artificial reality systems are still years away, some of the related technology is starting to be used in medicine, robotics, aviation and other applications. In the future, artificial reality systems could become even more important than computers or television, according to J. Lanier of VPL Research (Redwood City, CA). VPL Research produces gloves and other articles of clothing for use in virtual environments.

The user wears a specially designed helmet containing two small TV screens, one for each eye, so that he or she sees an image that appears to be 3-dimensional. Since nothing but the TV image can be seen, the user is completely immersed in the simulated environment. A sensor mounted on the helmet monitors the user's head position and orientation, so that the image moves when the user's head turns. (Extracted from New York Times, 10 April 1989)

Hybrid circuit requiring no alumina substrate

TDK Corp. and Sony Corp. have jointly developed and begun production of a hybrid circuit that does not require an alumina substrate. The multilayer hybrid circuit (MHC) is a monolithic structure that consists of a capacitor and resistor network and on which an IC can be mounted. The revolutionary MHC was already used for the equalizer circuitry of the new Sony Walkman model. The development significantly enhances the array of SMD (surface-mount device) products currently available.

The new MHC is the first chip device to incorporate an active component. Instead of capacitors, resistors, and an active element all mounted on an alumina substrate, an MHC's structure consists of an active element mounted on a monolithic structure with a built-in network of capacitors and resistors. This was achieved by introducing a simultaneous sintering technology of magnetic and dielectric materials which have different sintering temperature and shrinkage rates.

This compact construction enables significant miniaturization of electronic circuits. For example, although the MHC now being produced contains elements equivalent to 16 ceramic capacitors and 16 resistors, it requires one third the space needed to mount 32 individual 1608 chip components (1608 components, the smallest type on the market, measure 1.6 by 0.8 mm). In effect, TDK has succeeded in integrating 16 chip capacitors - each measuring 0.7 by 0.35 mm, far smaller than any capacitor currently available - into a monolithic chip. (Source: JETRO, January 1989)

Quantum effect transistors may transform electronics

Quantum effect transistors are a new innovation that many foresee transforming electronics in the same way semiconductors did. The transistors are thought to have the potential to enable a laptop supercomputer to run on flashlight batteries, according to press releases from Texas Instruments. Last December Texas Instruments claimed to have invented the first quantum effect transistor, but AT&T Bell Laboratories developed a resonant tunnelling bipolar transistor in 1986 that employed "quantum well" technology - building on a 1985 Bell Laboratories' proposal. Bell Laboratories contends that the TI transistor is 90-95 per cent identical to the Bell Laboratories device and a patent battle may ensue. Fujitsu also fabricated a device with a quantum well in 1985, but it was a unipolar device without the practical applications of either Bell Laboratories' device or Texas Instruments. (Extracted from Semiconductor International, March 1989)

Experimental quantum wire structure

Nippon Telegraph & Telephone's Electrical Communications Laboratory has fabricated an experimental quantum wire structure transistor that has mutual conductance six times that of high electron mobility transistors (HEMTs). HEMTs are considered state-of-the-art for operational transistor speeds. The breakthrough was enabled by the novel wire structure, consisting of vertical superlattice crystals, and a metal-organic chemical vapour phase deposition process, which can create quantum wires 5 nm (13 atoms) wide. The smaller wire width, one tenth that capable with state of the-art very large scale integration production techniques, allows current levels four orders of magnitude higher than previously achievable, according to N. Susa, NTT. (Extracted from Electronic Engineering Times, 3 April 1989)

Conservative logic seen as solution to overheating problem

The increasing miniaturization of computers allows the faster transfer of information, but the millions of electronic switches generate heat that hurts computer efficiency. Researchers at MIT and IBM have discovered that conservative logic, a new approach to computing, reveals computer-generated heat can be reduced to nearly nothing. The process involves replacing AND switches, or gates, with "conservative" gates. Researchers have shown that computers employing conservative logic are as effective as a regular computer. Overheating is not yet a problem for computers, but if they are developed at the same rate as during the past 40 years, overheating could bring a halt to the development of powerful computers. Conservative logic is seen as an answer to the problem. (Extracted from The Economist, 17 February 1989)

Shipley fills holes in board quality

The plated-through-hole printed circuit board remains the cornerstone of the PCB business, and quite remarkable results have been achieved in improving the board's quality, through the application of a recently developed process.

The essential feature of the PTH process is the deposition of a cohesive and adhesive conductive layer, normally copper, onto all the hole wall surfaces, including non-conductive surfaces. Typically, this thin layer of copper can then be overplated to the full desired thickness by conventional electroplating methods.

Good hole wall integrity is essential in the manufacture of boards, i.e. the complete adhesion of the copper to the laminate within the hole. Moisture can often become trapped behind the copper, so that when a board is soldered by passing it through a wave soldering stage, an outburst of gas from the vapour of trapped moisture can occur.

This defect can account for as much as 20 per cent of the manufacturing costs in the PCB business. Alternatively, baking a circuit board to remove any moisture can prove to be a long and costly operation.

In order to help PCB manufacturers improve the quality of their PTH boards at this stage, Shipley Europe laboratories in Coventry developed an alkaline permanganate treatment that cleans and de-smears hole wall surface, while removing drill debris. This process is called Circuposit 3000, and it has the effect of greatly improving the quality of metallized holes and eliminates outgassing almost completely.

Production tests using both double-sided and multilayer boards have shown good coverage and adhesion, but the most dramatic improvement is in solderability. The Circuposit 3000 process produced only 12 blow holes out of 141,000 - more than 15 times better than tests using existing processes, says the company.

Total process line capability for Circuposit 3000 is offered by Shipley's wholly owned equipment company, STS, based in Lausanne, Switzerland. The latest fully automated load and unload system from STS makes possible for the first time the linking of all process stages without any manual intervention. (Extracted from Electronics Weekly, 22 March 1989)

III. MARKET TRENDS AND COMPANY NEWS

Market trends

PC-based geographic mapping market

The market for PC-based geographic mapping will account for $222 million worth of the total $843 million mapping market in 1992; the PC-based market reached $58 million in 1988, according to Dataquest. Software will account for 80 per cent of mapping market revenues by 1992. The workstation-based mapping market will account for 51 per cent, $434 million, of the international mapping market by 1992, as against 25 per cent worth $148 million currently. The digital mapping market is one that combines informational and geographic data bases, providing a mapping format called Geographical Information Systems. The market will be strong for value-added resellers (VARs), especially the ones that produce applications for their niche markets, according to J. Erickson of Future Computer/Datapro. The mapping market is being aided by the increasing availability of geographic data bases from government agencies. For example, the Tiger (Topologically Integrated Geographic Encoding and Referencing Systems) data base, which includes data from the US Geological Survey transportation and hydrography data base. The leading uses of mapping products include analysis, e.g., census data, and operations, e.g. automated dispatching. (Source: Computer Society News, 27 February 1989)

Putting superconductors to work

Large-scale applications for new high-temperature superconductors will be at least 10 to 15 years off, although small-scale electronic applications may be developed much sooner. Engineers are trying to fabricate these often unwieldly materials into more practical forms, such as thin films, wires and ribbons. The commercial development of superconductors will depend partly on the transition or critical temperatures of the materials and their critical current densities. Critical current density and other properties improve as the material is cooled well below its critical temperature. Achieving a suitable critical current density is necessary for applications, especially use in magnets, although the superconductors will also have to meet many other performance requirements.

Materials used in magnets will have to be chemically stable, strong, metallurgically compatible with shunting material such as copper, and capable of being formed into wires or other shapes. For electronic applications, the superconductor must be deposited as a thin film, which should have a smooth surface and should not react with the substrate. High critical temperature materials still have a long way to go before they can satisfy these requirements. Scientists have been most successful in producing thin film superconductors, but have not done as well with superconducting wires and tapes. Various techniques have been used to make thin films, but laser deposition and direct current magnetron sputtering appear to be the most promising because they use a single target. Researchers are developing deposition processes that require temperatures substantially below 95° C. One aim of thin-film research is the development of a Josephson junction that will operate at liquid nitrogen temperatures.

Some potential applications of high-temperature superconductor materials

Medical imaging. In magnetic resonance imaging (MRI), the human body is exposed to a powerful magnetic field generated by a low-temperature superconducting electromagnet. The resulting image shows differences in chemical composition of the various types of tissue in the body. MRI machines using high-temperature superconductors are expected to be smaller, lighter in weight, and less costly than existing machines. They might also be more reliable as a result of the simpler cooling system.

Computers. Because superconductors do not generate heat, circuits made from them could be packed closer together, leading to smaller, faster computers. The high-temperature materials may be applied to Josephson junctions, superconducting electronic switches that work 10 times faster than semiconductor switches, and in optical switching devices for opto-electronic computers.

Sensors. A superconducting quantum interference device, or SQUID, is the most sensitive detector of electromagnetic signals known. It can measure magnetic fields as small as 10^{-14} tesla. Helium-cooled SQUIDs are used in monitoring neural impulses in the brain and heart and exploring for oil and mineral deposits. The new superconductors may make possible devices that are more compact.

Miniature antennae. An antenna made of a high-temperature superconductor could be made 5 per cent of the size required for a conventional antenna with no significant loss in sensitivity. For example, a high-T_c antenna 2.6 inches long could replace the normal 52-inch-long antenna used for commercial FM reception.

Electric power transmission. Superconducting transmission lines could carry significantly more current than conventional copper cable - without power loss from resistance. However, the energy savings would only be about 3 per cent, according to one expert. Superconducting cables may allow nuclear and coal-fired power plants to be located away from population centres.

Superconducting magnetic energy storage (SMES). In SMES, energy is generated by the magnetic field of huge superconducting coils buried in the ground. The energy is stored in the coils and circulates indefinitely without loss of power. When energy is needed, it can be discharged rapidly. Utilities could use SMES to store excess energy when demand is low and release it when demand exceeds generating capacity.

Magnetic levitation. Japan is developing a maglev (magnetically levitated) train that uses low-temperature superconducting magnets. High-temperature superconductors could give greater engineering reliability, and stronger, lighter magnets, which could cut propulsion costs.

Electromagnetic launchers. Superconducting electromagnetic coils could be used to launch objects at much higher velocities than current gas expansion launch systems. Applications include small guns for military purposes, aircraft catapults, and space vehicles.

Magnetic separation. This technique enables components with certain magnetic properties to be separated out of a mixture. Low T_c magnetic separators consume far less electricity than non-superconducting systems. High-T_c systems would be more reliable and less expensive because the helium-vapour recovery system would be eliminated.

Magnetohydrodynamic (MHD) systems. Electricity is generated by forcing an ionized combustion gas through a magnetic field that separates the positive and negative ions. Superconductors are used to generate the high magnetic fields necessary for highest efficiency. High-T_c magnets might be less expensive, simpler to operate, and more reliable.

Generators. Low-T_c superconducting generators have already proved to be less expensive than conventional 30 MW generators because of their higher efficiency (99+ per cent). As long as liquid helium is the refrigerant, small (less than 100 MW) superconducting generators will not be economic. But liquid nitrogen might make them competitive.

Motors. Superconductors expel lines of magnetic flux (the Meissner effect), so they repel approaching magnets. This repulsion can be used to drive the rotor blades of an electrical motor. High-temperature superconductors could reduce by as much as 25 per cent the cost of large motors that produce 1,000 hp or more, according to a recent study.

Shields and waveguides. Because superconductors repel magnetic flux lines, they can be used to create regions free of magnetic field. And since they can be plasma-sprayed, they could be applied to surfaces with complex shapes. Thus, they could be potentially useful for coating the walls of microwave cavities, shielding against nuclear explosions, and shielding space vehicles upon re-entry into the atmosphere.

Ship propulsion. Japanese researchers are working on ships driven by superconducting motors or by electromagnetic fields from superconducting magnets. Coupling superconducting motors and generators also could result in significant improvements in propulsion.

Magnetic fusion reactors. Experiments with magnetic fusion reactors require superconducting magnets that generate fields up to 11 tesla. The magnetic field confines the plasma in which the fusion reaction occurs. High-T_c superconductors would simplify the magnetic-cooling system and reduce costs. (Extracted from Chemical and Engineering News, 20 Feburary 1989)

Investment in superconductor development slow

Venture capitalists generally feel that it is still too early to invest in superconductor development. Commercial development is still at least five to 15 years in the future, if parallels with other high technology industries are any indication. R. H. Stavers of Coopers and Lybrand says that despite a great deal of interest in high temperature superconductors among 100 of the most active venture capitalists, very few have actually invested anything because the payoff is too uncertain and too far off. Venture capitalists want at least a tenfold return on their investment within five to seven years. About 27 per cent, however, think the field will eventually provide an excellent investment opportunity. A few technologically oriented individuals have made some investments, which average $3.2 million per venture. Some of the early start-ups have no business plan, but have acted to attract top scientists and acquire key patents.

J. Schoch of Asset Management says the formation of superconductor companies has slowed down after an initial flurry. Some large firms have taken an interest in superconductors, and some have a stake in new start-up companies. Only a few of the large firms (AT&T, IBM and DuPont) conduct their own superconductor research. The early investors expect some small niche markets for superconductors to develop within a few years, with huge markets developing thereafter. S. Tatsuno of Dataquest expects the first small-scale electronic products to come from Japanese firms, since US firms tend to aim at more complex products. Applications include superconducting quantum interference devices, sensors, switches, optical devices and interconnects, most of which might use thin-film technology. Of 700 patent applications in the US for high-temperature superconductors, about 33 per cent are from foreign sources, including 25 per cent from Japan. (Extracted from Chemical and Engineering News, 13 February 1989)

Workstation market trends

The workstation market totaled $4.1 billion in 1988, compared to $2.7 billion in 1987, according to Dataquest. Factors in the market's performance include price decreases, volume purchases, low market penetration, and a poor minicomputer market. In the international market-place, some 20 per cent of the engineering sector has workstations in place; less than 5 per cent of the office, university, and financial sectors have workstations installed. Sun Microsystems has 28.3 per cent of the world wide workstation market in 1988, up 4.2 per cent from the previous year. Its growth rate was 80.6 per cent in 1988. The 1988 growth rates for Intergraph and Silicon Graphics were 83.3 per cent and 81.8 per cent, respectively. In market share, Intergraph and Silicon had 6.7 per cent and 4.4 per cent, respectively. Digital Equipment had 18.6 per cent of the 1988 workstation market; Apollo's share is 13.5 per cent; and IBM's is 2.6 per cent, down 1.1 per cent from 1987 due to the late entrance of its RT PC, plus a shortage of third-party software developers for the machine. (Extracted from MIS Week, 20 February 1989)

Downward trend in computer systems growth

Sales growth for computer systems could fall to as low as 6 per cent per year by 1992 compared to 10 per cent or more in recent years. Although the downturn could be a cyclical phenomenon, some observers say growth in the $118 billion per year world market is slowing. While PCs and other newer types of computers are still recording sales gains, they are not enough to offset slow growth in older mainframes and minicomputers. In support of this view, Prudential-Bache Securities analyst R. Martin says that 60 per cent of the approximately $169 billion in revenues tallied by the world's major computer makers (those with $500 million per year in sales or over) came from older technologies. Another case in point is IBM, a leader in the PC market, which is still growing 12 to 17 per cent per year. However, IBM's revenues from the technology have not compensated for a slowdown in sales of mainframes and minicomputers, a slowdown ironically caused in part by the success of PCs. As computer technology advances, older machines continue to be replaced by the new, thus, holding down overall growth. A related problem is that consumers already have a tough time keeping up with all the new technology, a situation exacerbated by a lack of available software to take advantage of this new power. In sum, these changes will lead to a consolidation of the industry and dominance by a few major players, and will necessitate the use of marketing skill over entrepreneurialism. (Extracted from Business Week, 6 March 1989)

Biopolar TTL market expected to drop

The market for bipolar TTL (transistor-transistor logic) devices will fall to $1.49 billion in 1990, against $..72 billion in 1989 and $1.8 billion in 1988, according to Dataquest, a market researcher. But the biploar TTL market will improve in 1992, when it will be worth $1.59 billion, when compared to $1.52 billion in 1991. Dataquest believes that an IC depression will cause the market to decline in 1989-1990. Dataquest has indicated that the market for CMOS logic devices will be worth more than a billion dollars in 1992 against $900 million in 1988. When including CMOS logic devices in the family of TTL devices, the entire market will be worth $2.7 billion in 1988 and slightly more than $2.7 billion in 1992. Meanwhile the entire IC market is expected to reach $65.7 billion in 1992, against $39.4 billion in 1988. The high-speed CMOS device market should reach more than $200 million per year in 1992, against $60 million per year in 1988. (Extracted from Electronic Engineering Times, 26 December 1988)

Data base software market forecast

The US data base software market will total $3.5 billion in 1993, compared to $1.8 billion in 1988 due to the increasing use of distributed data base management technologies, according to a report by Ovum called "The Future of the Database". The European data base software market will also get a push from distributed data base advances; the market will total $3.9 billion in 1993, against $1.2 billion in 1988. Most organizations currently store their data in different data base systems on different computers. As a result, users cannot access all data within the organization. Distributed data bases would solve that problem. The driving force behind distributed data base technology is the increasing use of relational data bases, which are more easily distributed due to their modular structure. Another key to the distributed data base market will be the use of IBM Systems Application Architecture which, by 1993, will provide a distributed data base environment for all IBM mainframes. IBM is also providing the Structured Query Language, which facilitates the connection of different data bases, as well as the link between data bases and other software. (Extracted from MIS Week, 27 February 1989)

Slow growth of graphics supercomputer market

The growth of the graphics supercomputer market is being held back because the industry cannot exploit the machines. A lack of a wide variety of software, networking bottlenecks and high prices are hindering the growth. The graphics supercomputers bridge the gap between high-end workstations and minisupercomputers. They are targeted at computer-intensive applications that need high-performance graphics, but only a few software developers have committed themselves to developing applications for the graphics supercomputers and even they may be enticed away by the promise of greater profitability of personal computer applications. Solutions to networking bottlenecks are now available in the form of servers that Ardent Computer and

Stellar Computer, two graphics supercomputer vendors, have introduced. The fibre Distributed Data Interface and the High-Speed Channel, which has a 1,600 Mbps maximum data transfer rate, will also help reduce networking bottlenecks. (Extracted from Computer World, 6 February 1989)

Superconductor parts market forecast

The US high-temperature superconductor parts market is forecast at $375 million by the year 2000, according to a Falmouth Association study. However, if the present effort to synthesize 150-300K superconductors is successful, the market could total $3.2 billion by the year 2000. The most promising near-term uses for high-temperature superconductors are magnetic shielding, magnetic separators, and SQUIDS for medical and defence uses. Promising uses for 1993-1995 are in magentic resonance imaging, mag-lev bearings, Josephson junctions and microcircuit elements. Promising uses for 1995-2010 are energy storage devices, mag-lev trains, power transmission lines and MHD ship thrusters. (Extracted from Ceramic SB, February 1989)

CMOS PLDs expected to replace bipolar PLDs

Bipolar programmable logic devices (PLDs) will achieve propagation delays of 5 ns, against the current 7 ns, within two years, according to D. Rutledge, director of product development at Lattice Semiconductor (Beaverton, OR). These devices may also support 1,500 gates in the next five years. Currently, only 500 gates are supported. CMOS PLDs will also have propagation delays of 5 ns by 1992 compared to the current 10 ns. Metallization and these devices' power consumption characterics will lead to the development of PLDs that have 0.6 micron effective channel lengths with gate oxides of 180 A by 1992. Gate integration is expected to increase to 10,000-20,000 gates/device soon against an average of 1,500 gates currently. The quality of bipolar PLDs varies with each device since the device cannot be tested once it is manufactured. In contrast, CMOS PLDs can be tested and are reprogrammable. This is one of the reasons why CMOS PLDs are expected to replace bipolar PLDs except in the most speed-sensititive applications. (Extracted from Electronic Engineering Times, 20 March 1989)

Mainframes being overtaken by microprocessors

Mainframe computers are rapidly becoming technological dinosaurs in favour of the smaller, cheaper and dramatically faster computer chip, or microprocessor. For years, computers so large they had to have their own air conditioned rooms have powered US business. However, reports in recent weeks of new financial trouble at the top three US computer makers reflect a fundamental shift away from giant mainframes. Mainframe sales will rise only 2.3 per cent by 1998, according to the Computer & Business Equipment Manufacturers Association. IBM, which previously obtained 50 per cent of revenues and 70 per cent of profits from large systems, has noted slow growth in its mainframe market since the mid-1980s, and is now trying to rebuild its product line around powerful workstations that can store and retrieve files from a large, centralized computer. Digital Equipment caught up with IBM in the early 1980s by relying on a single design and advanced networks to link its computers, but that design is aging. It has now launched its own microprocessor based workstation. Unisys, formed in 1986 from the merger of Sperry and Burroughs, is trying to support both firms' mainframes, but is shifting to microprocessor-based systems running the Unix operating system. (Extracted from New York Times, 4 April 1989)

Equipment growth forecast

The world-wide semiconductor equipment and materials market is expected to grow by an average of 11.5 per cent in 1989, according to SEMI, the international trade association for the business. Europe was warned that it needs to have a semiconductor infrastructure if it is going to be a world-wide player.

Figures released by SEMI at the 15th Semicon Europa show, held in Zurich in March, indicate that equipment and materials suppliers can expect an 11.2 per cent and 11.9 per cent growth rate respectively, over the next nine months. But no new European wafer fabrications are planned.

The recent decision by the European Commission to change the definition of European origin for chips could help to expand the market for new equipment. In order to qualify as European devices, and so avoid the 14 per cent import tariff, chips will have to be fabricated in Europe. Previously, they only had to be assembled and packaged in Europe.

Bill Reed, the head of SEMI, now based in Brussels, said that it was important for Europe to create a semiconductor infrastructure, if it wanted to have a world class semiconductor industry.

The question of wafer yields remains a sensitive issue. According to BOC, a supplier of gases and related applications technology to the industry, the Japanese have continued to lead the world in improving their own manufacturing processes. Yield factors of 60 to 70 per cent are common in Japan for 1 Mbit memory chips, while elsewhere operating levels are 20 to 30 per cent.

There may be no European wafer fabrication starting up, but the upgrading of existing plant is going ahead, both for in house use and for the merchant market. At the front end of the chip manufacturing process, the demand for improved ion implanters continues to be strong. Matra Harris Semiconductor has chosen Applied Materials' 9000 implanter for the production of its 1 micron CMOS process in Nantes.

A spokesman for Eaton's recently restructured Semiconductor Equipment Divison, said that the business for ion implanters this year looks good. The company has a backlog of 45 systems.

"It is becoming more desirable to be able to tilt the wafer when implanting the ions into the side walls of semiconductor structures," he said. The NV 6200 AV has been developed to meet the industry's requirement for an implanter capable of high tilt angles and wafer repositioning during processing. (Source: Electronics Weekly, 15 March 1989)

US microelectronics benefits from small firms initiative

Small companies are squeezing out large companies when it comes to competing at the leading edge of microelectronics technology.

The number of small microelectronics companies has proliferated in the last 10 years and the growth rate of new microelectronics start ups has

accelerated. The same number of new companies have been founded in the last 10 years as were founded in the whole previous 30 years' history of the microchip industry.

It is these 10 year-old companies and younger which are squeezing the big, traditional companies. The trend is shown by the companies' revenue figures from US market analysts Dataquest. These figures look solely at the sales figures for integrated circuits (ICs) and leave out those for discrete components like individual capacitors and resistors for which the R&D spent is negligible in comparison with ICs.

ICs are where the big money in microelectronics R&D goes - e.g. the $1.5 billion Philips Siemens Megaproject, its $2.7 billion successor the European project JESSI, and the $2 billion US IC R&D programme Sematech. It might be expected that the big companies, able to afford the most microelectronics R&D, perform better than small companies when it comes to sales of the most advanced ICs. However, the Dataquest figures suggest that the reverse is true.

According to the latest Dataquest figures, based on 1988 revenues, many companies which deal only in ICs and which were started in the late 1970s and early 1980s are now in the $40 million to $350 million revenue bracket. Last year they accounted for over $2 billion out of a total of $16 billion for all ICs produced by American companies.

Moreover, not only are the revenues of the start-up companies exclusively for ICs, but they are for the most advanced ICs - microchips which are pushing the technological limits and which incorporate the most significant innovations.

Contrastingly, the revenues for the large companies are coming mostly from older IC products, which are obsolescing and from discrete components like individual capacitors, which do not require the most up-to-date technology or lage R&D expenditures.

The figures are a triumph for the American policy of promoting innovation through small entrepreneurial companies. Such companies are regarded as the best vehicle for taking the results of research to the market-place.

The role which the big electronics US companies have taken is to do the basic ongoing research and let the entrepreneurs take the results of that research to market. This formula has served America well, though in many ways it is against the interests of the large companies.

For instance IBM has supported Intel through difficult times. But Intel is in the business of making general-purpose chips, which allow anyone to make computers - kits if you like. That means Intel is providing the enabling technology to companies which set up to compete with IBM.

If there were no such kits, companies wanting to make computers would have to design and make their own microprocessors and support chips. Only very large computer companies can afford that.

Therefore it is in the interest of very large computer companies to keep the enabling technology to themselves and not have companies like Intel distributing chips all over the place from which anyone can make computers.

Why then does IBM support Intel? The only answer can be that it believes that in diffusing the technology widely around the world it is promoting the best means of seeing the technology rapidly developed and most effectively exploited and so used for the benefit of most people.

Clearly most large companies would be more interested in hanging on to such enabling technology and letting the products out in dribs and drabs to maximize their investment in it. Therefore it is farsighted of IBM and AT&T, particularly because for two decades they have pursued a policy of helping and encouraging innovative small companies.

They have done this by handing out development contracts, evaluating and buying the products of small companies and sometimes, like IBM with Intel in the early 1980s, coming to the financial rescue by taking a large shareholding (later relinquished) to keep the company going through a sticky period.

The policy has worked to the great benefit of America and to the world at large which has seen the technology rapidly developed. If the technology had stayed wrapped up in large companies the pressure to develop it rapidly would not have been created. Under the IBM AT&T policy, the companies which were most successful in developing the technology came out best in the market.

The latest example of IBM coming to the rescue is with its contribution of highly advanced memory chip technology - for a 4 Mbit DRAM - to the Sematech consortium, which aims to diffuse that technology throughout the US semiconductor industry, so bringing it back into contention with the Japanese chip industry (which took a one to two year lead over American chip technology at the 1 Mbit DRAM generation stage).

Europe, it seems, has yet to learn the lesson of America that the last people you want to listen to when it comes to promoting a lively, aggressive microelectronics industry are some of the large electronics companies, who are continually looking inwards at protecting their position in the home market and seem incapable of appreciating the wider international scene.

The notable thing about the small companies is that so many of them trade world wide. Within a few years of start-up, many of these small companies are opening offices in Tokyo, London and Munich to exploit foreign markets and many derive significant proportions of their revenues from foreign sources. By contrast, the large electronics companies of Europe, with the exception of Philips, Thorn and Plessey, have proved to be inept in selling microelectronics abroad.

So, unlike IBM and AT&T which have worked for the benefit of America, the large electronics companies of Europe (with some exceptions) have worked only for the benefit of themselves. The influence of such companies will have to be curtailed by government if Europe is ever to prosper in microelectronics. (Source: Electronics Weekly, 15 March 1989)

US makers will swamp single European market

American computer manufacturers are set to clean up in Europe when the single European market arrives in 1992. And even the biggest European manufacturers will have to merge or forge tight partnerships simply to survive.

Meanwhile users need to think about the changes needed to their computing systems before 1992 policies are put into place and the UK is behind its EC neighbours in its preparations.

These findings come from a survey of senior computing managers across Europe by research firm Romtec. It shows that users are not concerned about a supplier's country of origin.

The survey says that companies operating on a pan European basis already will benefit most from the legislation to create the single European market, and these are primarily the large US vendors. It is companies such as IBM and DEC that are truly European rather than the more nationally-based companies such as ICL, Siemens, Nixdorf and Philips.

Romtec says the European computer market is expected to grow 25 per cent because of 1992.

But it warns, European vendors which want to remain operating on a large sacle internationally have got to accumulate critical mass to survive. To do this, all the major indigenous European vendors need strategic alliances or mergers or takeovers to compete with the US and Japan.

The alternative, Romtec says, is to withdraw into niche markets. Existing business will become increasingly difficult to protect as US and Japanese companies exploit the single market from their already established positions of strength.

On the user side the UK is well behind other countries in preparing for 1992, Romtec says.

Yet every company will need to review its structure.

Other issues for computing managers include the greater mobility of staff across Europe, which will have a potentially great impact at a time of skills shortages. (Source: Computer weekly, 2 March 1989)

Probing the roots of PC purchasing

Recent user surveys and analyst projections have begun to show that while businesses still plan to buy more PCs this year than last, the rate of growth is slowing, particularly compared with dynamic growth spurts seen in 1984 and 1985 (see "The Coming PC Slowdown"). But the experts do not agree on how much growth is slowing or why.

Market analysts such as Dataquest Inc. and InfoCorp project growth in the number of microcomputers sold to slow to between 9.2 per cent and 12.5 per cent in 1989 from a 16.9 per cent jump in 1988. Securities analysts such as Prudential Bache expect units shipped in 1989 to grow 7 per cent. These figures contrast sharply with the 35 per cent growth rate in 1984 and 127 per cent in 1983. Even the growth projections of PC market bulls such as Compaq Computer Corp. are lower than in the recent past. The 1989 growth of 15 per cent to 20 per cent that Compaq predicts for its high end products would be down from the larger than expected 30 per cent growth Compaq saw last year. Of course, as the number of PCs shipped in any given year becomes larger about 16 million in 1987 it becomes more difficult for the PC industry to sustain a steep growth rate. But analysts see other reasons for the apparent moderating trend.

Analysts who have a PC product orientation assert that the recent proliferation of important new PC technologies such as 386SX, OS 2, Micro Channel Architecture, and Extended Industry Standard Architecture (EISA) has users confused and waiting for the smoke to clear.

Others see the PC market as a winded runner ready for a breather. The market has been growing so fast for so long, "it seems like people are predicting one just because they think there should be one," says Dataquest industry analyst Robert Charlton. Others think users are waiting for vendors to offer better PC deals before picking up the purchasing pace.

But demand is still there and the market will come back with a vengeance in mid 1989 when systems based on Intel's lower cost 386SX microprocessor begin to ship. At that point, 386 based systems now costing $4,500 will drop to about $3,000. Demand will rebound further in 1990 back to 25 per cent annual growth when systems based on Intel's 486 microprocessor double the price performance of 386 based systems and when new, blockbuster applications for OS 2 emerge.

At the same time, others note the slowing effects that user efforts to control and coordinate their management of end user based, company critical systems can have on PC based development.

While many users report that facing these issues is leading them to low end user and PC based development, in the long run, large company critical PC based systems will account for plenty of the PC market's growth. (Reprinted with permission of DATAMATION® magazine©, 1 February 1989. Copyright by Technical Publishing Company, A. Dunn and Bradstreet Company, all rights reserved)

Desktop publishing spreading

Take on a desktop publishing system for one particular task and chances are you will soon discover a multitude of uses. Recent reports suggest the market is continuing to grow apace as it permeates more and more areas of corporate life.

In its survey, National Documentation for the Computer Industry, Digitext states that "there has been a large increase in use of desktop publishing in terms of its spread into a huge array of different departments and job functions". It goes on to predict increased usage and enthusiasm.

The survey, published in December, was based on just under 50 companies with turnovers ranging from 1.5 billion pounds sterling to 350,000 pounds sterling. According to the report, over 50 per cent already use desktop publishing extensively, compared with just under 27 per cent in 1987. A further 21 respondents plan to take the plunge within the next 12 months.

User manuals and newsletters top the list, followed by product data sheets. Desktop publishing, says the survey, is not just being used for many, constantly changing documents but also for one-offs in a variety of departments, ranging from marketing and publicity to development, technical systems production, computer services and general administration.

Increased speed of production, ability to merge text and graphics and near typeset quality from an in-house system are major advantages. But there is a downside. Desktop publishing is slow on large print runs, has high costs, needs extensive training, and lacks effective supplier support.

Training also got the thumbs down in a Computer Weekly/Absolute Research survey of over 1,200 users which was published in September. Although 75 per cent cited improved company image and 57 per cent claimed to have reduced costs using desktop publishing, 41 per cent were dissatisfied with supplier training.

Without training, it seems, users do not get true value for money; half of those surveyed by Computer Weekly/Absolute Research who had formal training rated the software as excellent compared with only 31 per cent of those who learnt from manuals. This is a market where the adage that a computer system can never replace expertise holds particularly true.

An ever-increasing number of packages cater for a wide range of user needs, from sophisticated commercial make-up to word-processed applications. Uses for desktop publishing are widening - companies tend to buy it for one thing and then find 25 other uses.

The software itself is a relatively minor part of the cost equation - prices range from 50 pounds sterling to over 2,000 pounds sterling. All those essential added extras that push up the prices. The Computer Weekly/Absolute Research survey found that, on average, users invested 6,500 pounds sterling per system after adding the cost of graphics, word processing and a reasonably versatile printer offering a range of typefaces and additional fonts.

Scanners range in price from 200 pounds sterling to 12,000 pounds sterling but printing can really bump up the cost - unless, of course, users can compromise on quality with a dot matrix or use one of the many bureaux that are springing up. For the future, observers do not see page printing costs coming down, but they believe users will get more value for money, with an increasing emphasis on page description languages.

Most of the major manufacturers offer one-stop solutions, which guarantee compatibility but are obviously more expensive. The September survey found that 65 per cent of users buy hardware and software separately.

It is worth pointing out that different manufacturers offer different parts of the desktop publishing recipe, maybe including a colour monitor or a scanner, as in the case of the Canon Express Desktop Publisher 5.

There is still a lot of room for growth if users are made aware of the potential applications.

These new systems have emerged on the back of major technological developments: state-of-the-art business graphics encompassing several packages within one software environment; the processing power of 386 and 68020-based chips; and the availability of slidemaker machines and full colour printers. (Source: Computer Weekly, 16 February 1989)

Technologies for 1989

On the cusp of the 1990s, artificial intelligence, which only a few years ago received a chilly and sceptical reception at IS shops, is heating up the technology thermometer in 1989. AI in the form of embedded expert systems will add sizzle to a host of systems applications in industries as diverse as utilities and chemicals. And companies in other sectors - transportation, electronics, health care, and process manufacturing, for example - will have expert systems projects simmering away during a year that marks the end of the decade that brought technology down to the desktop and onto the factory floor.

Communications fuelled some of these changes. In 1989, communications will continue to be a hot project area. Within the communications domain, local area networks (LANs) with tentacles that reach to the workstation and PC still spark the interest and investment of firms in a wide cross-section of industries. Some of these newly wired workstations may be powered by Unix, AT&T's portable operating system that is slowly migrating away from the campus and into the heart of corporate America.

Two newer and unrelated technologies, computer-aided software engineering (CASE) and imaging systems, have also ignited interest among a variety of industries. The banking and finance, insurance, and transportation sectors all hope to realize their vision of imaging systems within the next few years. A bit cautious, perhaps, but equally enthusiastic are firms in the health care and petroleum sectors that will actively be experimenting with optical technology during the year.

While most of the companies were either evaluating, experimenting with, or expanding their AI activities, they still were not committing much money to these efforts. The overwhelming majority were pragmatically optimistic about the technology's prospects.

Expert systems: Many railroads want a system that will perform better derailment and accident analysis modelling. In one effort, the industry and the US Department of Transportation have teamed up to develop the Advanced Train Control System.

LANs: At banks and other financial institutions, investments in expanding and improving LANs will accelerate in the new year. The goals for these organizations is clear: improve productivity and improve operational efficiency.

CASE: Retailers such as Wal-Mart, Best, and Penney have climbed onto the CASE bandwagon in the hopes that this emerging technology will provide significant productivity tools over the next five years.

The technology action, today and tomorrow

Local area networks and workstations are front-running technologies in most industries, with imaging systems queuing up for investment.

	Today	Tomorrow
Banking/finance	LANs, OLTP, workstations	Imaging systems
Insurance	OLTP, AI	Imaging systems, CASE
Transportation	Optical storage, communications	AI, imaging systems
Utilities	AI, LANs workstations	CASE
Food & beverage	LANs	Optical storage
Health care	Packaged software	Imaging systems, AI
Retail	LANs, satellite nets	CASE
Electronics	LANs, work-stations, CASE	CIM, AI
Chemicals	AI, CIM	CIM
Petroleum	AI, PCs	Imaging systems, CASE

Company news

Unix puts on a friendly face

Last year, the Unix industry came out with user interfaces that promise a friendlier face for the portable operating system. That "friendliness" factor is important to office users who need to access applications easily using a common interface. Those new interfaces are now here, but still no standard has emerged.

Vying to set that standard are the two Unix camps - the Unix International group that includes AT&T and Sun Microsystems Inc., and the Open Systems Foundation (OSF) that includes IBM and Digital Equipment Corp. The AT&T-Sun produced Open Look in April 1988. Sun developed the graphic user interface with technology licensed from Xerox Corp.

Responding to Open Look, the OSF proclaimed late in 1988 that it was supporting the OSF/Motif interface, which is a combination of technologies from DEC, Hewlett-Packard and Microsoft Corp. As might be expected from its heritage, OSF/Motif is very similar to OS/2's Presentation Manager.

Confusing this matter further, IBM has licensed the interface of Steven Jobs' new NeXT computer for use on AIX, IBM's version of Unix. According to IBM officials, the company will adopt the OSF interface, but will also offer the NeXT interface for its Unix machines as well.

Ironically, this fight between the two factions is about user-friendliness; one hopes the two sides will eventually work out their differences.

AIX-based products

AIX- (IBM's version of Unix) based products will play a major role in the IBM product strategy of the 1990s, according to a report by the International Technology Group (ITG) (Los Altos, CA), entitled "IBM Directions Report". According to the report, some $3.84 billion worth of IBM AIX-based hardware and software will be in place in 1993; high-performance workstations will account for $1.9 billion; mainframes and "mainframe-like supercomputer platforms", $1.3 billion; microcomputers, $449 million; and mid-range systems, $174 million. Another forecast, again for 1993, has IBM taking in $1.93 billion from high-performance equipment, and $1.262 billion from mainframes and supercomputers. In 1989, AIX-based systems sales will total $96 million, of which AIX-based workstation revenues will represent $73 million; AIX-based mainframes, $11 million; microcomputers, $8 million; and mid-range systems $4 million.

By 1991-1992, IBM also intends to market an RISC-based mid-range workstation line that performs 100 Mips. The RISC plans include a parallel architecture with up to 64 processors initially, eventually expandable to 256 processors. Also by about that time, the firm is looking at providing various other new technologies and products, e.g. fibre optic communications, GaAs components, laser-based products, and a dedicated I/O processor in an integrated vector facility. Another key component in the IBM product strategy is the AS/400. Among its workstation-related plans, the firm will produce two solutions: a high-end Advanced Technical Workstation with 100 Mips performance and 64-bit RISC architecture; and the Intelligent Workstation to replace its high-end PS/2s. THE IWS line will use RISC architecture and Intel 80386 MPUs. (Source: MIS Week, 20 February 1989.

Chip snags hit IBM profit

Deliveries of IBM's key new 3090S mainframes are being delayed because of a chip problem. This has had such an impact that the company has already warned investors to lower their expectations of its first quarter and even full year results.

The delays mostly involve upgrades rather than new systems.

The industry leader is having to make special arrangements for users seeking upgrades: these include lending equipment and putting in older models temporarily.

IBM is giving few details about the problem but says it relates to one chip and that it has now been fixed.

IBM sources have been quoted as saying the problem concerned the percentage of usable chips which the company has been getting: the figures have been put at 15 per cent to 30 per cent.

The 3090S was launched last July with new chip technology. It came just 18 months after the launch of the 3090E, which already offered a 32 per cent improvement on chip packaging density than earlier models. (Source: Computer Weekly, 30 March 1989)

IBM's new RISC-based graphics board

IBM is working on a new RISC-based graphics board that boosts high-resolution graphics. Initially aimed at document management (scanning and archiving large volumes of paper), the new board will come with a daughterboard. Together the two boards will display 1,600 x 1,200 pixel resolution in monochrome, and 1,280 x 1,024 pixel resolution with as many as 256 simultaneous colours. The existing IBM 8514/A high-resolution board displays 1,024 x 768 pixel resolution. The new boards will be powered by a Reduced Instruction Set Computer (RISC) processor and a raster-image processor (RIP). The daughterboard's RIP boosts the laser-printing speed of graphics images. (Extracted from PC Week, 13 February 1989)

Fourth generation data base management system

Information Builders will form a separate division to develop, market and support a version of its Focus fourth generation data base management system for IBM's AS/400 computers. The IBM SAA-compliant product will also function as an application development tool for maintaining applications and offering a complete set of reporting and data base management utilities. The AS/400 version will offer Cobol programmers a tenfold productivity boost in applications development. Only 10 per cent of the Cobol coding requirements will be necessary. The new version will greatly help large organizations because users will be able to develop applications on a personal computer using a Focus 4GL personal computer product and move the applications up to the AS/400. (Extracted from MIS Week, 27 March 1989)

Motorola's new chip

Motorola has provided details of its new 68040 chip. The processor's performance will be three times that of comparable 68030s thanks to its extensive use of parallel pipelining. The chip will have full object-code compatibility with 68030 software. The initial 25 MHz version will produce 1.6 cycles/instruction and 15 Mips performance, and a future 33 MHz version could offer up to 24 Mips performance. Users can share memory among multiple processors and other devices. The new chip incorporates its own 80 bit floating-point unit integrated on-chip, which is software compatible with the MC68882 floating-point chip. The chip's Snoop Controller capability monitors the external address bus to detect and flag any information modifications, thereby guaranteeing that other processes running simultaneously employ the updated data. J. Nutt, technical marketing manager for Motorola's microprocessor products unit, anticipates 68040 general sampling by the end of 1989, and production quantities in early 1990. (Extracted from Information World, 3 April 1989)

DEC bids for fibre link lead

Digital Equipment (DEC) is poised to take the lead in supplying semiconductor technology that will link local area networks to a high-speed fibre optic backbone.

DEC has promised that it will supply full details of its chip set, which conforms to the fibre data distributed interface (FDDI) specification set out by the American National Standards Institute, based on a 100 Mbit per second fibre optic cable.

The company plans to license the chip technology to third parties, and is also expected to provide its own products for token ring local area networks (LANs), on which FDDI is based.

The company emphasized it was far from abandoning Ethernet, on which it has based its LAN policies since Ethernet's development in the early 1970s.

If DEC goes ahead with its plans, it will be the first computer vendor with a full FDDI chip set, and only the second company after UK communications group Fibronics with FDDI products.

It incorporates a chip set from Advanced Micro Devices called Supernet in its System Finex.

FDDI offers a high-speed backbone to which any number of LANs can be connected. Its high throughput is especially useful for intensive applications such as high-volume transaction processing and scientific applications. Both these application areas are expected to be DEC's initial targets at existing DEC sites.

According to US research group Dataquest, the FDDI market is estimated at some $500 million today, easily increasing to $1 billion in the next few years.

That represents a huge potential market for DEC from manufacturing, supplying and licensing its FDDI semiconductor technology to third party companies.

DEC's plans have surprised the industry, despite the fact the company said it would develop its own FDDI chip set well over a year ago.

Western Digital, which is in "advanced stages of development" of its own FDDI product, says DEC's plans, if they go through, could prove very important. However, DEC has still to make available a product for end users.

Fibronics is the only company presently offering end-user FDDI systems. (Source: Computer Weekly, 30 March 1989)

Intel reshapes ASIC strategy

US chip giant Intel is quietly revamping its approach to the cut-throat application specific integrated circuit (ASIC) market following the disappointing performance of its ASIC Group.

The company plans to boost sales by putting its most popular chips at the heart of ASIC devices, and announced that its best-selling embedded controller, the 8 bit 80C51, was available in ASIC form.

This means that customers can precisely tailor an embedded controller to their own particular system by incorporating the necessary local memory and glue logic on the same piece of silicon as the processor. Intel will extend this to 16-bit and 32-bit embedded controllers.

This technology could be used to shrink personal computers even more, by cramming most of the

circuitry onto a handful of chips. (Source: Electronics Weekly, 22 February 1989)

Cheap EEPROMs

INTEL announced that flash EEPROM memory chips would be as cheap as DRAMs in 12 months' time, in a move that astounded the industry. Intel said that they would be selling megabit EEPROMs in April at $25 to $50 a time compared to the current $15 for a megabit DRAM, and that they would be matching DRAM prices by 1990.

An Intel spokesman said it would lead to personal computers the size of notebooks. The advantage flash memory has over DRAM is that it retains its memory when the power is switched off. DRAM does not.

Current E2 prices are five or six times DRAM prices. Near price parity would wipe out the DRAM business for applications which are not speed critical. DRAM still retains a speed advantage over E2; that would keep it in use where high speed is required. (Source: Electronics Weekly, 1 March 1989)

Amtex secures Soviet deal

Soviet-made crystals will soon be available in the West thanks to a new deal pulled off by British marketing company, Amtex.

The agreement is one of the first to tap into the benefits of perestroika (restructuring) and gives Amtex the world-wide distribution rights for sapphire, gadolinium gallium garnet and sodium iodide crystals, plates, windows and epitaxial wafer products from the USSR.

The products will have a wide variety of applications in the manufacture of hybrid integrated circuits, magnetic bubble memories, light emitting diodes, and laser components.

Amtex was set up last year by an organization which had been working with Soviet manufacturers in the non-destructive testing field.

Amtex is currently making contacts with potential buyers in Europe, USA and the Far East. (Source: Electronics Weekly, 15 March 1989)

AT&T clears path to form alliance with Italy's Italtel

AT&T, the US telecommunications giant, has cleared nearly all the bureaucratic hurdles in its bid to form a partnership with Italtel, the Italian telecommunications equipment manufacturer.

The company revealed that the prospective partnership would extend to the development and marketing of both public and private telecommunications equipment in Europe and the US.

Details of the structure and scope of the alliance have yet to be finalized, but they are expected to include technical collaboration on new products and the marketing of Italtel's transmission systems in the US. In return the US company will gain another foothold in the European telecommunications market.

It is not clear yet what price the Italian company is paying for access to AT&T's technology and the lucrative US market. It is possible that Italtel will be required to buy a stake in AT&T Network Systems, the joint venture AT&T formed with Philips in 1984.

Philips recently reduced its own stake in the joint venture company which has had only limited success in marketing AT&T's public telephone exchanges in Europe. (Source: Electronics Weekly, 22 February 1989)

Risc technology is challenging for supremacy in the divided PC realm

A standard Unix workstation with 20 Mips processing power, emulation software to run all existing PC applications and with a price tag of less than 5,000 pounds sterling will arrive on the desktop by the early 1990s.

This is the claim made by Risc (reduced instruction set computer) technology company Mips, following its licensing agreements with chip companies NEC and Siemens to manufacture its Risc processors in Japan and Europe.

Mips now has the market power to set a de facto standard for Risc workstations, which will be the successor to the IBM PC. Mips already has more than 60 per cent of the US market. It will ship 120,000 microprocessors this year and the Siemens/NEC deal will put the marketing power behind its chip in Europe and Japan to make Mips a clear world leader.

These large claims rest heavily on the agreement Mips has with DEC. DEC uses the Mips chip in its P/Vax desktop workstation. P/Vax breaks a long tradition for DEC: it runs the Unix operating system rather than the company's proprietary VMS.

Mips will launch what it describes as its own clone of the P/Vax at the Uniforum Unix show in San Francisco, at a price between $10,000 and $20,000. The company has also signed deals with Sony and Sumitomo of Japan and an unnamed European systems company to produce clones too.

The marketing clout of DEC, Sony, Sumiton and the European systems partner will do for disc workstation standards what IBM did for microcomputing standards. The ready supply of Mips Risc chips means other clones will follow.

Sun claims the lead in the Risc workstation market. The machines are based on its Sparc Risc architecture. It can boast licensing agreements with five chip producers, including Texas Instruments, Fujitsu and LSI Logic, to make the chips and a list of more than 100 systems companies with agreements to use the Sparc chip, including ICL.

Indeed Sun has already set out a strategy to be to Risc what IBM is to personal computing. It claims that its vast list of licensees makes Sparc the only truly open Risc architecture.

The Sparc chip can claim higher market acceptance than the Mips chip, but Sparc is not a standard chip - each licensee has taken Sun's instruction set and architecture and come up with its own version of the chip.

Mips agreements with its semiconductor licensees specify production of a standard chip.

Motorola believes that it, too, is creating a standard around its Risc chip, the M88000 launched in April 1988. More than 30 hardware and software companies have signed up for the 88Open Consortium set up by Motorola to promote the use of the chip and development of Unix applications to run on it.

Motorala however has yet to start shipping the M88000.

Intel weighs in too, by launching what it claims will be the world's most powerful Risc chip.

Last week Microsoft took a significant stake in the US Unix software house, Santa Cruz, indicating that the leading PC software company sees an important future for Unix on the deskt

IBM invented Risc and introduced it in the 6150 in 1986.

The rise of Risc has grave implications for IBM PC clone makers: Compaq is weighing up its options on how to follow IBM's PS2 micro. For Apple too the graphics capability of Risc machines poses a threat.

The power that Risc will bring to the desktop also has serious implications for local area network companies. Users will need optical fibre networks to reap the benefit of Risc. LAN specialist Torus is already making headway, with a prototype board for fibre-optic networks.

Risc technology backed by Unix will open the US and European markets to the Japanese. It was the de facto software standard set by the IBM PC, for example, that gave Toshiba the base for building its highly successful laptop business.

Whether or not things turn out as Mips optimistically projects, there is no doubt that Risc-based Unix machines are about to usher in a new era in personal computing. (Source: Computer Weekly, 23 February 1989)

Logic chips

Semiconductor firms are working to extend state-of-the-art logic chips beyond the currently attainable 1 million device level to microchips containing more than a 100 million devices. Most experts agree that a 100 million device chip is at least 10-15 years away. Technology areas that must be addressed to develop such chips include better design test methods, and improved construction materials, chip speed, power (heat) dissipation and power supplies. (Extracted from Semiconductor International, February 1989)

Scaling down logic

Powerful computer systems are physically bulky because their CPUs are built from large numbers of high-speed, low-density bipolar integrated circuits.

Personal computers and workstations are physically compact because their CPUs consist of small numbers of much denser CMOS chips. But the trade off is a relatively sluggish performance compared with bipolar-based machines.

The early 1990s offers the exciting prospect of the best of both worlds - high performance and small size - as machines emerge configured around single-chip bipolar CPUs. Moreover, these devices will employ the ultra-high performance version of bipolar called emitter coupled logic which has so far been confined to the CPUs of mainframes and superminicomputers.

Desktop workstations configured around single chip ECL CPUs will offer similar performance to today's mainframes and superminis, while the same improvements in ECL circuit density that make the single chip CPU a reality will also further boost the performance of bigger systems.

The application areas for ECL are virtually limitless and this has led to the growth over the last decade of a major industry supplying ECL-based application specific integrated circuits (ASICs).

Semi-custom ASICs can be built to the design specified by a systems manufacturer by connecting logic gates on a prefabricated gate array in such a way as to achieve the functionality required. This personalization is achieved by a process called metallization.

Manufacturers of ECL gate arrays are working just as hard at pushing forward density and speed characteristics as companies building CMOS memory chips, microprocessors and ASICs.

A UK company, Plessey Semiconductors, is a world leader with ECL gate array technology. The company's ECL semi-custom marketing manager, Tony King, promises gate arrays with more than 40,000 gates by the early 1990s, enough in his view to construct a complete 32-bit CPU on a single chip.

Plessey's latest ECL gate array offering is the ELA 80000 Series which provides up to 16,000 gates per chip and is the result of a technology exchange agreement with Applied Micro Circuits Corporation (AMCC) of San Diego, California. This company is a high-performance semi-custom chip specialist and offers an identical product to the ELA 80000 under the name, Q20000 Series. So customers have a second source of the technology.

One way of increasing the density of ECL chips is to reduce the size of the emitter part of each transistor on the chip. In the semiconductor industry emitter size is quoted as what is referred to as the drawn emitter width, and on the ELA 80000 this is one micron. By the early 1990s Plessey hopes to be shipping devices with a drawn emitter width of 0.7 micron and this is the level of geometry that will make possible gate counts of 40,000 plus per chip.

Geoff Hannington, design manager for computers and ECL at Plessey, explains that smaller geometries will also increase the speed of ECL devices. The ELA 80000 features a gate delay of 100 picoseconds while 0.7 drawn emitter width devices are expected to push this down to 25 picoseconds.

Bipolar chips in general, including ECL devices, consume a lot more power than CMOS chips and so can pose serious heat dissiptation problems as densities increase. This is why some very high performance CPUs need water cooling. But smaller gate geometries offer the possibility of lower power consumption per gate, so the overall power consumption/heat dissipation per chip should stay the same as the number of gates increases.

Measures taken by Plessey and AMCC to reduce heat dissipation in the ELA 80000 and Q2C000 mean that these devices are the first bipolar arrays to employ a density boosting structure called sea of cells which has so far been confined to CMOS devices.

Cells are small groups of gates and sea of cells eliminates the channels which lie between the rows of cells in older type arrays and which are used to carry signals between cells. Instead the new metallization process that links individual cells when the array is personalized lays down connections on top of the cells. The result can be a doubling in density without interference with the operation of the cells.

Sea of cells arrays can pose problems during the design process because of the restricted amounts of space for routing connections. According to Plessey not much more than 45 per cent of the gates in a typical sea of cells offering can be utilized because of routing problems.

But the architecture adopted by Plessey and AMCC for their array pushes gate utilization all the way up to 95 per cent through features like three levels of metallization.

As chip densities increase, Plessey's strategy is to continue providing its customers with improved devices that can still be air cooled rather than having to be cooled by water or any other type of fluid, and this is going to change the way individual devices are packaged.

Increased density and hence complexity means that the number of pins coming out of a device - the pinout - is likely to increase to around 400/500 for each device and this will also affect packaging.

Packages with pins that go through holes in the PC board, like pin grid arrays, will have to be replaced by surface mounted devices. One type being investigated by Plessey and regarded as offering a lot of potential is the tape automated bonded (TAB), package where the bare chip is transferred from an adhesive tape to the surface of the board with no packaging at all apart from varnish material to protect the surface. King believes that heat dissipation will be a lot easier with these devices.

Designing an ECL ASIC demands close collaboration between supplier and customer.

First the customer has to provide Plessey with a definition of the device required so Plessey can check that this can be met by one of its gate arrays.

Plessey can then carry out the detailed circuit design on behalf of the customer. Alternatively, the customer can opt to handle the job in-house. In this case Plessey can supply the customer with its computer-aided design software called Plessey Design System.

This runs on Digital Equipment Corp. Vax/VMS computers with colour graphics terminals. The design software for the ELA 80000 and Q20000 can also run on Daisy, Mentor and Valid workstations.

Representations of the circuit logic can be generated in schematic or textual form and are converted into a file called the Net List. This is then converted into a form suitable for simulation where the design is fed with inputs akin to those the device will encounter in operation.

The next stage involves the actual physical design of the chip, including the way gates are routed within the array and the definition of pinout and packaging.

When the physical design is complete Plessey makes the photolithographic masks needed to fabricate the device and builds typically 10 fully tested prototypes. After these have been evaluated by the customer Plessey can proceed with full-scale manufacture.

Five masks are needed to personalize ELA 80000 arrays compared with a dozen or so for full custom devices designed from the ground up. Three masks form the metallization layers and another two form the insulation between the metal layers called vias.

The complexity of the 0.7 micron devices Plessey will be building in the early 1990s will demand the use of four metal layers rather than three.

At one time digital chips based on the compound, gallium arsenide, rather than silicon, were thought to have a great future in high performance CPUs. They were seen as a much faster replacement for silicon ECL devices.

These days there is some enthusiasm for digital gallium arsenide mainly because of the expected speed and low power consumption. But Plessey's view is that gallium arsenide devices with comparable numbers of gates to ECL chips still pose some fundamental questions as to their economic manufacturability in volume.

Plessey hopes to increase its position in the ECL array market through its world-wide network of ASIC design and support centres, including a US design and marketing operation at Scotts Valley, California, with 350 people. The US accounts for about 40 per cent of the workd market for ECL ASICs.

Plessey is smaller overall than some of its giant US and Japanese competitors but it stands at number four in the world-wide league of bipolar ASIC suppliers and is also a significant force in the CMOS ASIC arena. (Source: Computer Weekly, 12 January 1989)

Plessey voices world ambitions

British electronics firm Plessey has laid the foundations for a major push into the world digital telecommunications market. In the UK that means rivaling British Telecom and Mercury.

At the official launch of the company's private digital network, Plessey welcomed the recent recommendations by industry watchdog Oftel to deregulate voice communications. It argues that this puts Plessey in a strong position and will start by leasing the service to large UK companies.

Plessey claims it has the most advanced integrated service digital network (ISDN) in Europe. It is a joint venture with service company Hoskyns, which Plessey bought last year, and Canadian firm Telephone Service Bureau

Telephone Service Bureau, which is developing the network management and maintenance systems for the network, won the contract against competition from several European and American firms.

Working with a Canadian company like Telephone Service Bureau offers Plessey further inroads to the North American market; and that factor weighed heavily in the final selection.

However, the network's first links to North America will be to Plessey's semiconductor design centre in California.

The network itself handles voice, data, electronic mail, group IV fax and image simultaneously. It will have 15,000 users once Hoskyns staff are incorporated, and has a capacity to handle over 100,000 users. (Source: Computer Weekly, 16 March 1989)

ICC takes the antifuse a step further

Before the end of the year, a new player in the user-programmable logic and memory market will be arriving on the scene with a highly promising technology. Instant Circuit Corporation of San Diego, California, has developed an innvoative antifuse-based technique that is compatible with all types of processes: CMOS, bipolar, and gallium arsenide. Company founder Bruce Roesner believes the approach will pave the way for a new generation of speedy, high-density VLSI-level memories, logic chips, and gate arrays.

In embracing the antifuse concept, the ICC parts are kin to the programmable gate arrays from Actel Corporation of Sunnyvale, California. An antifuse approach means implementing functions by establishing interconnections at predetermined locations. By contrast, the current crop of bipolar fuse-based technologies, including programmable read-only memories and logic devices, gets programmability by blowing connections between gates to configure a function.

ICC's antifuse technology, for which at least half a dozen patents have been issued, differs radically from Actel's. Actel relies on a proprietary dielectric placed between an n^+ diffusion and polysilicon layer in any CMOS, biCMOS, or bipolar process. ICC, on the other hand, builds its antifuse structure atop a pre-existing substrate and subsequent layers of logic and/or memory. Except for specific contact points, these two layers are separated by an oxide layer in an architecture much like that used in silicon-on-oxide insulator techniques.

When programmed, the memory element is essentially a diode in series with a short circuit. When unprogrammed, it acts as an insulator. As a result, the diode and interconnect structures are less affected by radiation than are active semiconductor transistor and diode structures. Test devices have remained operational even when subjected to as much as 5 Mrads, full dosage.

One indicator of the performance improvements possible with the ICC approach is the first product the company is developing, an 8 K by 8 bit, two level metal CMOS field programmable ROM. The device, to be introduced before the end of the year, is fabricated using conservative 2.0 μm design rules and has a target access time of 35 ns (comparable in speed to similar EPROM based devices fabricated with 1.2 to 1.5 μm design rules). The programming rate is 30 ns/byte. Active power dissipation is 140 mW and standby power is 110 μW. Initial devices will closely approximate the performance specifications of existing parts, even though the technology allows parts that are even faster. (Source: Electronics, March 1989)

IV. APPLICATIONS

Optical devices to be used in expanded devices

Optical devices are being sought by computer makers to bring about expanded capacities and quicker access in storage compared to magnetic techniques. Although practical erasable optical storage devices have started being launched in the past year, optical devices are expected to account for 40 per cent of the data storage market by 1995, according to a study by Mobay (Pittsburgh, PA). The systems, which read data via a laser in such a medium as a compact disk, are becoming reality partly due to such electronic developments as high sampling rates; compact, low-cost, solid-state lasers; accurate servomotors for positioning the heads; and the use of durable materials. The main benefit of optical storage media is its large storage capacity, brought on by the capability to focus a laser on a spot down to one micron. (Extracted from Material Engineering, February 1989)

A PC that can read

Spanish company Ciencia i Tecnologia Aplicada (CTA) of Barcelona, will release the second generation of its Textpert OCR system. According to officials at CTA, the new Textpert is one of the first affordable, high-quality optical character recognition (OCR) systems for PCs.

OCR software for PCs has been around for a few years, but earlier programs could read only a few typefaces and a very limited range of type sizes. They were also error-prone and somewhat difficult to operate. Textpert can read all non-stylized typefaces - in any Indo-European language - between six and 46 points in size. It will also recognize precise hand-lettered manuscripts, though not ordinary handwriting. The program, which requires one megabyte of computer memory, is designed for use with a Macintosh and a standard digital image scanner. In May it will be compatible with an IBM PC. Textpert can read at a rate of 1,500 characters per minute. A full-page typewritten document can be scanned in one to two minutes. Textpert can handle hyphens and other punctuation, read directories, graphics and spread sheets (meaning numbers) and recognize different type fonts on the same page, and it can be trained to read unusual type styles. Once trained, it will read different sizes of that style automatically. The program's error rate - when used with original, uncreased documents in good condition - is said to be less than .05 per cent.

There are many potential applications. In desktop publishing, OCR systems can be used to enter original documents and graphics into a computer for editing and reprinting. It might also become a boon to legal and financial companies, libraries and archives, which instead of employing armies of key punchers to enter and manage large volumes of data, could scan pages of information rapidly for storage on optical disks. Six years ago a team from Oxford University Press began the Herculean task of transferring the six volume second edition of the Oxford English Dictionary into computerized files. It was not feasible to use OCR for the task because, at that time, the systems could not pick up the multitude of fonts in the dictionary. As a result, it took 150 clerks 18 months to key punch all the information into computers. Today, with improved

OCR, the task would take half as long. It is estimated that the world wide market for OCR software will grow from $10 million in 1988 to some $25 million in 1992.

CTA, which was founded by three young Spaniards, has distributors throughout Europe and in the United States. (Source: Newsweek, 10 April 1989)

Virus- and tamper-proof PC

American Computer Security Industries (ACSI) (Nashville, TN) has unveiled a new 12-MHz 80286-based personal computer that is fully virus- and tamper-proof. Designed for use in any office environment, the new Immune System features a secure kernel, which prevents changes to the computer's DOS and basic input/output system (BIOS). Other features include 1 Mbyte of memory, a formatted 40-Mbyte hard disk, a 1.2-Mbyte 5.25-in floppy disk, 2 RS232C serial ports, a parallel port, DOS, and GWBASIC. (Extracted from PC Week, 13 February 1989)

Ethereal networking without wires

Hardwiring computers, printers and other terminal devices into a local area network has many advantages over wireless systems: the wires let the devices communicate at high speed (10 megabits per second for Ethernet) and are relatively immune to interference. But wiring also has disadvantages: it is expensive to install and inconvenient to alter.

A wireless system, on the other hand, in which terminals broadcast data to one another through the air, could be portable and so easy to install that one could be set up even for a short-term project or conference. But the kinds designed so far suffer from multipath interference from two or more paths of transmission and reflection. They are also vulnerable to fading, as people walk between transmitters and receivers. To cope with these drawbacks, wireless systems have had to be several orders of magnitude slower than wired systems - 10 to 20 kilobits per second.

These problems have been addressed in a new wireless system designed by Jack H. Winters, member of the technical staff at AT&T Bell Laboratories, Holmdel, NJ, and Anthony S. Acampora, director of the Center for Telecommunication Research at Columbia University, New York City. Winters and Acampora received US patent 4 789 983 for their idea on 6 December 1988.

The Bell Laboratories wireless network matches Ethernet's hardwired transmission rate of 10 Mb/s. It has a central base station that polls each remote terminal in turn, to see if any of them has any data to transmit.

To minimize multipath signal distortion, the base station has four receiving dipoles spaced one quarter wavelength apart (8 centimetres at a microwave frequency of 900 megahertz). The controller at the base station picks out and processes the least distorted signal.

Each user's terminal is equipped with only one dipole, but the transmitting antenna at the base station can be any one of the four, to guarantee best reception at the terminal. If interference between the base station and one user becomes particularly bad, the bit rate between the two can be temporarily lowered without significantly altering the network's throughput.

Computer simulations, along with low speed tests of a wireless private branch exchange network, indicate that the probability that a link might fail would be lower than 10^{-6} about as reliable as a wired system, Winters said. A high speed system has not yet been built, and he declined to comment on what plans AT&T might have for commercializing the network. (Source: Spectrum, April 1989)

CTRON as standard operating system

Nippon Telegraph & Telephone (Japan) may succeed in establishing CTRON as the standard operating system for the switching equipment sold to NTT. NTT has taken control of the CTRON project, which is an offshoot of the TRON (Real time Operating System Nuclear). TRON is a national Japanese project intended to develop an original computer operating system. NTT, a $45 billion network operator, intends to develop CTRON subsets for such machines as exchange switches and PBXs. CTRON was originally intended for running large machines but, by taking control of the CTRON project, NTT risks getting expelled from the project as its goals for CTRON are not aligned with those of TRON's founder, K. Sakamura, according to some observers. (Extracted from Communications Weekly, 13 February 1989)

New educational tool

Digital Video Interactive (DVI) combines audio, video and graphics into an interactive whole, stored on CD-ROM and accessible via personal computer, that gives the user a window into a distinct world. Bank St. College of Education (New York, NY) has created a DVI of a Mayan ruin in which the student (target ages: 8-14 years) can explore the ruins, the surrounding rain forest and a "museum" that exists only on the optical disc. Pulling the data, programming and creativity together will call for combinations of specialities that have not hitherto merged their efforts, but those who do it may catch the next round of serious personal electronics money making. (Extracted from Electronics, February 1989)

Expert systems as time savers

Expert systems for engineering are finding their way into industrial practice as time savers, irrespectively of whether they actually attain their theoretical goal of mimicry of thought processes of experts. 3M's KLUE (Knowledge Legacy of the Unavailable Expert) applies a stepwise decision graph structure to bring the benefit of the experts widely dispersed in the corporation to any production problem. TLT Babcock (Akron, OH) has cut design engineering time for one proposal from nearly 8 hours to under 30 minutes with the Concept Modeller from Wisdom Systems (Chagrin Falls, OH). GE Aircraft Engines (Lynn, MA) uses ICAD System from ICAD (Cambridge, MA) to let design engineers exploit, in the design of turbine blades, commonalities with compressor blades. (Extracted from Design News, 27 February 1989)

Received with thanks

When one supplier alone sends you 40 Mbytes worth of invoices a week you give thanks for electronic data interchange.

Without EDI - the process of sending information in a standard format from computer to computer - high street stores would have to rekey the suppliers' invoices, along with those from every other company it deals with.

That soon adds up in terms of time, and money. Ron Morrell, Boots' project manager for retail accounting systems, says that one supplier's use of electronic invoicing, as opposed to paper methods, saves between one and four staff.

It also cuts down on rekeying errors. For example, Philips Components saves 5 pounds on each order by implementing EDI throughout its entire ordering, delivery and invoice cycle.

Such savings are the result of fewer processing errors, tighter inventory control, a reduction in staff and time and the removal of geographic barriers. In theory, at least, businesses become more efficient.

In the UK, EDI is undoubtedly a success story, with most large firms showing some degree of involvement and, therefore, by the very nature of EDI, sweeping up their suppliers and customers as they proceed.

Take-up started in the 1970s and around 2,000 UK companies are using EDI systems accounting for 70 per cent of the European activity in the area. According to the Yankee Group, the UK EDI market stands at about 100 million pounds a year.

The majority are linked with the Article Numbering Association's (ANA) retail and distribution initiative. The ANA played a large part in the UK's early adoption of EDI. In its principal role of administrating the international article numbering and bar coding initiative, it was responsible for putting together its own standard for EDI, called Tradacoms.

This is used by more than 1,500 firms in the UK, around 1,000 of them sending invoices and orders over networks. The rest use electronic media, either disc or tape.

The leading suppliers of EDI network services are IBM, Istel with Edict, and ICL and GE Information Services via their joint company, INS.

INS is the approved supplier of Tradanet, the ANA's network, until 1990, and consequently gets much of its business from that area.

John Jenkins, INS's marketing director, says the service has around 1,100 contracted subscribers in the UK, and another 3,800 in the rest of the world which can be accessed via GE's international network. Around 800,000 documents are sent over the network each month, with volumes doubling every six months.

In its recent study, EDI for competitive advantage, UK consultancy Langton looked at a range of companies and concluded that "EDI has evolved as a cross-industry phenomenon".

EDI is not without its government champions, both in the UK and Europe. The Department of Trade and Industry set up Vanguard in 1986, in conjunction with British Telecom, INS, Istel and Midland Bank, to promote general awareness of EDI.

More recently the European Commission has called for proposals for its own project to promote the use of standards.

As with every other area of computing, standards are a key issue for EDI users. In the UK most use the ANA's Tradacoms, although the motor community has its own, Odette. Still more use proprietary formats.

The problem is further exacerbated by the international situation. In the US, the leader of the EDI world, companies use proprietary formats of an Ansi standard, X.12.

With the prospect of an EDI equivalent of the Tower of Babel, the International Standards Organisation responded with Electronic Data Interchange for Administration, Commerce and Transport, or Edifact.

The standards scene is further complicated by the X.400 electronic mail open system interconnection (OSI) standard.

Edifact is intended to supersede various other "standards" world wide. But while the concept is ideal - with its promise of universal compatibility for EDI uses - in practice the majority of users are keen to protect their investment in their existing formats.

The solution, in the UK at least, is a peaceful coexistence. Tradacoms is by far and away the best popular standard for domestic trade - and around 9 per cent of EDI is contained within the UK. But at the same time the Tradacoms standards group has an "effective" relationship with the promoters of Edifact.

It seems likely that in the future users will continue to use Tradacoms for domestic transactions, but adopt Edifact for international communications.

For now though the emphasis is on the importance of adopting EDI, whichever standard you choose. (Source: Computer Weekly, 16 March 1989)

New version of the time clock

Honeywell Bull (Canada) is using its new CP8 smart card to regulate entry to offices at its corporate headquarters in North York. CP8 incorporates a computer chip and memory to store secure data. It also has a distinct data base for each cardholder to indicate which areas may be entered, valid dates and the periods during which access is permitted. Memory capacities of 1 8 Kbytes are offered. Permanent record and erasable configurations are available. (Extracted from Computer Data, February 1989)

Supercomputers used to accelerate drug development

Proteus Bio-technology (Marple, UK) has introduced its Bio-engine system that employs supercomputers to accelerate the development of many drugs. The new computer system also gets rid of much of the guesswork involved in the drug development process. Chemists use computer codes to find out the molecular shape of a drug from its chemical structure. Chemists will be able to develop drugs on screen, changing the structure and form to obtain the appropriate level of interaction with target compounds. (Extracted from Research and Development, January 1989)

New electronic notepad

Microtouch Systems' (Woburn, MA) new Screenwriter electronic notepad (used with a flat panel display) allows users to input handwritten information directly into their personal computers.

The device is aimed at developers working on next-generation keyboardless computer systems. Screenwriter's screen sensor boasts a resolution of 2,048-x-2,046-pixels. The controller digitizes more than 100 points per second. (Extracted from Information World, 23 January 1989)

Use of computers in dentistry

Computers can be used to create dental prosthetics. CAD/CAM could provide the tools needed to speed the production of dental crowns, bridges and inlays. Some European dentists already use such systems, but the technology has not yet been approved for use by FDA. The technique eliminates the need for impressions. R.J. Caudill of the University of Alabama (Tuscaloosa) say computers will shift dentistry from being an art to being a numerical-based science. Lost wax-casting now used (virtually unchanged for hundreds of years) requires two visits and anaesthetics. Key to the computer technology is an optical probe that can map the tooth surface in three dimensions.

D. Rekow of the University of Minnesota School of Dentistry (Minneapolis) uses a stereophotogrametric probe that transmits the surface data to a high-precision milling machine that makes the crown. A probe, designed in France, uses a bundle of optical fibres and lasers to map the tooth surface based on light diffraction patterns. This system is close to marketing by the French firm Hennson International. The Minnesota system, which uses photographs taken from two angles, may provide better resolution, however. This brings up the debate about how accurate is accurate enough. J.D. Preston of the University of Southern California says there is little scientific basis for claims that gaps between the crown and tooth base must not be more than 50 microns. The Hennson system leaves gaps of 0-300 microns, with an average of 120 microns. Rekow says this is unacceptable. It may be that existing materials will limit the accuracy possible no matter how accurate the CAD/CAM systems become. The economics of the CAD/CAM system may limit its use at first. The systems will cost $150,000 initially, making them affordable only for dentists who do a high volume of business in crowns. However, as costs come down, the CAD/CAM may save dentists the $70-100,000 laboratory fee for each crown. CAD/CAM systems might have further applications, such as planning orthodontic strategies, keeping records and educating dentists. (Extracted from Science News, 10 December 1988)

Risc chips success

The latest word on the lips of chip architects is Risc. If you are not building or enhancing a reduced instruction-set computer system, then you are out in the cold at computer designers' cocktail parties.

But for all their promised benefits, are they easier to program?

The old, or at least established, architecture is the complex instruction-set computer (Cisc) such as the Intel 8008, which was used in the first IBM PCs, or the Motorola 68000. But rival Risc chips are on the increase, though they are new enough for programmers in systems and software houses to still be working on how best to use them.

The appearance of new Risc chips has been marked in recent weeks with the two industry heavyweights pitching in, in their own ways. Intel at the start of the month launched its 64-bit i860. Almost simultaneously Motorola announced the Software Initiative Organisation, involving 26 independent software houses.

Under that initiative, the companies are putting a range of program, from compilers to word processing packages, on the Motorola 88000 Risc chip launched almost exactly a year ago. They all plan to have the products out by the end of this year.

For porting software in high-level languages, moving onto Risc chips makes no difference, says Robin Schlee, group chief operating officer at UK Unix software house Unisoft.

For porting compilers and similar software which relies on assembler-level coding, it is a different story. But the answer is not as simple as just learning to get by without the complex instructions available on Cisc chips.

Unisoft ported Unix System V version 3.2 onto the Motorola 88000.

Tim Clarke, technical director, explains the use of an artist's word like elegance in the distinctly unromantic context of kernel code porting. The key to it is the availability of addressing modes and of registers on the chip itself for different instructions.

"Any instruction on any chip has got several attributes, so there is a basic operation it carries out, such as adding two numbers. But then there might be lots of other ways it can do that under different addressing modes. It might add the numbers immediately; or add them to another memory location on the chip," he says.

A much-used metaphor is of trying to shift prisoners round in a jail: the cells are the memory registers, the prisoners are the data, the wardens and their varying range of keys are the instructions. You, the user, are the chief warden whom you instruct to get you a certain prisoner. How they manage to get him from the cells, while making sure no one else is set free by mistake or doubled up with someone unsuitable, is somebody else's problem. That is, the porting programmer's problem.

"The Intel 8086, for example, has an enormous number of instructions where you have to use a particular register for some operation. The result then appears in another register," Clarke says. That creates restrictions on putting the new code on the chip and it had to be examined carefully to see whether there might be a knock-on effect.

"Elegance is where every instruction supports every instruction mode. That's the epitome of elegance. In the 88000 every instruction can use every mode, and can use any register. On the 8086 you have to put data in one place depending on the mode ... there are ifs and buts. Ifs and buts are inelegant." (Source: Computer Weekly, 23 March 1989)

S-RAMs launched by Sematech

Sematech (Austin, TX) has launched its first batch of memory chips, static random access memories (S-RAMS), etched onto silicon wafers. They are used in the fastest computers as a scratch-pad memory to temporarily store program and data. The chips, based on circuit dimensions of 1 micron, store 64 Kbit of

data. Seratech, formed to help the US semiconductor industry compete with that of Japan, will invest $200 million/year for five years to develop new chip processes. (Extracted from New York Times, 31 March 1989)

The advantages of parallel processing

Small-disk arrays could completely change the way the computer industry builds mass data storage. Parallel processing of arrays on Winchester-level disks has been applied all the way up to supercomputers. For the same investment, a RAID (Redundant Array of Inexpensive Disks) assembly of 100 small disks beat one large disk for capacity, data rate, I/O rate, power drain, cost/MByte, mean time between failure and space required - by factors ranging from 1.33 to 27.33 - in tests carried out at the University of California (Berkeley). Challenges come at two extremes of operation: fast transfers of large blocks of data, though not very many transfers per unit time, for supercomputer and other computation-intensive uses; and transfer of a high number of relatively short data blocks per unit time, as in high volume transaction processing.

Industry observers suspect the first wave of RAIDS will be produced in-house by large system houses and computer manufacturers for their own purposes. It is not yet clear if suppliers should plan to upgrade to disk array provision themselves, or let their customers add this element of value. (Extracted from Electronics, February 1989)

Parallel processing non-determinism

Non-determinism in computing is one price users will pay for parallel processing, according to computer researcher J.L. Gustafson of Sandia National Laboratories. Adding up floating point numbers in different orders, for example, will give slightly different results because of rounding errors. Different strategies of parallel programming will thus give different outputs for the same input. Users must accept getting slightly different answers each time an application runs, or even a failure to run, as parallel processing takes off in the 1990s. (Extracted from High Performance Systems, February 1989)

Keyboard replacement

Presentation Electronics (Sacramento, CA) has announced a 23-key remote device that can replace a computer keyboard. The device looks like a TV remote control. Three function keys give the product 60 virtual keys and each can represent either an individual keystroke or a series of as many as 78 characters. A receiver plugs into the computer's keyboard port, and the remote system communicates by IR up to 35 ft. Presentations are the intended application, but the hand-held device could also be used by academics or the physically challenged. (Extracted from Design News, 13 March 1989)

Programmable mouse

Prohance Technologies (Los Altos, CA) has developed a programmable mouse. The 40-key Powermouse 100 is compatible with IBM PC, XT, AT, PS/2, and compatibles and offers pre programmed definition tables for Lotus 1-2-3. Numeric data entry, function keys, and intricate programming statements may be pre programmed. Commands employed often - such as copy, erase, and format commands - may be carried out from the mouse without the operator having to move back and forth between the keyboard and the mouse. The device is Microsoft mouse-compatible. (Source: Information World, 3 April 1989)

I get the music in me

Musical instruments started acoustic, were electrified in the 1950s and synthesized in the 1970s, and now computers can compose and play music. The next technological leap in musical instruments may be your body.

An electronic system called Biomuse, developed by a pair of scientists at Stanford University in California, detects electric signals generated by muscles or brain activity, and uses them as control commands for electronic instruments.

Biomuse has eight channels, one for voice input by microphone and seven for input from the musician's body. A headband includes four electrode pairs, two for electroencephalograms (EEGs), which record electric brain waves, and two for electro-oculograms (EOGs), which track eye movement. The other three electrode pairs are for electromyograms (EMGs), which pick up muscle activity.

The heart of Biomuse is a TMS320C25 digital signal processing chip from Texas Instruments Inc., Dallas, Texas, which extracts certain aspects of a signal - for instance a particular amplitude of frequency.

For example, the chip performs a fast Fourier transform on EEG signals to detect the 10-hertz component of brain activity; this is an alpha wave, which can be created by closing your eyes, or "thinking black," said R. Benjamin Knapp, the electronic engineer who built the system. His partner, Hugh S. Lusted, a medical researcher, said turning alpha waves on and off can be used as a switch, commanding a shift from a trumpet to a violin sound, for instance.

Eye movement can be made to correlate with step functions. For example, looking to the left towards the EOG electrode might cause volume to be increased, looking away could signal a decrease. EMG signals are usually processed to extract voltage levels. When a muscle is flexed, a low voltage could correspond to a low note, and successively higher voltages to successively higher notes. The rate at which a muscle is tensed can determine whether discrete notes or a smooth run up the scale is produced.

The system can be used with any electronic instrument that uses the standard Musical Instrument Digital Interface (MIDI); it also has an IEEE RS 232 interface port to plug in to personal computers.

The inventors say they now have a prototype with the new TI chip in it, and that the Biomuse will soon be licensed by Stanford to a manufacturer.

And what does it sound like? "You can either use it as a controller for standard compositions," said Lusted, "or you can make really weird avant-garde listen to-muscles music". (Source: Spectrum, January 1989)

New rewritable optical disc sub-system

Hitachi America Computer Division (San Bruno, California) has unveiled a rewritable optical disc

sub-system for massive dynamic information storage needs. The system consists of a 5.25-in. rewritable optical disk and a formatter/controller. The OD112-1 optical disk has applications in high-end image processing workstations, in mainframe storage systems, and as a network file server. It stores 644 Mbytes of user information. The average access time is 75-ms, while data transfer rate is 925 Kbytes per second. The OF112S formatter/ controller has a SCSI interface and offers a 1.5-Mbps data transfer rate, a read-after-write feature, and a polarity switchover time of 1-ms. The device records 16,000 tracks per inch, has a linear recording density of 24,000 bits per inch, and a continuous-tracking servo technique. Two optical-library configurations of the drive will be sold. The OL112-11 can store 15 Gbytes of information with 24 optical disc cartridges, and the OL112-12 stores 30 Gbytes, with 48 optical disc cartridges. (Extracted from Information World, 6 March 1989)

Finite element analysis

Availability of finite element analysis (FEA) on personal computers has major impact on design engineering. When first introduced, FEA was restricted to large mainframes because only those machines could do the many simultaneous-equation solutions FEA requires. This in turn limited FEA to those mega-projects that could justify large-mainframe machine time. Today, however, PCs using an 80386 processor and multi-megabyte memories can handle FEA. This permits just about any design engineer to reduce product cycle times and bring new products to market much faster and cheaper. (Extracted from Design News, 27 February 1989)

New desktop conferencing system

AT&T Bell Laboratories has developed a prototype integrated desktop/conferencing system, as part of its efforts to merge office paper- and electronics-related operations. In the Rapport program, AT&T is merging telephone, facsimile and personal computer technology into a workstation that would be connected to the outside world via ISDN. The firm has a demonstration system that features Unix-based Sun workstations linked via Ethernet and a voice network. The system's "conference server" is capable of providing "virtual meeting rooms". On the screen of a system display, one might see a photograph of someone taking part in a conference, a shared "chalkboard", a telephone dialer and keyboard, and an in-the-background document available for editing by conference or meeting participants. (Extracted from MIS Week, 20 February 1989)

Computerized trouble-shooter for electronic components in cars

A microcomputer-based diagnostic tool for rapid trouble-shooting in automotive electronic systems has been developed by Per Henrik Persson of Autodiagnos, a Stockholm-based company. The device, dubbed Multi-Tester, makes it possible to do a complete check-out of all input and output signals in, for instance, the ignition and brake systems while on the road.

The operator is guided by instructions on the display. When an error is revealed, the tester beeps and shows the error-message on the display. Even very difficult intermittent errors are easily found and stored, the company claims.

By changing a memory unit it is possible to include newly installed electronic systems on the checklist. It is also possible to choose the language. English, French, German and Swedish are standard and other languages are available on request.

The Multi-Tester weighs 600 grammes and measures 126x202x50 mm. It is connected via a special adaptor between the cable harness and the control unit in the car and uses power from the battery or the cigarette lighter. The display has a push-button keyboard of membrane type. The microprocessor is crystal-controlled. The new device has an extremely fast trouble-shooting capacity, according to Autodiagnos. A complete test does not take more than 15 seconds, while a mechanic may take hours to do a manual diagnosis. (Source: Swedish International Press, 1989)

Digital implant awakens sound in deaf ears

Researchers at the University of Antwerp in Belgium have developed a versatile device that will enable people suffering from total deafness of the inner ear to hear. The instrument, named Laura - an acronym of the names of the research units involved in the project - electronically stimulates groups of the 32,000 nerve cells that send messages to the brain from the cochlea, or inner ear. Unlike a conventional hearing aid, which amplifies and delivers sound down the ear canal, Laura involves 16 tiny silicon-platinum electrodes, each 20 micrometres thick, implanted into the cochlea.

A programmable speech processor, the size of a personal stereo, analyses sound from outside the ear and converts it into digital code which is carried down a wire to a radio transmitter in an ear plug. The data then travel by a radio link which connects, through the skin, to a custom-made circular chip. This chip is 22 millimetres in diameter and packed in titanium to protect it from corrosion by body fluids.

A surgeon implants the chip in its package into the mastoid bone, behind the ear. It receives and decodes the radio signal and relays it, via a cable through the bone, to the electrodes in the cochlea.

The surgeon can obtain a rough idea of the number of nerve cells that are still functioning, by injecting a current into the outer wall of the cochlea before surgery. If some nerve cells are working, the patients will hear a noise. What the patient hears after surgery is a crude approximation to the real sound, rather like an artifical voice generated by computer.

The chip in the mastoid bone can also send information back to the surgeon from the electrodes. It relays this information back, by radio link, to a personal computer in the laboratory which is linked to an oscilloscope. By monitoring this feedback signal, the surgeon can check the status of the internal electronics. If these are working properly, any deficiency in the patient's hearing must be due to the degeneration of the wearer's own nerve fibres.

Once the electrodes are in place, the surgeon can control the stimulation of specific channels by modifying the software in the speech processor. This has full control over the chip in the wearer's mastoid bone, and sends it coded data to alter the current which the chip passes through to the

electrodes. Hard-wired devices can monitor the electrodes in a similar way, but surgeons must replace the entire chip if it needs any modification.

Stefan Peeters, Laura's chief electronic engineer, believes that users will be able to graduate within a year from "closed speech" - with a limited vocabulary of recognisable words - to an average vocabulary, provided that they use Laura and receive treatment from a speech therapist at the same time. Already, Laura has helped people who have been profoundly deaf for 30 years to converse - even on the telephone.

Several devices that use implants in the cochlea are on the market: all stimulate nerve fibres in the cochlea. Some complex implants cost at least 10,000 pounds each. Laura should cost around 5,000 pounds, once the surgeons find a cheaper alternative to the titanium packaging. (This first appeared in New Scientist, London, 11 February 1989, the weekly review of science and technology)

BiCMOS: still an underachiever

BiCMOS was the hot topic of the 1989 ISSCC.

The general conclusion was that BiCMOS should be good in theory but it has not delivered the goods in practice. "If BiCMOS is really that good," asked Professor Mark Horowitz of Stanford University at the workshop, "why hasn't everyone done it?" The advantages he listed as:

- Improved drive, good sensing.
- Capacitors in ECL.
- Switches in ECL.

Horowitz has no doubt the fault was firmly placed on the conversation of chip designers.

"Rather than look on the world as a CMOS world and wonder where to add bipolar", said Horowitz, "designers should look at the world as an ECL world and add MOS devices". He argued that the major BiCMOS design trade-offs should not be between speed and power and area but should be between speed/power/area, on the one hand, and design time on the other.

The moderator of the evening panel session on BiCMOS, Charles Erdelyi, of IBM's General Technology Division, agreed that the improved drive capability of bipolar transistors was the main advantage of putting bipolar on CMOS chips. The main disadvantages were the extra process steps which doing that entailed. Those extra steps cost between 1.2 and 1.4 times more than straight CMOS, said Erdelyi.

The other problems of BiCMOS, he added, are reduced freedom to optimize device characteristics; different scalability of bipolar and CMOS, and incompatible signal levels. BiCMOS products are more the exception than the rule and one wonders why. One explanation might be that the needs of the market can be met with CMOS and bipolar technologies separately and the applications do not overlap enough to warrant the combination technology. If this is true, BiCMOS will only become the technology of the future through the invention of new and uniquely valuable circuits that capitalize on the combination. (Source: Electronics Weekly, 22 February 1989)

A college project gets processors talking

A research project presently taking place at City University is seeking to extend the power of computers.

At first sight the idea seems familiar. It uses several microprocessors working simultaneously to produce a much faster computer. It uses standard microprocessors, not Transputers.

But the clever parts of the system are the way in which the processors can talk to each other, using custom ASICs, and the operation system, which to the user looks exactly like Unix.

The technique evolved by the research team, Professor Peter Osmon, Unix specialist Gerry O'Nions, and hardware/software expert Philip Winterbottom, means that if two processors need to talk to each other via intervening processors, these intervening nodes do not need to interrupt their normal operation.

Winterbottom's operating system is truly distributed - this means that processors do not have to wait in a queue for operating system functions, because the majority of these functions are provided individually for each processor.

The basic building block of the system is a stack of chips interconnected vertically by Dowty's Chiprack system. At the top of the stack are eight RAM chips, followed, in descending order by ROM, glue logic, the processor, a diagnostic chip, then the two ASICs which communicate with other stacks, or nodes as the team calls them.

Each node is then mounted on a PCB with a square mesh of interconnections, giving each node four communication ports.

When one node needs to talk to another, the two ASICs come into action, creating a path between nodes. Data transmission is done in 8-bit parallel fashion, allowing much faster message passing than, for instance, a Transputer-based system which uses serial communication. Winterbottom says that the interface is also flexible, because it is not tied to any particular processor, and can work on any protocol.

Because of this method of interconnection, and because the operating system is implemented locally, it is possible to expand the system by adding extra nodes, and by plugging boards together.

But this modularity has other implications. When one node fails, all of the others can happily continue working.

Winterbottom sees applications in fast graphics environments, and points out the possibility of providing a "diskless workstation". The vision also includes a data base with a distributed index.

Future work, he says, could involve creating a kind of three-dimensional mesh by adding optical communications interfaces at higher levels on each node, rather like shining a light across a street from one office block to another. Work on such ideas is at present in progress at Cambridge University. (Source: Electronics Weekly, 22 February 1989)

Standard cells

The speed-at-any-cost GaAs device business has turned decidedly towards pursuing a mainstream market, especially the established, larger, but slower-speed ECL market. This field has established standard electrical interfaces and a design and packaging infrastructure centred around ECL speed performance. The GaAs logic market is not so established with standards and a design infrastructure, and has much smaller sales.

Vitesse Semiconductor (Camarillo, California) has more than doubled the gate-count for GaAs and ECL ASICs. With a comprehensive line of GaAs standard cells encompassing up to 22,000 gates per device, Vitesse is attacking the lucrative ECL logic market. Its formula is to match ECL speed and prices, but at much lower power and higher density.

As part of the trend to compete in silicon-based markets, last year, Gazelle Semiconductor (Santa Clara, California) offered a high-speed factory-programme version of the 22V10 PLD with TTL pinout specifications. And other GaAs specialists such as Gigabit Logic are running their processes to be more directly competitive with silicon devices. A key element in the trend is to take advantage of silicon fabrication processes by adapting GaAs to them, gaining yield and cost improvements.

However, Vitesse appears to be the first to bring the cost of GaAs digital circuits down to that of ECL. The programme was begun in late 1987 when Vitesse made a pact with VLSI Technology, getting use of the latter's design tools for developing a large GaAs standard cell family that both companies could use.

GaAs is essentially unchallenged as the process to fabricate communications discretes. But in the arena of highest speed ICs, annual sales have grown to a mere $50 million, while the ECL-ASIC gate array sales were about 15 times that amount last year. Projections used by Vitesse indicate that amount will grow to about $1.5 billion in 1991. Some of the major players are Fujitsu, Motorola, AMD, National Semiconductor and AMCC.

Some 40 per cent of users of highest-performance CMOS gate arrays will soon begin using GaAs ASICs in some of their designs, thereby competing with the likes of Cypress, Performance, LSI Logic, IDT, AMCC and Plessey.

But so far GaAs has not lived up to its projections for logic. The conventional wisdom considers GaAs a niche technology with an important role but small future market. But the new Vitesse offerings are intended to make GaAs competitive in logic, at price, power and speed ratings that are aimed directly at the ECL user. The company has trimmed GaAs back in speed to only twice that of ECL, and use less than a fourth of the power dissipation. The strategy is to shrink ECL-based high-speed systems and "put a Cray on a desk".

Out of several circuit topologies possible to form logic gates for digital GaAs ICs, Vitesse chose direct coupled FET logic (DCFL). It requires both enhancement and depletion mode transistors.

The ECL NOR gate requires six transistors and three resistors, as well as several voltage references that set current or provide the reference voltage to the transistor pair in the differential switch. Resistors seem simple on such a diagram, but they add significant processing difficulties.

The majority of the power dissipation in the ECL circuit is in the emitter follower used to drive succeeding loads and interconnect capacitance. The DCFL NOR gate is simpler, in schematic and in the devices that compose the schematic. It uses only three transistors and no resistors. A depletion mode MESFET current source is an active load pull-up. The two enhancement switches are pull-down switches. The power drain is constant, with the pull-up current at the output of each gate being sinked by a majority carrier Schottky diode at the input of each subsequent enhancement device. Within each gate, the current is therefore taken by either or both of the enhancement devices, or allowed to flow from the output to the diode-clamped input of a next stage, or stages. The voltage swing is therefore only about 500 mV, necessary to overcome the diode knee, and the current drain of each gate is constant, determined by the depletion mode current pull-up generator.

Because of the constant current, self-generated noise on the signal and power line is negligible, reducing the need for large noise margins or fancy power line filtering.

But the major improvement that this technology brings to the high-performance arena is reduced power dissipation. By operating from a single - 2V power supply, Vitesse claims speed comparable to that of ECL circuits, with only a fourth of the power. The implications for circuits with VLSI gate densities are profound. Water cooling can be eliminated for devices with 10,000 to 20,000 gates, operating at 500 MHz to 1 GHz data rates, but consuming only 5 to 10 W. (Source: Electronics Weekly, 22 February 1989)

New IBM disk product

Several IBM competitors are saying mainframe users should expect an announcement of IBM's next large disk sub-system generation as early as the second quarter, with general availability as early as the first quarter in 1990. The new direct access storage device, which is being called the 3390, is expected to feature several major technical changes, including smaller disks, an expanded track length, and support for fixed block architecture. The changes are seen as positioning the so called 3390 to be a part of IBM's System Managed Storage push. The 3390 is expected to use disks of about 10 inches in diameter, thin film heads, and advanced particulate media offering the storage equivalent of a current 3380 Model K, or 1.89 GB, on each actuator. IBM is then expected to use an array of actuators to achieve total storage of between 15 GB and 20 GB per box. While the new track lengths and fixed-block architecture support will mean a conversion for 3380 users, many expect that initially the 3390 will be available running in a compatibility mode as well as a higher performance native mode. (Reprinted with permission of DATAMATION[f] magazine[C], 1.1.89, copyright by Technical Publishing Company, A. Dunn and Bradstreet Company all rights reserved)

ASIC tests cause big headaches

At last the ASIC business is doing what its champions have predicted for over a decade outpacing the growth of the total semiconductor

market. But in developing those devices and getting them into production there are big headaches - especially in testing.

ASICs have become a fundamental driving force within the electronics and semiconductor industries, but not in a traditional way. It is a new type of revolution, in engineering methodology and tools.

ASIC devices are accelerating their penetration of the IC business, significantly fuelled by the parallel emergence and wide availability of powerful and economical ASIC design tools. ASICs spotlighted the possibilities. Design tools are making it happen.

But much is still lacking on the tool front. Integrating the design of devices with the development of their testing is one of the critical gaps in this revolution of engineering methods. Filling it requires several disciplines and therefore a number of differing hardware and software vendors to address it.

Progress in system design is now so dependent on ASICs that very few, if any, computing, control, test, measurement or consumer systems can be made to be competitive without them. ASICs are no longer just gathering random logic or analog functions to reduce the count of packages in a system. They house the essential competitive heart of many new systems.

However, ASICs achieving this level of importance does not mean all is rosy, for the process of designing and verifying ASICs, getting them into production, and supporting them in the field is still fragmented and full of costly hurdles.

Getting the entire ASIC development process together tightly is necessary for realizing the potential of the ASIC concept. ASICs are integrating systems. But the means of designing and making ASICs are not adequately integrated.

With ASICs so important, it follows that filling the ASIC gaps will touch on every aspect of the engineering profession. It challenges the weak links in engineering practices, requires efficient management of teams of specialists and effective co-operation among teams of differing specialities in different divisions or separate companies. It challenges hardware and software technologies, and the ability of marketing and business experts to create new engineering environments that implement a broader, highly integrated and more effective order of system design.

It is possible to diagram the ideal flow of development from system specification to field support, but there are still big gaps in organization, technologies and resources. One of these gaps is still the link between device design and their production testing.

When the streamlining of this process is achieved, it will not only save development time and costs but leave more creative time for engineers. And having efficient and effective commonly accepted methods carried out independently by competent individual practitioners is what makes it a profession, rather than a job.

The issues in integrating design and test of ASIC devices are: time-to-market; device and system complexities; and the networking of companies, products and teams of experts.

Buried in these issues are: the changing role of the test engineer, expensive production testers, the challenges of in-circuit testing, on-chip test supporting resources, the bulk of ASIC design activity moving rapidly into the system houses, the formation of new companies and business units to address the gaps in the design flow.

The primary issue is time-to-market. Designs not only must pass the foundry tests on their first fabrication, but do their job when first inserted in their target systems.

Although ASIC producers crow about very nearly always meeting design specifications on the first pass, experts indicate that only about half of those designs work properly in their target systems on the first pass. Simulation of device designs and processes are excellent. But process variations, the complexities of interactions on PCBs and in the production test environment make it nearly impossible for system designers to specify a device so it can be designed with high assurance so that it will perform adequately in the system. And the problems of testing devices with the same assurance they will play in their systems are as elusive.

Software is now bringing a badly needed new element - incorporating procedural discipline into the tools themselves. The linking of design steps, before microprocessors brought about economical computer-aiding of the engineer, were by written procedures or understood practices that had to be manually implemented. But such practices are always tailored to a design group or a division, not being consistent even across any large company.

The typical interfacing of test development with device design has been, as those involved often describe it, "by throwing designs and test requirements over the transom into the production department".

Design and production test development have traditionally been separated.

The advent of complex testers from the likes of Teledyne and Fairchild brought the test engineer into prominence. But the large testers and the test engineering organizations were effective so long as the number of parts was low and their production volumes high. Both were geared to high throughput and low unit costs. Production and test engineers understood the products.

System design houses are resorting to outside specialists to get more robust tools. Without a set of specialists that keep up with latest developments it is impossible to keep pace even with the rapidly changing in-house engineering environment.

Production departments are buying new testers and engineering departments are installing new workstations, adding simulators and analysis tools. Across the industry, dozens of simulation environments must be matched to even more test equipment interfaces. And ASICs greatly intensify the problem. They produce orders of magnitude, more device types, usually of short runs or low volumes, and their test programs must be written more rapidly. There is no time to shake out ASIC test programs as is the practice for high-volume standard products. There is no time for the traditional debugging of test programs.

In the near future we will see technical and managerial solutions to these design/test integration issues.

An important trend is the emergence of desktop ASIC design equipment - testers, verifiers and analysers. ATE systems are expensive and inappropriate for the design process. They are optimized for high throughput and are extremely cumbersome as a vehicle to develop programs for quick turning ASIC devices. The new smaller speciality ASIC desktop verifiers are different from previous generations of engineering testers. They are no longer copying the features of ATE, but provide more precisely the functions needed for ASICs.

The current trends in co-operation and new hardware and software tools will lead to fully integrated tool suites, provided by numerous companies, said S. Rutherford, Vice-President of marketing at Test Systems and Strategies Inc. (TSSI, of Beaverton, OR). "We will recognize a joint responsibility and there will be no test/design barrier." And as other experts agreed, the big system companies will lead in implementing the solutions. (Extracted from Electronics Weekly, 15 February 1989)

Silicon still favoured to gallium arsenide

For 30 years the old adage that "gallium arsenide is the technology of the future ... and always will be" has held true.

From the 1950s when UK scientists working in gallium arsenide R&D formed ASS - the Anti-Silicon Society - to 1988 when the UK Government decided to put a 20 million pounds plus push behind the technology, gallium arsenide has promised much and delivered practically nothing in terms of commercial market returns.

To a scientist this is aggravating because gallium arsenide has theoretical natural advantages over silicon. These advantages should - in theory - have allowed gallium arsenide to take over from silicon as the standard material used in the substrate or base wafers for microchips.

There are three supposed advantages of gallium arsenide over silicon:

- Gallium arsenide circuits should work five times faster than silicon circuits - according to the laws of physics - because of its greater conductivity, i.e. the speed at which electrons move through gallium arsenide is five times faster than the speed at which electrons move through silicon.

- Gallium arsenide is considerably more resistant to radiation than silicon by as much as an order of magnitude. That is an important plus for space and defence applications.

- Microchips made with gallium arsenide typically use around five times less power than microchips made with silicon.

What is unarguable is that the last two advantages are demonstrably true both in theory and practice. What has been argued about for 30 years is whether gallium arsenide's speed advantage over silicon is as true in practice as it is in theory.

In practice, the last 30 years have shown that silicon has so much unexpected "stretch" in it that it is continually surprising scientists and technologists by what it can do. Just as it looks as though gallium arsenide chips are fulfilling their potential as the speed leaders, silicon chips overtake them.

It is probably fairly accurate to say that the highest performing silicon technology - bipolar ECL (emitter coupled logic) - just about matches conventional gallium arsenide for speed. But where speed is roughly equal, silicon chips are always preferred to gallium arsenide chips because they are cheaper to make.

Accordingly, wherever cost is the important issue, while radiation and battery operation are non-issues, silicon is preferred to gallium arsenide. But gallium arsenide chips are preferred to silicon chips, where radiation and battery operation are important. Equally where cost is a non-issue as in esoteric applications like super-computers, such as the forthcoming Cray 3, gallium arsenide would be chosen.

So, in the West, it is the big military/aerospace companies - McDonnell Douglas, Texas Instruments, Rockwell, Ford, Plessey - who do most of the gallium arsenide R&D work. They are heavily subsidized by government to develop the technology and mainly use it for making speciality chips for particular pieces of equipment rather than making general-purpose chips for sale into the merchant market.

However, with the modern pressure to convert enabling technology divisions into revenue earners, some of these companies have formed commercial divisions to market gallium arsenide chips. From these have sprund new start-up companies like the venture capital-backed companies Vitesse Semiconductor and Gigabit Logic, and Triquent which is a former Tektronix enabling technology division now launched as a commercial offshoot.

The current relationship between silicon and gallium arsenide can best be demonstrated by memory chips. Whereas with silicon the largest merchant commercial device is a 256K SRAM with one Mbit SRAMs in the sampling stage, with gallium arsenide it is 1K SRAMs that are currently available on the market and 4K SRAMs that are being sampled.

This can be contrasted with the relative position between laboratory specimens of silicon and gallium arsenide chips. At the 1988 International Solid State Circuit Conference, Texas Instruments demonstrated a 32-bit RISC microprocessor made in gallium arsenide that worked at a blistering 200 mips. That is between five and six times better than silicon RISC processors.

One difficulty of gallium arsenide manufacturing is that it is impossible to grow a natural oxide layer on gallium arsenide. The oxide layer on a silicon wafer is used in the construction of the transistors, and because it cannot be grown naturally on a gallium arsenide wafer, more expensive ways of forming the transistors have to be adopted.

Gallium arsenide is also very brittle. During processing the wafers go through many different stages and at each stage they are handled and transported around the processing plant.

Gallium arsenide wafers have many more defects in them than silicon wafers. If there is a defect in the material making up the base of each circuit then that circuit may fail. That means the yield - the number of working chips obtainable from each wafer - is low. Since the overhead is fixed - i.e. the cost of making the wafer - the yield becomes all-important in determining profitability - the low yield of gallium arsenide therefore contributes to its high cost.

The cost of the base wafer further affects expense levels. The cost of a gallium arsenide wafer is about $160 which is four to five times the cost of a six-inch silicon wafer and nine to 10 times the cost of a five-inch silicon wafer. Moreover, the largest gallium arsenide wafers commercially obtainable are three inches in diameter.

Therefore yet another cost advantage is the small size of the wafer. The main manufacturing overhead is the cost of fabricating chips on the wafer. That cost is little enlarged by processing an extra three inches, making the smaller wafer proportionately more expensive per chip.

There is one further gallium arsenide disadvantage and that is the heat which its chips generate compared to those made of silicon. The disadvantage derives from the natural physical properties of gallium arsenide which make it a poor conductor of heat.

This causes difficulties when a chip is packed full of transistors all of which have to be turned on and off to make the switch effect required for a gate.

Manufacturers are now into a process called enhancement depletion mode where half the transistors are turned on and half turned off. This cuts down the heat dissipation but the snag with it is that you have to have both the one and off transistors switching simultaneously to get a working circuit - and that is difficult to do.

So gallium arsenide has a long way to go before it solves the problems which prevent it becoming "the technology of the future". (Source: Computer Weekly, 9 February 1989)

Promise of progress and probability

Neural computing, inspired by the structure of the brain, with its massively parallel networks of neurons and variety of network arrangements, is not about to replace expert systems and logic programming. It is seen as a complementary, if powerful, technique to solve problems where the rules are not known, and so do not lend themselves to conventional programming.

Vision, natural language and speech recognition are areas which could benefit.

Neural computers are not programmed like today's computers, rather they learn by example and experience. Some believe problems are best solved using neural nets, others by using logic programs: experimental and formalized knowledge should be complementary.

Akio Kokubu of Japan's Electrotechnical Laboratory suggests the two approaches could be linked by extracting the rules, which the neural net discovers during training cycles, to provide the expert system rule base.

The idea of neural computers goes back to the 1960s and the pioneering work of Finland's Teuvo Kohonen on associative memory.

Over the last few years work has moved out of university research laboratories and into industry. Estimates from US research group New Sciences put spending on neural computing at about $20 million annually in the US; Europe and Japan are spending similar amounts.

Japan is taking the technology seriously: it plans a large-scale collaborative programme beginning in 1991, and in 1988 Fujitsu announced it was working on neural chips for robot control and image processing.

But the US leads the field in applying neural nets; over 150 companies claim to be exploiting the technology. The finance sector has proved a willing recipient.

San Francisco and Los Angeles airports are using an explosives detection system, Snoope, developed for the American Aviation Authority by Science Applications International.

New Sciences researcher Gerald Michalski expects firms to start making money out of their investment in neural net technology in about two years.

There are two approaches to developing neural computers - to simulate neural networks on conventional hardware, or to implement them in silicon as special purpose processors.

A good number of co-processor boards for the IBM PC, Sun workstation or DEC Vax exist: these allow simulation of a neural network and make neural computing an inexpensive technology to try out.

Elsewhere, at IBM and NASA's Johnson Space Centre, for example, researchers are emulating neural nets, using (in NASA's case) arrays based on Immos transputers.

To reap the full promise of neural computing means directly fabricating the network in hardware, says Philip Treleaven of University College London.

Treleaven's team is developing a silicon compiler, which will design and build special-purpose neural chips.

In contrast, Igor Aleksander of Imperial College, London believes that current RAM technology will suffice for building neural computers.

He has already built a prototype, Wisard, made up of 250,000 nodes. It has been used for a variety of image recognition tasks including sorting Ecuadorian bank notes (by the de la Rue company) and guarding an airfield from intruders (by the UK police).

At last week's seminar Aleksander showed a video of Wisard in action; it could recognize an intruder in around one twenty-fifth of a second. Now with money from the Government's Information Engineering Directorate (IED), a team from Imperial College and Brunel University will develop the next generation of Wisard, comprising six million nodes, which will have important feedback and probability assessment properties.

British Telecom has a small team at Martlesham Heath laboratories, to apply neural computing to a range of problems including natural language in the human-machine interface, translation, and speech. Directory inquiries is a likely candidate.

These are areas where conventional computers, using rule-based systems, have been unsuccessful, says Charles Nightingale, leader of BT's five-year project. His team is trying out new methods of coding images for video telephone.

The problem is that the ISDN (integrated services digital network) video telephone will have to use very low transmission rates (of the order of 2.4 to 4.8 Kbits per second) which means the information being carried has to be highly compressed. Neural nets are being used to extract the important features - eye and mouth - from facial images, and simulate their movements.

Unilever also has neural computing research under way, and Logica's space and defence division is applying the technology in a current military project. So far, its system is out-performing human operators.

The UK Atomic Energy Authority (UKAEA) at Harwell is working as part of an ESPRIT project to investigate potential application areas.

Thomson CSF of France has a 25-strong team investigating neural nets for its defence work, but envisages commercial applications such as fingerprint recognition. Thomson is leading another ESPRIT project, Pygmalion, to develop a dedicated neural network language, user interface and a library of reusable algorithms.

Project leader Bernard Angeniol hopes to make the software as widely available as possible, to give European industry the common platform required if it is to keep pace with the US and Japan. (Source: Computer Weekly, 23 February 1989)

V. SOFTWARE

Software supplier challenges SAA

The world's biggest independent software company, Computer Associates, claims to have beaten IBM at its own game with the launch of an equivalent to IBM's Systems Application Architecture (SAA).

The new CA Application Construction Environment (CA-Ace) offers a family of software development and data base tools which provides compatibility across a wider range of IBM operating systems than IBM SAA products - and also DEC machines.

The Unix operating system is also covered - and Computer Associates expects ICL machines to be included later.

Like SAA, CA-Ace provides Cobol and fourth generation language products which run on everything from personal computers to mainframes.

CA-Ace consists of 14 existing products and six new ones, still under development. They are almost all from the former ADR company, which Computer Associates took over last year, including Metacobol, the Datacom data base products and the Ideal development language.

The new products are mainly personal computer versions of Datacom and Ideal, plus versions of Datacom for distributed mainframes and for local area networks. (Source: Computer Weekly, 2 March 1989)

IBM returns to the DB2 drawing board

IBM has cast aside the relational data base model as part of a complete rethink of its strategic data base offering DB2.

Its Heidelberg research laboratory in the Federal Republic of Germany has gone back to the drawing board with DB2, to look at non-relational solutions to the needs of users who do not or cannot work with structured data base columns and tables.

The project called NF2 (non-first normal form) ignores the relational data base rule that data has to be broken down into simple parts and allows users to store graphics, pictures and other data that cannot be held relationally.

NF2, under development for the last three to four years and employing 50 staff, is being seen as an alternative, if not a replacement, to DB2, the data base product at the core of IBM's Systems Application Architecture (SAA). (Source: Computer Weekly, 16 March 1989)

PC-based software package for non-programmers

DataEase has developed a PC-based software package for business information analysis applications. The CrossView package is designed for non-programmers, allowing them to combine the capabilities of spreadsheet and data base packages for decision-making tasks. CrossView gives the user a multi-dimension look at data against, for example, the 2-D approach of a spreadsheet; as a result, a user can look for important data patterns without trying to assimilate the information through various reports. (Extracted from MIS Week, 20 February 1989)

Software to control machines in a cell structure

Computer software, which will supply guidelines of how to delegate control to machines in a cell structure, will be developed by a consortium, under the sponsorship of the UK Department of Trade and Industry. The consortium intends to form a generic cell controller containing open system interconnects that will go beyond the networking supplied by Manufacturing Automation Protocol to define the jobs each machine will carry out. The consortium includes Texas Industries Ltd., GKN Technology, GKN Group Management Services, AFE Displays and OD Systems. The first research in the two-phase project will establish what production control functions should be executed at the cell level and how the cell should communicate upward to management information systems and downward to the machine controllers themselves. Upon successful completion of phase one, the consortium will develop prototype systems to be mounted at Birmingham University and at a GKN site. They would be generic and formable systems for the supervisory control and uniting of discrete production cells. (Extracted from Metalworking News, 6 February 1989)

Fixture library with organized data base

Jergens (Cleveland, OH) and Brigham Young University (Provo, UT) have jointly developed a fixture library with an organized data base for use

on workstation and mainframe sized computers. The new system's software supplies computerized manual template tracings, and controls independent views, functional origin points, consistent presentation of views, and an organized data base for fast part identification by function against a certain part number. A Brigham Young University study rated the system 500 per cent quicker against manual fixture design techniques. Because the system's original computer size eliminated its use by smaller firms, Jergens developed FixturePro software for use on micro-computers. FixturePro permits a designer to make workholding fixtures using pre-drawn standard tooling parts. The software data base has 1,800 commonly used parts and almost 4,000 drawings. Jergens produces jig and fixture parts. (Extracted from Metalworking News, 6 February 1989)

New types of computer programs

Computer programs known as daemons, sprites, phantoms, dragons or agents are now available for personal computers. Unlike traditional personal computer programs (e.g. spreadsheets, data bases and word processors), the new programs generally run in the "background". They can act as a doorkeeper to permit various computers to share one printer, or as a "town crier" to alert a user at a certain time about an event that is about to occur. They have been available on larger minicomputers and mainframe computers but were not suitable for smaller computers that could only do one thing at a time.

R. Kahn, President of the Corporation for National Research Initiatives (Reston, VA) and former head of the Pentagon's Defense Advanced Projects Agency, suggests a new kind of program called a "Knowledge Robot", or sophisticated searcher that would imitate the skills of human librarians. It would store data on various computer data bases that it could reach via computer networks, and be able to translate the user's queries to retrieve data. It could also compile a profile of the user. Daemon programs (not demon, a related type of program) can be used to scan news reports on a wire service and compare the reports with instructions about what to save and discard, thus building "custom newspapers".

The most notorious daemon program is the finger daemon, a Unix utility program allowing a user to easily obtain data (e.g. a phone number or simple biography) of another user of a computer, if both users are working at the same computer or tied to the same network. Daemon programs have also been used to combat computer crime or infect computers with a virus. (Extracted from New York Times, 8 March 1989)

New software development tool

Microware Systems (Des Moines, IA) has introduced a new software development tool, RAVE (Real-time Audio/Video Environment) that should reduce the time and cost of developing sophisticated software. Designers can mix high quality digital sound, still and moving video and computer-generated graphics. Originally designed for consumer interactive compact disc application, a market that has been slow to emerge, the package has been applied to industrial control, Microware's primary market. RAVE would typically run on touch video screens, expected to be more popular with factory personnel unaccustomed to keyboard/monitor formats, and give audio feedback as confirmation that an action had been effected an appropriate sound or a verbal confirmation, rather than mere beeps and buzzes. (Extracted from Electronics, April 1989)

New warehouse handling methods

New software and communications technology is making it easier for warehousing to achieve its standards in order integrity, customer service and inventory control. Various inventory control and reporting functions are offered for current software buyers. They include pre-routing for outgoing shipments, pre-sorting for inbound shipments, cycle counting for rapid turnover products in the warehouse, wave and batch picking capacities, UPS manifesting, lot number data storage for lot control, quarantine specifications, management by expiration date, order-picking strategies to prevent deadheading and backtracking, inventory thresholds that bring about replenishment orders, and uniting of barcode reading and printing into the picking and placing operations. The future of Electronic Data Interchange (EDI) will involve the uniting of warehouse software control systems with EDI networks, leading to the writing of software that is more in tune with EDI requirements. (Extracted from Material Handling, March 1989)

Software programs to track hazardous waste information

There are now about 400 software programs available to help companies track information on their hazardous wastes, according to R. Young, editor of Pollution Engineering News. The number of programs has doubled in the past year due to stricter US Government regulations concerning hazardous chemicals and wastes. Because of these guidelines, companies may have to have instant access to information about what to do if an employee spills a certain chemical on himself, for example. Hazox (Chadds Ford, PA) is one supplier of such software. Growth in the field is expected as an increasing number of states regulate disposal of hazardous medical waste. (Extracted from Wall Street Journal, 25 January 1989)

Software to examine materials forming

Battelle (Columbus, OH) has introduced finite-element-method software that examines and simulates the forming of materials to supply data on variables needed for die design and process development. The Design Environment for Forming (DEFORM) software can be used to examine cold , warm- and hot-forming of metals; moulding of plastics and glasses; forming of powder metal preforms; and customary and isostatic pressing of metal powders. The first system will be offered in early 1989, with customers getting more system features by the summer. The analysis module of DEFORM supplies linear thermoelastic examination, non-linear heat transfer examination, interface modelling to simulation deformation of a number of objects with any mix of material models, and non-isothermal deformation examination of a number of objects with different material models. (Extracted from American Machinery, January 1989)

CASE becoming more popular

Computer aided software engineering (CASE) tools are getting into the system engineer's kit, providing interactive modelling, design verification, simulation and automatic code generation. System engineers require a CAD environment that helps them express their concepts easily, rigorously and consistently, and lets them manage the inescapable complexities of software development. CASE tools answer these needs. (Extracted from High Performance Systems, February 1989)

Optical data entry system

A route to faster and more accurate data entry is offered in the shape of TransImage 1000, a hand-held optical data entry system used to selectively scan printed text and data.

Designed as an alternative to the keyboard for PC-compatible microcomputers, the TransImage 1000 enters scanned information directly into popular software packages such as WordStar, WordPerfect, Lotus 1-2-3 or DBase III.

The system consists of three elements: a lightweight, hand-held camera, a custom microprocessor board, and system software diskettes. The camera comes equipped with definable function keys, which can emulate the pressing of any key - or combination of keys - on the keyboard. Commands such as those for saving, printing, or entering repetitive information, can be executed in a single keystroke.

The TransImage 1000 uses an enhanced feature extraction method of image classification and recognition. This process accommodates variations in typefaces and type sizes. Image recognition takes place without regard to a specific font, resulting in virtual font independence and automatic font recognition.

Once identified, scanned characters are passed through an application filter, which formats the data for insertion into a specific application program. When used to scan characters into a Lotus 1-2-3 spreadsheet, for example, the filter removes commas and dollar signs which the software cannot accept.

The TransImage 1000 can also be "trained" to recognize special characters, symbols (such as the copyright symbol), icons, or unusual fonts. The system's training software is used to teach the system to recognize an unfamiliar character or symbol, to substitute another keyboard character, to enter a series of characters, or to respond by executing a command. If, for example, the copyright symbol is scanned, the TransImage 1000 can be taught to enter a substitute character (c) into a word-processed document.

TransImage 1000 retails in Switzerland for Swiss francs 7,250. For further information, contact: TransImage Corporation, 910 Benicia Avenue, Sunnyvale, California 94086-2887, USA. (TP +1 408/733 4111) (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

Software plots the progress of food poisoning

A microbiologist at the United States Department of Agriculture is developing a computer-based model to help him predict the growth of common bacteria in processed foods. Eventually, the model may allow a food manufacturer to find out in a few seconds how changes, such as raising the salt content of foods, could alter their shelf life.

This type of computer simulation is common in the design of aircraft or in forecasting the weather, but it is in its infancy in the food-processing industry. According to Robert Buchanan, the microbiologist from the department's Microbial Food Safety Research Unit in Philadelphia, companies in the industry tend to be fairly conservative about testing for the bacteria that cause food poisoning. A company laboratory will expose a sample of food to a known quantity of a microbe, such as listeria or clostridium, and allow the bacteria to grow for hours or days, then measure the number and size of the colonies of bacteria at the end of the run.

The problem with this method, says Buchanan, is that the laboratories never get reproducible results: the products from each company are different and their laboratories do not use standard methodologies. This approach is also time-consuming and expensive. Another problem is that whenever the manufacturer changes the formulation of a processed food - by increasing the salt content or the conditions of storage, for example - they have to run the whole thing again.

Buchanan's program for the model, which incorporates data from his own laboratory and information from other American and British food researchers, is a model of a simple testing system, developed with cured meats in mind. He wrote the model to appear as a standard graphical display on a computer. It uses a program written by Lotus, the software supplier. The program prompts users, first to select a pathogen - salmonella, listeria, shigella or aeromonas - then to enter various details of the formulation of the food. These include the temperature at which it is stored, the salt content, acidity and the quantity of sodium nitrate. The system then asks what level of contamination with bacteria, in units per gram, the manufacturer assumes to be present at the start, and asks the "level of concern" - that is, the number of units per gram that would be cause for alarm.

The program then calculates the growth of the bacteria over time and produces the results as numbers or a graph. Users can look at a growth curve and see how many hours they can store the food before it becomes unacceptably contaminated. They can also look for the "lag phase" - the period during which there has been no growth of bacteria. "If the lag lasts indefinitely," Buchanan says, "it means that the bacteria will not multiply under those conditions".

Most of the data in Buchanan's model come from his own work with samples of standardized bacteria in a broth made from vegetable protein. "Any laboratory in the world can order the same bacteria and formulate the same broth. Their results will then be consistent with my work." He has used data from the AFRC Institute of Food Research, in Langford near Bristol, and from Unilever.

Buchanan's model will run on any IBM-compatible computer. He used bio-statisticians, programmers and a mainframe computer to devise the formulae that the spreadsheet relies on. He then tested the formulae against real inoculations. It took several months to refine the equations to fit reality, but Buchanan now expects to have a model that will work for listeria and salmonella within six months, for shigella within a year, and for aeromonas and clostridium within 18 months. (This first appeared in New Scientist, London, 28 January 1989, the weekly review of science and technology)

Data base on disability available on diskette

An international data base of disability statistics is now available from the United Nations on PC-compatible diskettes. The United Nations Disability Statistics Data Base (DISTAT) was developed by the Statistical Office, Department of

International Economic and Social Affairs, United Nations, in close co-operation with the United Nations Centre for Social Development and Humanitarian Affairs and the World Health Organization. The data base, which can be purchased from the Statistical Office, contains information on sources and availability of statistics on disability for 95 countries and areas between 1960 and 1986, and detailed statistics from 55 of those countries or areas for the period 1975-1986. A comprehensive compendium of these national statistics is in preparation by the Statistical Office for publication in 1989.

An 86-page Technical manual (United Nations publication Sales No. 88.XVII.12) for users of the data base is now available in English, and will be produced in Arabic, French and Spanish in the course of 1989. The manual, like the data base itself, is intended for use by persons with previous experience in the use of spreadsheet packages on micro-computers.

Copies of the manual may be obtained, at a cost of $US 10, from bookstores and distributors handling United Nations publications throughout the world, or from United Nations Sales Sections in Geneva or New York. Inquiries concerning DISTAT should be addressed to the Director, Statistical Office, United Nations, New York, NY 10017, USA. (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

Marine data exchange system

The International Oceanographic Data Exchange System (IODE) exists to help improve global understanding of the oceans and their applications, with a view to achieving: an understanding of the fundamental scientific processes of the ocean; the extraction of energy and food from the sea; the exploitation of mineral and fossil deposits in the seabed; the control of pollution, and prediction and adaptation to changes in the world's climate.

To attain these goals, access to wide-ranging information on the oceans is necessary. The IODE system helps researchers not only to find marine data and information anywhere in the world, but also to use it. It currently gives access to millions of measurements and observations, and millions more are added yearly. The data results from more than 10,000 research expeditions by ships from over 70 countries, and is stored in more than 2,000 data bases.

IODE's organizational structure consists of: National Oceanographic Data Centres (NODCs), more specialized Responsible NODCs (RNODCs), and two World Data Centres (WDCs), situated in Moscow and Washington DC. Users can approach their NODC with requests for information or advice regarding data or information management. Information and data flow within the IODE system is co-ordinated by an IOC Technical Committee.

The IODE system regularly organizes training courses on the management of marine data and information, and can provide scientists or engineers with copies of quality-controlled data to use for themselves. IODE data holdings can be analysed on request, to provide the user with statistics, extreme values, specialized data presentations and other data products. The IODE Technical Committee is actively supporting global programmes of oceanographic research, aimed at producing more marine data and improving its dissemination. A number of technological innovations, including optical data storage techniques, and electronically-available inventories and catalogues, are being actively considered for the future.

For further information, contact NODCs, RNODCs or WDCs. A full list of addresses of these is available from: IOC Secretariat, UNESCO, 7 place de Fontenoy, 75700 Paris, France. (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

New programs help in evaluation

New personal computer programs are helping MIS managers optimize their own operations. For example, Graphic Management Group's (Mt. Pleasant, NY) new personal computer-based Graphic Data Center Management (GDCM) can be used for information centre installation and layout management. It features both a 2-D drawing capability and a data base. Also, Profile Analysis' (PAC) (Ridgefield, CT) new Risk PAC automated risk assessment package helps MIS managers by allowing users to evaluate exposure to hazards. Built around an expert engine that produces detailed questionnaires, the program also operates on a personal computer. (Extracted from MIS Week, 10 April 1989)

Machine translation processes

Software packages that presently allow personal, mini- and micro-computers to translate languages are part of a machine translation market capable of $10 billion in current business and 10 per cent per year growth, according to the European Economic Commission. Engineering and business information contained in product manuals, brochures, and manufacturing instructions can be competently translated by two current forms of machine translation processes. The first depends on memory to search and replace each word of one language with the appropriate word from the other language, a process which is prone to contextual, idiomatic, and other mistakes. The second process avoids mismatching words by using an intermediary mathematical language, based upon artificial intelligence and parallel processing research, which represents entire thoughts or concepts and then picks the appropriate words in the other language to communicate the same thoughts.

Carnegie-Mellon University researchers have developed such an intermediary language, Interlingua, so a machine can translate from Japanese to English and vice versa. Logos (Dedham, MA) is selling software packages employing an intermediary process called Semanto-Syntactic Abstraction Language. According to Logos, the software uses Unix to operate IBM and Wang computers to translate primarily European languages with 90 per cent accuracy. Worldwide Communications (Chicago) offers machine translation of several language pairs using the word-for-word method on long instruction texts. Fujitsu and Matsushita, who are financing a large share of the Carnegie Mellon research, have furthered voice recognition developments by enabling personal computers and 32-bit workstations to recognize speech from any number of voices. (Extracted from Design News, 27 March 1989)

Multilingual software

The arrogant assumption that it is up to foreigners to learn English - not vice versa - certainly holds sway in the computing industry. IT

is so geared up to relaying data on screen in English that, with the exception of Japanese and Arabic, the market for software in non-Roman scripts remains largely untapped. Now there is a small industry dawning in the UK which aims to challenge the attitude of "if they don't speak English, shout louder". Those directly involved with PC word processing in non-Roman scripts are difficult to classify as a single group as they range from a Chinese food processing company based in Islington, north London, to Lord Avebury, a former Liberal party spokesman on science and technology, to the developer of the standard word processing software for the Amstrad PCW.

"Multilingual software is an interesting niche market people haven't thought about," says Avebury, director of 2020 Technology, sole UK distributor of the Californian word processing package Multilingual Scholar. The package covers a variety of languages including Vietnamese, Urdu, Tamil and Thai. A single hard disc manages five scripts.

So far the main market for the package has centred on local authorities with large ethnic groups, advice centres, translation agencies and health authorities, he says.

Clearly, dropping a normal rates bill through the letterbox of a non-English speaker cuts little ice, nor will minorities benefit from an AIDS warning printed in an alien alphabet.

The really fiendish language to try and get on a word processor is Chinese. To write the word "I" in Chinese requires nine separate brush strokes.

Rather than giving end-users a pair of roller-skates to do their word processing, the Chinese package Brushwriter comes with a keyboard of 36 common characters, and 36 components of characters ("radicals") which can be used to build whole characters.

These have to be typed in in sequence according to the traditional brush stroke order. Why this is remains one of the mysteries contained within the inscrutable Brushwriter.

Chinese is such an awkward customer from the point of view of word processing that Brushwriter took six years to develop and now requires over three megabytes. It runs on IBM PC AT compatibles, and costs 840 pounds sterling.

In the early 1980s an ideographic workstation could have cost around 25,000 pounds sterling, with little chance of support. Meanwhile increased graphics capabilities for PCs and added memory have made Chinese word processing a viable market.

Growing trade and cultural links with oriental countries are all grist to the mill for suppliers of foreign language word processing software.

Meanwhile there are tens of thousands of Chinese in the UK to provide a modest test market, before tackling China itself whose population is 1,000 million.

Last June the London based Community Information Project, which supports advice agencies in the UK, brought the British multilingual word processing industry together in a one-day conference. This was sparked by a rash of inquiries from the agencies.

One of the chief points to emerge was that manufacturers lack standards to go by when producing systems for foreign languages.

"The main needs are to define standards for character sets so that text can be interchanged between different users and different systems, and for keyboard layout," said one speaker, John Clews, from the British Library Documentation Centre.

There is an International Standards Organisation (ISO) committee for determining character set standards, but Clews says, "Unfortunately, hardly any developing countries have asked for representation". So it remains very difficult for manufacturers to settle on a character code.

Meanwhile, the company most likely to build a mass market for word processing in foreign scripts is Dorking-based Locomotive Software, producer of Locoscript, the standard word processing package for Amstrad PCWs.

Locomotive claims that it is possible to write a letter with its 25 pounds sterling Amstrad package in any West or East European language - including Welsh which requires a W with a circumflex. The package includes normal word processing facilities like cut and paste.

In two months it will release a package for Arabic and Urdu. Ironically, Locomotive's approach is similar to ancient Arabic calligraphers - many of whom were illiterate and did not understand what they were writing.

Director Howard Fisher says the developers of Locoscript for foreign alphabets are not language specialists. They collect anything from exercise books to phrase books to get the right shapes for the letters, produce the alphabet, then get it checked by experts at universities.

As with the calligraphers, if they make a mistake it gets chucked back. One problem Fisher has found with Arabic though is that experts disagree on what is acceptable and what is not.

To get the word processing code to print a shape other than a Roman letter on the screen is in itself a "trivial task", according to the chief developer of Locomotive's Arabic package, Bruce Godden. You simply instruct the core word processing software to project different dots on the screen (each letter has to be within an area of eight dots by eight).

European characters lend themselves more to the squarer representation needed for screen display, whereas Arabic tends to be more flowing and harder to compress within the 8 x 8 dot frame, or "cell".

Getting accents in is a bugbear for developers of multilingual software. Again Arabic causes problems by demanding that vowel accents above and below letters are included and the cell may have to grow by 50 per cent to incorporate them.

Comparatively, getting the computer to write from right to left, rather than left to right is simple, Godden says.

The area where multilingual word processing is sure to expand is in education. With pupils speaking 172 different languages, the Inner London Education Authority has developed its own core package, Allwrite,

It runs on RM Nimbus PCs, with a minimum of half a megabyte of memory. Clear lettering and ease of use are the priority, rather than extensive features. (Source: Computer Weekly, 23 March 1989)

How to survive a data deluge

We are all of us deluged with information. It comes to us from every angle - by post, by telephone, by fax, through the media, by word of mouth. The problem is to extract from all these data sources the information that is useful and valuable.

Information technology ought to help us. In practice, it does not. IT systems do contain masses of information, but their ability to process it for us in anything other than a highly structured way is very limited.

The reason is that the data storage arrangements in IT systems are dominated by the capabilities of the hardware technology used. The emphasis since computing began has been on constant refinement to this technology - on increasing storage densities and capacities and on reducing costs.

One of the interesting trends in IT is that this focus of attention on hardware development is likely to change in the near future. There are two reasons for this. First, storage technology is mature and its potential for future development is limited. Already in big systems technical progress is failing to keep pace with user demand.

Second, the very success of the technology so far has created problems which hardware alone cannot solve. Computers today store enormous masses of data. Ensuring this data flows smoothly through the system and results in the desired answers when processing is complete is becoming harder. New methods are needed simply to maintain present levels of effectiveness.

These factors will ensure a switch of emphasis from producing ever more compact and cheaper hardware to concentrating on software that will enable our data storage systems to operate more effectively. Information management rather than data storage will be the theme song of the 1990s.

To summarize, there are two underlying trends in data storage today: the failure of hardware technology to match user demand, and the steadily increasing size of corporate data bases. These two trends will force a switch of attention from hardware technology to software over the next decade.

This process has already started. Consider one of the implications of the failure of hardware technology to match user demand. Either your disc drives increase in number till they are eating you out of house and home, or you have to keep them in check in some way.

The obvious way is to ensure that the only data stored on disc is that which you really need on line access to. You move the rest onto tape, microfilm, or some other archival storage medium.

Users are doing this now. It takes time and effort, and that costs money. So there is a market for products which automate the process and cut down on that time, effort, and money.

IBM was one of the first companies to see the opportunity. The company announced its System Managed Storage concept in around 1985, and has followed up since with a range of products, codenamed DF (for Data Facility).

The idea is that many of the decisions about what data should be in which type of storage are decisions that the computer itself is best fitted to make. It knows how many accesses are made to a given data set in a given period of time: it can calculate how likely it is that one access will be followed by another soon after, and so on. The major DF product, Hierarchical Storage Manager (DFHSM), is designed to serve precisely this purpose.

The system managed storage concept was taken a step further with the announcement of Enterprise Systems Architecture (ESA) in February 1988. The ESA operating system, which works in conjunction with the DF suite, is designed to ensure that all the data in the system is in the right type of storage (cache, main memory, expanded storage, controller cache, disc or tape) at the right time.

Getting data to flow smoothly through the system is one problem. Turning it into information is quite another.

The first attempts at doing this came in the 1960s. They were called management information systems and were so unsuccessful that even today those are dirty words.

The 1980s saw an attempt to recreate the management information systems concept under a different name - decisions support system. Decision support systems have not attracted the same opprobrium, but they have yet to prove themselves successful in significant numbers.

This type of system has been unsuccessful because it does not cater effectively for the extent to which business circumstances, and therefore information requirements, change. More successful have been data base management systems.

These operate at a lower level than decision support systems, and therefore, in theory at any rate, offer greater flexibility. The latest relational systems allow users to extract various items of data from different parts of the data base.

In November Unisys went a step further still, announcing a new type of system known as a semantic data base. The company argues that relational data bases, with their tabular method of representing data, are unnecessarily restrictive and ask too much of the casual end user. It says that semantic data bases, by storing contextual information together with the data, overcomes these problems without sacrificing any of the disadvantages of the relational model. (Source: Computer Weekly, 2 February 1989)

"Virus proof" computer security system

Two computer scientists have developed a computer security system which they claim is invulnerable to computer viruses such as the one that recently struck networks across the USA.

The system, designed by Michael Rabin, a computer scientist at Harvard University, and his former student Douglas Tygar, now assistant professor

in the School of Computer Science at Carnegie-Mellon University, is an adaptable set of programs designed to regulate access to information on computer systems.

The system, called ITOSS (Integrated Toolkit for Operating System Security), is the culmination of a four-year effort by Rabin and Tygar. Among its features is a battery of built-in "sentinels" which can be employed either to warn away users from high-security data, or to record every access to sensitive data files without users' knowledge. A "fingerprinting" algorithm can also alert system operators to any changes made to programs on the system. Included in the program's design are a "minimum security" protection for all files against "trojan horse" programs that might come into the system illicitly, hidden in innocuous messages, and a "maximum security" feature which requires a specified number of system operators each to input commands in order to make any far-reaching changes in the system.

New systems to protect computers are likely to be necessary if computer operators are to gain the upper hand over hackers. (Source: Nature, Vol. 337, 5 January 1989)

Viruses

A number of organizations and individuals are now setting out to explode the myths about software viruses in an attempt to put the threat to PC data in perspective and silence the scaremongers and ambulance-chasers who follow the virus bandwagon.

Yet despite the scepticism, few are prepared to dismiss the damage a software virus can do as a joke. The viruses detected in 1988 may have been more of a nuisance than a threat, but their long-term potential to develop into something more sinister is recognized.

Professor Henry Beker, a mathematician and cryptologist at the Royal Holloway College, London, claims companies have already been held to ransom by hackers who plant viruses in their computer systems and defuse them only on payment.

A small number of unnamed UK companies have paid up for fear of virus damage, though the consequences of not doing so have proved trivial.

The incidence of virus blackmail is on the increase across all market sectors, but most companies have back-ups and a lot of viruses are harmless.

But even a virus with only nuisance value could have a devastating effect on a safety-critical system.

No virus has been reported in one so far but this is no reason to be complacent, says Martyn Thomas, chairman of software house Praxis Systems.

"Such systems should be immune because in general they are not networked and are difficult to modify. But one could be introduced by a disaffected member of an authorized maintenance and development team."

A second level of safety critical system is more vulnerable. This is the grey area of systems that store vital data, like blood banks, and automate vital functions, like the monitoring of a patient's blood pressure in hospital.

Concerns about the potential harm a virus could do in such circumstances have strengthened the move to clarify what the real virus threat is.

The trend towards putting the unquantifiable virus threat into perspective with other risks to software, such as those posed by hackers, badly designed software and natural disasters, gained momentum with two initiatives. Ironically, one of them was the result of a user admitting to having suffered serious though short-lived damage from a software virus.

British Rail (BR) made an open admission that it had suffered damage from the 1813 virus and would make available free copies of a virus detection program developed in-house.

BR is the first major user to publicize its virus experience and share its response with other users.

The second anti-virus initiative is in the form of a non-profit-making, hardware independent organization called the Computer Threat Research Association (Cotra). Its specific aim is to clarify the facts about viruses and dispel the myths.

Local area network specialist Novell is co-ordinating Cotra and also distributing BR's virus detection program on its Netwire bulletin board. Cotra has two levels of membership, one of which allows access to the virus code.

To date the highest profile of any organization promoting the virus issue has been the IBM PC User Group, in particular its chairman Alan Solomon. Solomon runs an IBM data recovery centre in Amersham.

He has welcomed Cotra's formation and intends to become a member.

But concerns that he was instrumental to overhyping the virus threat persist. His initial comparison of the virus threat to the AIDS scare in the medical world panicked users into looking for protective anti-virus and virus detection packages from the software industry.

Remedies duly flooded forth, some from Solomon, including a book called The Computer Virus Crisis.

Solomon's refusal to release virus code for fear of its falling into the wrong hands has provoked strong reactions from those who say that keeping users in the dark only feeds their fears.

The advice to PC-using organizations from the PA security consulting centre's principal Peter Jenner is to make staff aware of the problem.

"It is one of many risks to PC systems and shouldn't be taken out of proportion. Neither should it be ignored as its effects can be frightening.

"Inoculation of programs against viruses is very dangerous as virus writers will always overcome that. Anti-virus programs designed to eliminate viruses are also dangerous as they are viruses themselves and can turn against the user.

"It is better to spend money preparing to recover quickly from a virus than to try to prevent a virus getting into the system. If you have one, the best thing to do is to panic and switch off the machine so it cannot do any damage."

Jenner's concern is that companies will use viruses to damage competitors for their own advantage.

In a similar vein, Rod Smith, librarian of the UK public domain software interest group, reckons viruses are a ploy by software vendors to try and wipe out shareware, commonly blamed for spreading viruses. (Source: Computer Weekly, 23 March 1989)

The symptoms

Viruses that hit the headlines in 1988 1989 include nVIR and Scores on the Apple Macintosh, and Brain, Italian, Stoned, 648, 1701 4 and 1813 (the Friday the thirteenth virus) on IBM PCs and compatibles.

nVIR and Scores. These viruses enter a PC by floppy disc or travel over a network, storing themselves in the system and finder area of Macintosh software. From there they have access to the core of the software, the resource and data forks. Both viruses install themselves in the resource fork which contains the programmable code for running the software, by presenting themselves as proper resource utilities. They then slow the system down and can cause crashes. nVIR can lurk undetected unless the Macintalk package is in use, when a disembodied voice tells the user not to panic. Scores can only be detected with the help of a virus detection tool, like Ferret from Apple.

Brain, Italian and Stoned. All infect by diskette only and install themselves in memory and on the boot sector so they can spread to every disc inserted in the drive. Brain and Italian only slow the system down very slightly but Stoned is more harmful. Stoned has been known to overwrite one section of the allocation file table on a small number of hard discs, according to Solomon. Brain can be identified by looking on the volume label for the signature (c) Brain. Italian bounces ping pong balls across the screen and Stoned flashes up the message "your computer is stoned", but only to selected users.

648, 1701, and its version two, 1704, and 1813. These viruses are named after their program code length in bytes. They spread on floppy disks and affect DOS files. The 648 virus skips memory and spreads directly from file to file. It can re-boot or crash a computer. The 1701, 1704 and 1813 viruses lodge in the memory and from there spread to other programs. All three attack .COM files. The 1813 virus also attacks .EXE files. The 1701 and 1704 viruses trigger a hailstone effect on the screen, dislodging characters and swirling them to its base. The 1813 virus deletes files when the PC system clock reaches Friday 13, but these are recoverable. (Source: Computer Weekly, 23 March 1989)

VI. COUNTRY REPORTS

European Economic Community

Joint research programme on computer chips

Three major European electronic groups will conduct a joint research programme on computer chips within the EUREKA framework.

The French Italian corporation SGS Thomson, the Dutch group Philips, and the German company Siemens have announced that they will co operate in equal shares in a joint research programme called JESSI (Joint European Semiconductor Silicon) within the EUREKA framework. The three corporations will develop a new generation of large-scale electronic components. JESSI will officially start next year and will include two stages: during the first period (until 1991-1992) industrialists will focus on medium-scale integrated circuits; during the second period (until 1995 1996) industrialists will develop much more sophisticated circuits.

This programme requires large scale financing. It will be necessary to spend at least $400-$500 million each year during seven years. In total, the financing will exceed $3.5 billion. This is the first programme of such scope at the European level. The Governments concerned (the Netherlands, Federal Republic of Germany, France and Italy) and the European Community will contribute half of the funds, the other half to be provided by the industrialists themselves.

Co-operation between European countries appears to be the only way for Europe to catch up with the US and Japan in the area of computer chips. Currently, Europe controls less than 10 per cent of the world production of semiconductors, compared with the US whose share represents 39 per cent, and Japan which has taken the lead with 48 per cent. Furthermore, European manufacturers have not attained the best technological level. Through co-operation, Philips, Siemens, and SGS Thomson whose sales in 1987 amounted to $1.6 billion, $657 million, and $860 million respectively barely att in the level of the first world groups the Japanese corporations NEC (with a turnover of $3.2 billion) and Toshiba (with a turnover of $3 billion).

The distribution of functions within JESSI was apparently easily resolved. Each partner will concentrate on the areas it is best familiar with. The distribution of responsibilities, however, was not easy.

The three corporations now have to prove that their co operation agreement can last. The success of the JESSI programme and of the collaboration between Governments and industries will also constitute a test for the Europe of 1993. (Source: European Science News, January 1989)

Further progress towards an advanced telecommunications network in Europe

An ambitious research programme has been quietly gathering momentum throughout Europe over the last three years. Some 350 organizations are already involved with commitment to spend about 600 million pounds sterling.

The programme: RACE (Research in Advanced Communications in Europe) has an objective "to provide Europe with advanced telecommunications services in a timely manner" by 1995.

The goal is to build a new infrastructure for European telecommunications a new network of high speed, high capacity cable to carry voice, data, movies, home banking, interactive distance learning, or almost anything else you care to imagine.

The strategic plan of action was unveiled in Brussels by a panel of six world experts who had been asked to conduct a strategic audit of the programme

for the European Commission, which is co-ordinating and part-funding RACE.

The panel of experts included such people as John Alvey, whose report to the UK Government some years ago led to the Alvey research programme here. The panel looked beyond technical issues to the wider contexts of competition between Europe, Japan, and the US; to issues of European co-ordination and pluralism; to policy and regulatory issues; and to standardization questions.

The panel produced eight recommendations for further action. Most are addressed to Governments, and administrative and regulatory bodies. All are set into a tight timetable.

The European Commission has accepted the consensus that emerged in the first phase of RACE, when researchers studied what the programme should entail, that there should be European integrated broad-band communications (IBC) by 1995.

The panel of experts has accepted that this target date "is optimistic, but probably about right for full IBC services, provided that procurement decisions can be made in about 1992".

Working back from this target date gives a very demanding timetable, not least for the computer services industry. By the middle of this year there should be some memorandum of understanding about a set of pilot applications working towards a business-led introduction of IBC by 1992.

The panel of experts points out that this memorandum should be reached among administrative bodies (covering telecommunications, broadcasting and cable television), equipment manufacturers, and service providers.

It is as service providers that the computer services business will become involved in the RACE plan. So far, everyone is trying to keep an open mind on what services could make sense on IBC. The idea of a fibre-optic network able to carry live television as well as voice and high-speed data transmission in an integrated service, which is what IBC really implies, tends to direct thoughts towards entertainment services.

Business applications, however, could include such applications as extending an ASIC (application-specific integrated circuit) design service or creating an illustrated parts ordering service.

Such applications will require imagination and some brave investment decisions. But they give a flavour of the vision that pervades the RACE programme.

Participants regard the idea of a high-speed, high-capacity communications network as having the same potential for stimulus as the creation of networks for canals, railways, motorways, and airline routes.

The research seems to be on course and the panel of experts is sticking to the goal and the timetable. But the clock is running and there is still much work to be done. (Source: Computer Weekly, 9 February 1989)

European project comes up with a breakthrough TV screen

Finland's Lohja Corp. is ready to produce a monochrome flat-screen TV with a 12-in. electroluminescent screen. The event marks an important milestone in the European Community's RACE programme for Research and Development in Advanced Communication Technologies in Europe. The screen, including the electronic circuitry behind it, is only 54 mm thick. That means it can be used to make radically different TV sets - models that can be hung on a wall, for example. The screen is the largest developed so far using EL technology, claims Jorma Anston, marketing manager for flat screens at Lohja's Finlux division. The monochrome prototype runs off a 12-V dc power supply and consumes only 20 W. Images are built up from sizes of 200 by 384 pixels, each pixel measuring 0.6 by 0.6 mm. The project's goal is a colour version of the set, with commercial products available by the second half of the 1990s. Besides Lohja, the RACE participants include France's Matra Communications, the Italian-French combine SGS-Thomson Microelectronics, and the University of Ghent in Belgium. (Source: Electronics, March 1989)

New regulations for a new Europe

The 285 reforms proposed by the European Commission in Brussels cover wide areas of industry and life in Europe. Approximately 250 have been tabled at the Council of Ministers and about 100 have been adopted so far. Among the proposals are measures that will, if adopted, change many customary ways of doing things:

- Eliminate technical barriers to trade such as differing standards and regulations in the 12 member countries;
- Abolish restrictions on transfer of capital;
- Harmonize trading rules for automobile, pharmaceuticals, food, construction, and media and information technology industries;
- Liberalize financial services - there will be single banking licence, more open securities trading, common insurance market;
- Liberalize telecommunications, transport, and utilities industries;
- Liberalize public procurement policies of member States;
- Allow free movement of professionals between member countries;
- Eliminate border controls - goods will have a single transit document; and
- Harmonize tax and some social laws.

Special survey on the impact of 1992

A common trading market in Europe may be the goal, but IS approaches to it are still mostly nationalistic in nature.

The Acceleration of Standards

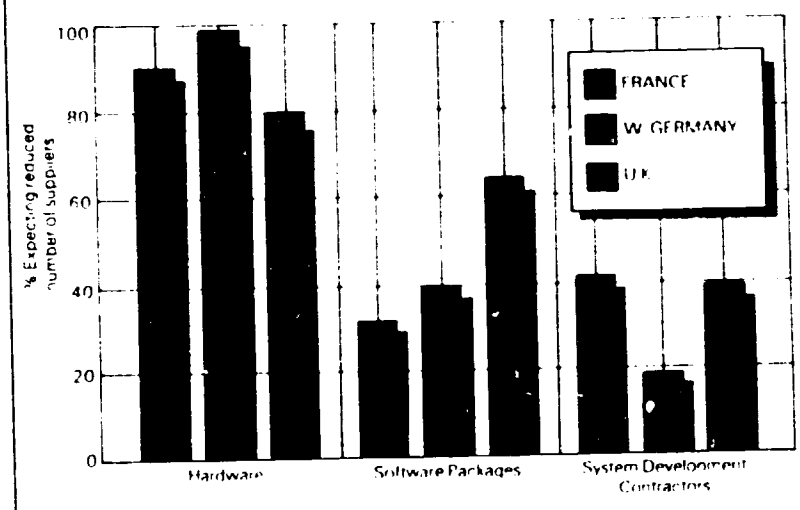
European users are most eager to embrace standards for operating systems as they revamp their IS strategies for 1992.

(by percent)	Operating Systems %	Packages %	Database Systems %	Software Dev. Tools %	Suppliers %
FRANCE	72	72	28	50	56
GERMANY	100	13	67	27	7
U.K.	29	32	19	20	24

Source DATAMATION/Price Waterhouse

Hardware Suppliers Face Shakeout

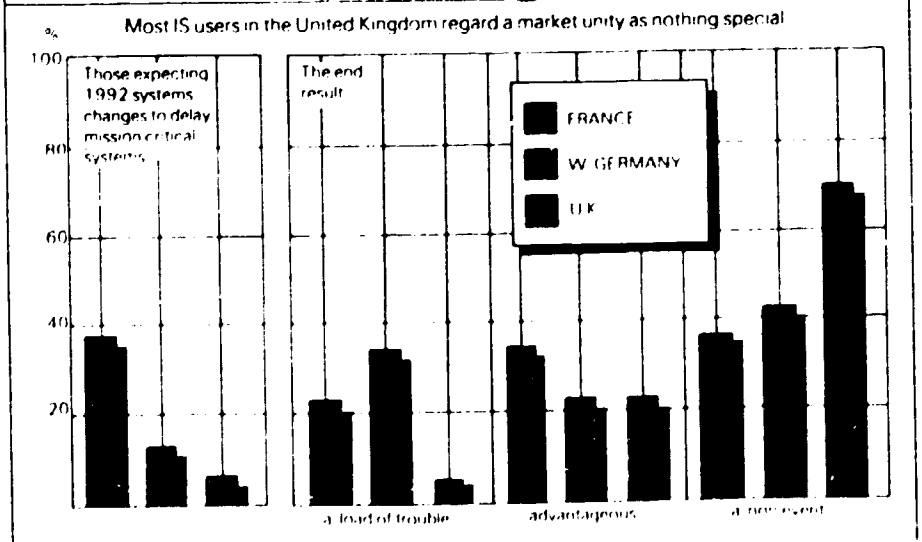
Most European users expect the number of systems suppliers to dwindle as 1992-inspired competition heats up



Source DATAMATION/Price Waterhouse

British Regard 1992 Cautiously

Most IS users in the United Kingdom regard a market unity as nothing special



Source DATAMATION/Price Waterhouse

That is the conclusion of a special survey of 100 European users by DATAMATION and accounting firm Price Waterhouse. Covering France, the United Kingdom, and the Federal Republic of Germany, the survey found that French IS managers are ahead of their continental counterparts in understanding the need to prepare for 1992. More than three quarters of French users believe a 1992 IS plan is necessary; under half of Federal Republic of Germany and United Kingdom users think so.

Advertising and conviction explain the disparities. The French Government's awareness campaign about the single market has been more successful than those in the other countries. Besides, many UK and FRG firms regard the single market as an extension of existing trends rather than as a new ball game.

Not many companies in the three countries have actually prepared a specific plan so far; France has the largest number of companies (17 per cent) that have a plan, followed by 13 per cent of FRG companies and only 9 per cent of UK firms. French users are certainly taking the changes very seriously. Almost 40 per cent predict that preparing for 1992 will delay the development of their mission-critical systems.

There is more consensus between the three markets on other issues, though. The overwhelming majority (90 per cent) of European users feel that the emergence of a single market will reduce the number of hardware suppliers in Europe, thus reducing the complexity of choice.

Prices are also likely to fall due to the benefits of the economies of scale, the effects of a reduction in tariff barriers, and increased competition. While around 40 per cent of French and Federal Republic of Germany users expect a reduction in the number of software suppliers as well as hardware suppliers, in the United Kingdom that expectation is higher - with more than 60 per cent predicting fewer vendors.

Reflecting the trend in the Federal Republic of Germany to tailor systems, users are confident that there will still be many systems development contractors around in the New Europe. That does not mean the software package market is in trouble. As one respondent put it: "One of the main advantages will be to establish common European core applications through the sensible use of package solutions".

A new era for standards

In fact, the greater standardization of systems - both those from suppliers and those being used within user corporations - is likely to be one of the most significant consequences of the single market. One French user predicts that there will be "a standardization of information systems in all European countries for our internal users and agents. We expect this to affect manufacturing, order processing, and distribution systems particularly."

Certainly users in all three countries expect European standards to influence their purchasing over the next four years. Operating systems purchases in particular will be affected. That is likely to have a shattering effect in the Federal Republic of Germany, where all the respondents predicted standards would influence their OS buys. A high number of French users (79 per cent) agreed, compared with only 29 per cent in the United Kingdom.

French companies also predict that their buying criteria for software packages and software development tools will be affected by 1992. FRG firms say they intend to alter their data base stragegies, while British users expect less influence in most areas.

Networking outward and upward

Network expansion also seems to be an inevitable consequence of the move towards a united Europe. "The single market, says one respondent, "will lead to more European links at the business level. IS will play an important part in providing the communications [infrastructure] for these links - electronic mail, electronic data interchange, etc. This will enhance the IS role in an organization."

That point was picked up by other users, too. The move towards a single market means that firms must prepare strategies to cope with the changes. Putting those strategies into practice presents "an opportunity for IS to become closer to the corporate strategy," says one UK user.

Another UK user takes the consequences of the process further, predicting that the single market will provide "an increased opportunity to push IS people higher up the company as it tries to deal with the business aspects of 1992".

Nevertheless, it will only be those IS executives who grasp the opportunities who are likely to benefit, and that is going to be tough for the UK since a large proportion of users remain cynical about the impact of 1992. A strong majority simply regard it as a non-event.

This attitude may change, though, as the pressures mount over the coming months. (Reprinted with permission of DATAMATION[r] magazine[c], 1 March 1989, copyright by Technical Publishing Company, A. Dunn and Bradstreet Company, all rights reserved)

Federal Republic of Germany

X ray lithography pilot work in Berlin increasing

European device research using X ray lithography exposure has trickled out in various reports since 1986. This work is being done with Karl Suss MAX I steppers attached to the BESSY synchrotron (Berlin Electron Storage Ring Society for Synchrotron Radiation) at the Fraunhofer Institute for Microstructure Technology (FIMT).

Now, based on reports presented in 1988, research efforts by microelectronics manufacturers in Europe, including Siemens, Telefunken, and Philips, appear to be accelerating and results are being related to commercial manufacturing applications. Reportedly, at least a dozen different devices have been fabricated at FIMT by European microelectronics manufacturers; reported work is summarized in table 1.

Table 1. European X-ray Lithography Device Research Done in 1988 With the SUSS MAX I Stepper and the BESSY Storage Ring, Berlin, W. Germany

X-ray research effort	Device	Critical dimension effective gate length (μm)	Lithography exposure levels		X-ray exposure levels	Remarks (reported at Microcircuit Engineering '88)
			X-ray	Optical		
Siemens Sietec	GaAs MESFET	0.45	1	3	Gate	Single device; same characteristics as comercial devices
Philips-Valvo	NMOS transistors	0.4-0.5	4	0	All	Electrical characteristics comparable with devices produced by e-beam lithography.
AEG Telefunken	Schottky diodes	0.6-0.7	2	4	Anode finger	Behavior as expected; cut-off frequency 90 GHz.
	MOSFET tetrodes	0.4	2	7	Gate and contact	Lower noise factor, higher cut-off frequency compared to commercial devices produced by optical lithography.
Institute for Micro-structure technology	NMOS transistors	0.5	4	0	All	Patterned exclusively by X-ray lithography.

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India

Software exports

The Government of India is to launch a package of incentives designed to boost the export of computer software. Most conspicuous is the provision of duty concessions on computer hardware imported for the development of software. The Department of Electronics is to complete technology parks at Bhubaneshwar, Bangalore, Chandigarh and Pune geared to the export of software.

Dedicated satellite channels will be provided for computer links with Western countries. Indian software exports, mainly to the United States, are currently worth Rs 800 million and are expected to be worth as much as Rs 3,000 million by the end of the decade.

The software trade is controversial because US engineers protest that they are losing jobs to India, and Indian engineers protest that they are much less well paid than their US rivals. (Source: Nature, Vol. 336, 8 December 1988)

Ireland

Teaching robots to see

The Department of Computer Science at Trinity College is involved in an EC project to teach robots to "see". Successful prototypes have been developed that use parallax in a similar way to humans to compute distance to an object. The work needs to live at the forefront of machine vision research but must also have a clear view of the commercial realities according to Dr. David Vernon of TCD.

The TCD work has won ESPRIT backing and partners include an Irish company, Captec, the University of Genoa, VDS of Florence and the University of Nijmegen. The philosophy in the vision group is to do two things at one time, to push back the existing technology and to try simultaneously to migrate that technology into industry. In terms of the project, the prototype is the front end of a complete vision system, like the eye itself that provides "early vision" before it can be analysed by the brain.

The prototype has two video cameras mounted 10 cm apart on a wheeled platform on a train track. The track is laid in an arc around a "target" scene of model houses. The system can view the scene and the algorithm calculates the distance from the platform to various houses.

The camera images are digitized using a "frame grabber" and are handled in memory as pixels. The two images can therefore be compared for the apparent change in position of an object caused by parallax and the distance is computed by the software. The prototype has been working for some time, but a year ago a separate research effort got under way to speed up the calculations using transputer technology. The original version required a 20 minute analysis on a Microvax system, not even close to real time. The newest version will do the same calculation in about a minute, not real time but clearly an improvement. This version could now be purchased by companies with use for such a device for between 4,000 and 5,000 Irish pounds, said Vernon, backing up his claim that it was worth doing if a company could afford to use it. The transputer design also allows for "stacking" of parallel systems to speed up calculations. Vernon hopes to stack 16 transputers to achieve three-dimensional ranging in as little as five seconds, still not real time but more than adequate for a guidance system in an automated vehicle, as would be used for example in an automated warehouse retrieval system. Such a device would cost about 40,000 Irish pounds based on the current hardware version.

Vernon's system only ranges to an object and does not attempt to recognize it. This work is being done by other project partners. It does however provide a crucial element of any automated vision system arising from the project and even in its present form offers commercial potential. (Source: Technology Ireland, January 1989)

New research in optoelectronics area

The establishment by Government of Optronics Ireland to promote and co-ordinate research activity in the area of optoelectronics will help to develop a higher profile for this technology here. It will also mean a welcome State research investment in excess of 2.25 million Irish pounds to be spent at five third-level institutions, particularly Trinity College and at the National Microelectronics Research Centre at University College Cork.

The National Institute for Higher Education, Dublin is participating with Dr. Martin Henry leading the effort there. The purpose of the research is to characterize the quality of the materials vis-à-vis the presence of defects and impurities and the role these play in electronic and optoelectronic devices, Dr. Henry explained. The work at the School of Physical Science is based on spectroscopic techniques, photoluminescence and optical absorption at very low temperatures. Samples are bathed in liquid helium to bring them down close to absolute zero for spectroscopic analysis and infra-red wavelengths can be analysed at a significantly warmer liquid nitrogen level. (Source: Technology Ireland, January 1989)

Italy

Texas Instruments plans semiconductor

Texas Instruments says it will build a $250 million advanced semiconductor wafer facility in Avezzano, Italy. Construction of the plant, which is to serve the European market, will begin early this year, with initial output expected in late 1990 and full-scale production by mid-1991.

It will produce metal-oxide semiconductor integrated circuit wafers, including dynamic random-access memory chips, which will be shipped to TI's Rieti, Italy, plant for assembly and testing prior to shipment. (Source: Chemical Marketing Reporter, 20 February 1989)

Japan

Joint effort to produce superconducting semiconductors

Government and industry will participate in an $80 million joint venture to develop technology for manufacturing superconducting semiconductors by 1999. The effort will include NEC, Toshiba, Hitachi, Sanyo/Umetric, Oki Electric Industry and Fujitsu, which will focus on developing superconducting devices. These firms will develop thin film and fine processing technology for designing, producing and evaluating superconducting devices. The joint venture hopes to find superconductive materials that have high critical temperatures, magnetic fields and current densities. Also participating in the joint venture will be the Agency of Industrial Science and Technology and six Ministry of International Trade and Industry laboratories. (Extracted from Electronic Engineering Times, 9 January 1989)

Large LDCs to be developed by consortium

A consortium is developing large coloured liquid crystal displays (LCDs) for consumer applications. The Ministry of International Trade and Industry will spend $52 million on the effort, while the 12 manufacturing firms involved will spend $22 million. The firms include Casio, Hitachi, Sanyo, Seiko, Epson and Sharp. The LCDs may be used in flat-screen colour TVs and super-thin copiers. A target is a 1-in. thick, 40-in. colour LCD that would weigh under 50 lb. Although development is planned by 1991, no products are scheduled until 1994. (Extracted from Design News, 13 February 1989)

US data base link helps open up Japan to the West

The Ministry of Education, Culture and Science (MESC) is giving US researchers on-line access to its scientific data bases. Computers at Tokyo's National Center for Science Information System (NCSIS) and the Washington headquarters of the US National Science Foundation (NSF) have been linked through international telecommunication lines and will reach out to US researchers through NSF networks from April 1989.

The new link, which will be extended to the United Kingdom and then Europe next year, complements efforts by the Science and Technology Agency to internationalize the massive data bases it runs at the Japan Information Center of Science and Technology (JICST). But there is still some way to go to provide electronic satisfaction to US negotiators' demands for "comparable access" - including access to basic technological research in private companies - voiced during negotiation earlier this year of the US-Japan Science and Technology Agreement.

NCSIS's Professor Shoichiro Asano hopes that the first step, of providing access to MESC's academic data bases, may make it possible for Japan to tackle the more difficult second and third steps of widening access to Government research institutes and to research in private industry. Much of the latter research, he points out, is "invisible" even to Japanese eyes. The US link is being financed entirely by MESC, with technical back-up and administrative help from NSF. Asano is hopeful that this "present" will demonstrate Japan's commitment to open communication.

For foreign researchers, the most valuable feature of the new link may be access to abstracts of academic conferences held in Japan. Abstracts are now often available in electronic form a few weeks after a conference takes place and long before a full scientific paper is published. Asano says that academic societies in the fields of electronics, computer and information sciences are making special efforts to ease foreign access by providing abstracts in English; researchers in the chemical and medical sciences are not far behind. Presentation and format will improve, he says, as evaluation comes in from foreign researchers.

The link also provides electronic mail, and access to the on-line academic library network and MESC's data base of grants for scientific research. The ordinary user will, however, be restricted to the fraction of the data base written in English, as special equipment (which has been installed at NSF headquarters) is needed to display Japanese characters. But information in English should help target material worth translating.

The language problem is not easily overcome. In late 1987, JICST began international on-line service by linking its own data bases (which emphasize space and nuclear power) with the Chemical

Abstracts Service in the United States and the Energy, Physics and Mathematics data base (FIZ - Karlsruhe) in the Federal Republic of Germany, but so far the flow of information has been mainly to Japan. The part of JICST data base of particular interest to foreigners concerns Japanese research; most of that is in Japanese and therefore inaccessible. JICST looks for a solution in machine translation, on which it is working hard. (Source: Nature, Vol. 337, 23 February 1989)

Japan plans fuzzy lift off

Japan's artificial intelligence researchers plan to apply fuzzy computing techniques to help NASA prevent a repeat of the Challenger space shuttle disaster.

In April over 40 companies from all industrial sectors are to set up the Laboratory for International Fuzzy Engineering Research (Life) with 20 million pounds sterling for a six-year research programme.

Around half the budget will come from Japan's Ministry for International Trade and Industry (MITI).

The target is to develop a fuzzy computer, a programming support environment and a range of key applications.

The project will extend fuzzy theory, designed to use human reasoning, which is often full of uncertainties. Such knowledge will be processed by a purpose-built computer, using computer languages which can handle generalities.

Fuzzy computing techniques will make information processing more user friendly, with a wide range of applications wherever data is overwhelming or incomplete.

Some 46 companies have so far applied to take part in the programme, including Hitachi, which will lead the project, Toshiba, Fujitsu, Toyota, Nissan, all Japan's leading steel makers and camera makers Canon and Minolta.

Already Japanese researchers have designed both analog and digital fuzzy chips, and fuzzy versions of the artificial intelligence languages Prolog and Lisp have been developed. A fuzzy version of the language C is also well under way.

The first few years of the programme will be devoted to basic research; little work has been done in fuzzy computing outside the narrow sector of control systems.

Project participants will have to agree on an architecture which will support fuzzy algorithms and select key applications areas in which to test the system.

Japan's industrialists have suggested a range of applications covering telecommunications, weather forecasting, image processing, investment, economic forecasting, engine control and medicine. (Source: Computer Weekly, 5 January 1989)

Spain

Information technology boom

The "costa del IT" may sound like a convenient cliché for information technology in Spain but it also happens to provide some useful analogies.

Like the tourists before them, technology companies have been attracted by the low prices in Spain. They have low overheads and cheap labour, plus a rapidly expanding local market.

Apart from these, and of course the sun and mandatory three-hour siestas, there are generous incentives offered by the Spanish authorities to foreign IT concerns, thanks partly to the lack of a major native computer company with the resulting patriotism.

Last, but not least, the impending unification of Europe has made it more desirable for both the Western and Eastern giants of the computing and telecommunications industries to have as large a foothold as possible in what is potentially the biggest market in the world.

US giant AT&T's European base at Tres Cantos, a purpose-built commercial dormitory just outside Madrid, is a prime example of the Spanish Government's endeavours to fill the gap left by the absence of a major national computer company such as ICL in the UK, Olivetti in Italy, Siemens in Germany or Bull in France.

Spain's aggressive policy on luring foreign IT companies to the country is also politically expedient; it provides permanent jobs which combat its high unemployment rates, and are preferable to the seasonal work available in agriculture and tourism.

IBM has also recognized the advantage of Spain's IT policy and is planning to set up a centre for technological research near Seville. Companies like Nixdorf have extensive Spanish operations and ICL recently announced a joint venture with local authorities to set up an applications software company in the Andalusian region of Spain.

Shifting focus to the East, Telefonica has joint chip and minicomputer manufacturing operations with Fujitsu.

The extent of Spain's policy of attracting IT investment can be gauged from a recent list of the 30 top foreign investors in the country. It includes Philips of the Netherlands, Nixdorf of the Federal Republic of Germany, Alcatel of France, Ericsson of Sweden and the United Kingdom's Amstrad.

Spain's IT expenditure is rocketing. A recent survey of IT expenditure per head of population showed that Spain's was increasing at a European high of 14 per cent a year with the UK trailing several places behind at 10 per cent.

Last year the Spanish Ministry of Industry and Energy revealed that domestic demand for semiconductors had grown at a rate of 25 per cent a year for the past four years.

While Amstrad was able to post a 22 per cent increase in turnover in its last full year, Alan Sugar, always a man with an eye for expanding markets, greatly increased the company's Spanish operation and was rewarded with a 74 per cent growth in PC sales.

Spain's production and use of IT may trail behind most of Europe's, but since its entry to the EC it has been making strenuous efforts to close the gap. Last year Italy's Olivetti joined forces with the Spanish telecommunications manufacturer Amper to form Olamptel.

Unlike some European nations which emphasize commercial funding for IT development, those involved in the Spanish IT industry openly advocate the maximum amount of public funding possible.

Telefonica, only 33 per cent Government owned, was the only private PTT in Europe before the British Telecom flotation. While it is strictly controlled by the Government, its growth from nowhere to the ninth largest telephone network in the world with healthy profits to boot has been impressive.

However, the economic boom in Spain, due in no small part to the country's aggressive IT policy, has created its own problems, with demand exceeding planned expansion. This has led to Spain's telecommunications service being labelled the worst in Europe, but the company believes the policy of selling off Telefonica's subsidiaries - thereby attracting foreign investment - and forming joint ventures, will solve the problems. And despite the temporary domestic difficulties the telecommunications boom is causing, there is plenty of evidence that Spain's policy towards attracting foreign investment to catch up with the IT giants of Europe is paying off.

On a more adventurous front, Ibercom, Spain's integrated business communications service, is doubling in size every six months.

The growth of Spain's IT exports has revitalized its traditional trading relationship with South America - Telefonica owns 40 per cent of Argentina's PTT - and has resulted in some less predictable deals.

One of these was a 25 million pounds sterling contract between Elektrim-Zwut of Poland and Spain's Alcatel Standard Electrica. In return for Spanish components, Poland will be allowed to market the resulting technological know-how of telephone exchanges in Spain.

The Spanish Government is keen to nourish IT growth with generous funding. It is anxious, however, to avoid over-enthusiastic mistakes that might result in the technological equivalent of the uncontrolled growth of unsightly concrete boxes which scar most of Spain's coastline.

To this end it recently passed telecommunications legislation aimed at curbing the potentially damaging and perhaps over-ambitious plans of Telefonica.

Pein II, the Government's recently published strategy for telecommunications and computer funding, is aimed at balancing commercial interests and directing effort towards pan-European research and development and standards initiatives. (Extracted from Computing, 9 March 1989)

United Kingdom

Maintenance research gets ESPRIT backing

Work has begun on a 6.5 million pounds sterling UK-led ESPRIT project aimed at improving techniques for software maintenance. Up to now maintenance has remained an under-researched subject in the IT industry.

A group of 11 European partners, headed by Lloyds Register of Shipping and including Oxford University and Marconi Command and Control, has started research on a European Commission ESPRIT II project called Redo.

Software maintenance chiefs have long complained that one reason why maintenance absorbs so much of IT departments' budgets (up to 90 per cent) is the lack of shared knowledge about good techniques.

For example, the main research reference used for maintenance today is the US Lienz and Swanson survey carried out 10 years ago.

Working on the assumption that prevention is better than cure, the Redo project will concentrate on software validation - looking into how to ensure that programs carry out what they are supposed to in the first place. Much of maintenance work goes into making the program function properly, rather than adding enhancements.

The Redo project will produce a toolkit to carry out validation and will concentrate on technical documentation, and how much is actually required for the purposes of maintenance. This has not been defined up to now. The third part of the project will cover the business of making changes and corrections to code. (Source: Computer Weekly, 12 January 1989)

Research work gets the green light

The Government has given the go-ahead to a 12 million pounds sterling national programme of research on interaction between humans and computers.

The five-year programme will involve universities and other research institutes in work on everything from system design tools to models of the way people learn.

It will cross discipline boundaries, with funding being managed jointly by the Medical Research Council, the Science and Engineering Research Council and the Economic and Social Research Council. The management team says the work will be as broad as possible.

Topics for which work proposals are being invited include system design tools and methods; interaction between humans and computers and between humans through shared computer systems; intelligent tutoring systems and the effects that different forms of presentation and feedback have on learning; and models of the ways people learn. (Source: Computer Weekly, 16 February 1989)

NCC finds managers ill-prepared for 1992

British computing installations face massive challenges with the arrival of the single European market in 1992 - but they are ill-prepared and risk being overtaken by events, according to a study by the National Computing Centre (NCC).

The system changes could be so far reaching that installations could even take the opportunity to rethink their whole approach to development, bringing in fourth generation languages, electronic data interchange and value-added network services, the NCC says,

Issues identified by the NCC range from the basic to the complex.

Personnel systems could need expanding to handle the new range of skills which will be needed.

Accounting systems might need to be changed to fall in line with the European Commission's new directives on auditing and on the layout of company balance sheets and profit and loss accounts.

New financial systems might be needed to cope with foreign transactions, currency dealings and so on.

There is likely to be growing use of electronic data interchange and computer-aided design and manufacturing.

Direct exporting is expected to increase, leading to system changes.

And new VAT rates are likely to be imposed across Europe.

The NCC says more fundamental questions will be raised by international takeovers and joint ventures.

A separate report by legal firm Clifford Chance gives a useful summary of the main business issues of 1992, including regulations affecting different trading activities. (Source: Computer Weekly, 2 February 1989)

Shake-up for UK electronics industry

The latest move in the reshaping of the European electronics industry could result in the take-over of the UK's largest electronics group, the General Electric Company (GEC), by an international consortium led by Plessey, the country's second largest electronics company. A firm bid has not been made and the members of the consortium are not yet known, but it is thought likely that it will include the UK companies Plessey and STC, as well as Thomson, the State-owned French company, and General Electric and AT&T of the United States.

British electronics companies are criticized for their reluctance to invest sufficiently in research and it is feared that if foreign interests were to dominate a consortium that controlled the company, then much of the defence research, which is the driving force of the UK's electronics industry, could go abroad. (Extracted from Nature, Vol. 337, 12 January 1989)

Oftel review presses for lifting of resale ban

Plans to deregulate the UK's private telecommunications networks and open up the market presently dominated by British Telecom have been drawn up by Oftel, the telecommunications watchdog.

The consultative document recommends lifting the ban on the resale of spare capacity on private networks and a simplification of fair trading rules.

The complexity of the present rules and the number of restrictions on private telecommunications systems has inhibited businesses from maximizing use of their systems.

The draft licence, if adopted by the Department of Trade and Industry, would replace the two class licences - branch systems general licence and value-added data services licence - currently in force. BT and Mercury are the only companies allowed to rent out lines to private network users at the moment.

If the DTI accepts the proposals, users as well as value-added network service suppliers will be able to install private voice networks. (Source: Computer Weekly, 2 February 1989)

UK and France to share project load

The UK and French Governments have teamed up to collaborate on projects where they share an interest in order to cut costs and prevent a duplication of effort.

The Central Computer and Telecommunications Agency (CCTA) and its French equivalent, Comité Interministérial de l'Informatique et de la Bureautique dans l'Administration (CIIBA), have signed a memorandum of understanding aimed at sharing the burden of new, innovative projects, particularly in expert systems.

The two bodies will also promote standards issues critical to both their Governments, notably Government Open Systems Interconnect Profile (Gosip), Structured Systems Analysis and Design Methodology (SSADM) and OSI technical and office program (Ositop).

The CCTA is also hoping to broaden its collaborative agreements by signing similar deals with other European Governments, particularly the Federal Republic of Germany. The UK, France and the Federal Republic of Germany are on the verge of announcing a common procurement policy for Open Systems, European Procurement for Open Systems (Epos), intended to bring the three together in this area. (Source: Computer Weekly, 12 January 1989)

United States of America

Major investments in new non-volatile memory technologies

US chip manufacturers are spending a great deal of money on new non-volatile memory technologies. The new technologies include ferroelectric RAMs, antifuse PROMs, and flash non-volatile memories, which unite the read and write features of EPROMs and EEPROMs. US semiconductor firms have recaptured their dominance in non-volatile memory, thanks to the 1986 semiconductor trade accord between the US and Japan, according to M. Villott, General Manager of the flash-memory division of Seeq Technology (San José, CA). The pact did little to bolster the US standing for DRAMs. M. Olsen, an industry analyst at Dataquest, says it appears likely that US companies will remain at the density and speed forefront in EPROMs and EEPROMs. Dataquest (San José, CA) expects the EEPROM segment to increase from $436 million in 1989 to about $707 million in 1992. In this segment, the major participants are the US companies Xicor and Seeq at the high-density end. Other US companies - such as General Instrument, International CMOS Technology, National, SGS Thomson, Atmel, Catalyst, and Exar/Exel are going head-to-head on a level playing arena with Japanese majors Hitachi, Fujitsu, Mitsubishi, and NEC. (Extracted from Electronics, March 1989)

Consortia urged to push superconductors

A presidential advisory committee has recommended a novel course: to compete successfully with Japan in the race to commercialize high-temperature superconductor technology with the

formation of consortia involving academia, industry and Government.

This approach is similar in some respects to the one Japan has used to commercially exploit other technologies. But rather than directly copy the Japanese model, the advisory committee calls for a home-grown and long-range R&D structure. The consortia would combine the scientific expertise of university and Government laboratories with the applications acumen of industry.

Formed last March, the Committee to Advise the President on High-Temperature Superconductivity believes four to six consortia with 10-year lifetimes could do the job.

The long-range commercial applications of high-temperature superconductivity include highly efficient transmission lines for electric power, ultrafast computers and powerful magnets for levitated trains, medical diagnostic devices and high-energy physics research. (Extracted from Chemical and Engineering News, 9 January 1989)

NSF opens high-speed computer network

Computer wizards may remember 1988 as the year of the worm - the time when a hacker nearly brought down the entire network that carries their electronic data across the continent. But it was a good year, too. A public system known as NSFnet has reached a high-speed transmission rate of 1.5 million bits per second, fast enough to unclog old traffic tie-ups and give scientists at remote locations a feeling of immediate access to US supercomputer centres.

The NSFnet was launched by the National Science Foundation (NSF) in 1985 as a means of opening up the supercomputer centres to distant users. It has grown into something far more ambitious. Today it is compared to a superhighway, to be used by any and all comers for whatever kind of research they like. In time, it is supposed to reach farther, run faster, cost less, and be more accessible than any other network in the world.

At present, however, the NSFnet is still under construction. One of the biggest challenges the builders will face in the near future is finding a way to charge for service. At the moment, maintenance is supported by a few private grants and a subsidy from NSF - justified as an aid to NSF researchers. But if the network succeeds in its goals, demand will grow, and users will have to come to grips with steadily rising budget demands. As yet there is no way to meter usage, which, no doubt, is one reason why the network is so popular.

The big news is that the "backbone" lines - crossing the United States in two redundant paths are up and running. Modest connections have been made to France and the Federal Republic of Germany, and others to the United Kingdom and Scandinavia are being negotiated. On the west coast, an arm is reaching towards Asia. A couple of slow links to Japan (9,600 bits per second) are already in place.

The NSF has committed itself to spending $14 million on the network through 1990. The project has received donations of hardware and software from the IBM Corporation, fibre optic connections from the MCI Communications Corporation, and $5 million from the State of Michigan (where the operations centre is located). The NSFnet is destined to serve as the high-speed lane in a complex, interlocking system called the Internet, or the National Research Network.

Overseeing the joint effort is a small group called the Federal Research Internet Co-ordinating Committee (FRICC). The agencies involved are NSF, the Defense Advanced Research Projects Agency (DARPA), the Department of Energy, the National Aeronautics and Space Administration (NASA), and the Department of Health and Human Services. By its own claim, FRICC has already improved efficiency by cutting back on duplicate satellite channels to Europe, each of which costs $120,000 a year.

Following the lead of two high-level reports on the use of computers in research, FRICC is now planning a bigger empire. NSF officials say that another $400 million in federal support will be needed through 1995, and that the speed will have to be raised 1000-fold. In time, NSFnet may become the trunk carrier for the entire tangle of university and Government laboratory connections known as the Internet, offspring of ARPAnet, the granddaddy of them all.

Although the NSFnet was initially promoted as a link to the supercomputers, it is rapidly growing into something bigger. The services it provides - electronic mail, rapid file transfer, access to exotic computing machines - are valued by all kinds of researchers. The goal is to link every research computer to every other research computer, in a kind of global electronic brain.

In the computer business, capacity and demand always chase one another in overlapping waves. Whenever capacity is improved, new users come in and old users find more demanding ways to use the equipment. The result is exponential growth in traffic. The NSFnet office at Merit Inc., in Ann Arbor, Michigan, reports that traffic on the backbone this year has quadrupled.

Another unique use of the network will be to hook into special data collections, but by far the biggest use of the network is for electronic mail. Scientific collaborators separated by thousands of miles use it to keep in touch on the progress of research, sending results and comments back and forth on a daily basis. Although the network at present has no way of distinguishing mail packets from, say, processed data packets, officials guess that 80 or 90 per cent of the traffic is mail.

None the less, there are still major obstacles to be overcome if the NSFnet and Internet are to live up to promises being made, of which the three biggest are international protocols, billing and priority routing and security. (Extracted from Science, Vol. 243, 6 January 1989)

VII. FACTORY AUTOMATION

Reasoning robot being tested

Martin Marietta (Bethesda, MD) will test a "neural network" system that would enable robots to operate on their own with little supervision by humans. The firm is creating software based on a new mathematical model that allows computers to "learn" and "reason" without a great deal of external programming. The project is being pursued for the Avionics Laboratory at Ohio's

Wright-Patterson Air Force Base. The neural control system will be tested on an industrial robot resembling a forklift and a human-like robotic arm. By using a variety of optical and sonar sensors, the arm will be "taught" to pinpoint the locations and positions of objects it will be required to lift and move. Martin Marietta hopes to sell the technology to manufacturers of unmanned land and underwater craft, and of automated machinery. Possible applications would be for work on assembly lines and disposing of hazardous wastes. (Extracted from Wall Street Journal, 16 March 1989)

Two levels of neural networking run robot motion

Fujitsu uses two levels of neural networking to run robot motion. Each robot has a "reason" network with 13 sensor inputs, nine interconnection units and seven outputs; and an "instinct" network with five each input, interconnection and output units. Instinct net shares right- and left-limit input with reasoning net, and also receives input from a short-term memory (SRM). Both nets share five motor outputs (forward, back, turn right, turn left, buzzer), and the reason net additionally outputs excitory or inhibitory signals to the STM. In the absence of stimuli the reasoning network defers to the instinct network, which maintains a search pattern. In the presence of stimuli the reasoning network takes over, but the instinct network continues to monitor the internal state of the robot and send out modifications of reason-net commands - e.g., reason says back up from an obstacle, instinct adds turn left at the same time to recover full manoeuvrability. Fujitsu displays the robots in a cops-and robbers chase scenario to dramatize the action. (Extracted from Electronics Engineering Times, 6 February 1989)

Robot applications

Robot makers are seeking applications in service industries. Some 75 per cent of the market may be in the service sector, according to J. Engelberger of Transitions Research. Applications could be found in fast-food restaurants and hospitals. Commercial cleaning services and the handicapped or elderly might also benefit from robotics. Transitions Research is developing a robot to work as a nurse's aide. The US robot industry had sales of only $300 million in 1988 (down from $550 million per year in the early 1980s), and Japanese robot firms had sales of only $60-80 million.

The Robotic Industries Association predicts growth of 5-10 per cent per year while Dataquest says robot sales will rise only 4 per cent per year through 1992, which when adjusted for inflation means no growth. The new robots will have to use advanced technology such as vision systems, tactile sensors and voice recognition. Robots might be used to deliver medicines or meals. Prab Command has developed a robot to let a person without arms or legs work in an office by using voice commands. Although the system might cost $30,000 50,000, it would return workers to a productive life and save insurers a lifetime of disability costs. E. Mittelstadt of GMF Robotics predicts a resurgence of robotics for industrial applications as well, saying many manufacturing companies could still improve their productivity with today's robot technology. Sales growth of 25-30 per cent per year is possible. The three large broad based robot firms in the US are ASEA Brown Boveri, GMF Robotics and Cincinnati Milacron. But there are many small robot makers, each with a special market niche.

Robots and computers should be used to fight bushfires, according to the Australian Institute of Engineering which, in a report, condemns the current state of technology used to fight bushfires. Robot vehicles should also be used to gather data and perform reconnaissance functions at the periphery of fires. Regarding computers, the report calls for the adoption of CI-COM (Computer-Integrated Bushfire Countermeasures) to integrate bush firefighting strategies at various levels. (Extracted from New York Times, 14 February 1989 and MIS Week, 13 February 1989)

Double vision for robots

Scientists working at Eastman Kodak in the US have unveiled a development which will double the vision capabilities of robots, weapons systems and industrial equipment.

The invention is a sensor consisting of four million square picture elements, each measuring 9 x 9 microns. The cells are made from silicon, using exactly the same technology used in other semiconductor devices, and work by producing an electron every time a photon of light arrives at their surface.

According to Dr. Rajinder Khosla, the main problem which the company has solved is yield. But whilst a wafer of electronic components is sliced into individual dice after production, the image sensor, which measures about 2 cm square, needs to be used as a whole, so a single bad cell makes the whole device useless.

The company has sample quantities of the device available now, with volume shipments in the US scheduled for the middle of 1989, and European availability later in the year. (Source: Electronics Weekly, 25 January 1989)

Robots to ease the burden in hospitals

An ambitious project to build intelligent robots as assistants for doctors and nurses in hospitals began in February. The programme is split between three teams. The first will work on a robot to help surgeons with pin point precision in eye and brain operations. The second will work on a robot designed to help nurses to lift patients in hospital, and the third on a "fetch-and-carry" robot for disabled people. Fulmer Systems, a contract research group, will co-ordinate the 3 million pounds sterling project, which brings together scientists from academia and industry. The three year programme is sponsored by the UK Department of Trade and Industry, and will require each team to develop some of the most advanced techniques in robotics. They will also have to master sophisticated sensor technology and make use of complex software, with built-in knowledge from experts, which will control the robots.

The robot destined for work in the surgery must be able to distinguish between bone and muscle, and between different types of human tissue, so that it can cut out tumours but leave healthy tissue intact. Fulmer is working on advanced sensors which use ultrasonics to produce far better resolution than is possible at the moment, to cope with such delicate operations. The teams will also have to develop vision and tactile sensors, which can "see" and "feel" their way around the human body.

The difficult part, according to Patrick Finlay, who heads the engineering and

robotics division at Fulmer, is to cope with the mass of data which each sensor produces, in real time, so that the surgeon has enough information to instruct the robot to carry out its next task. The researchers will have to employ some form of rapid number crunching, possibly by using parallel-processing techniques. It would be almost impossible to produce a robot this advanced within the three years, so the researchers will use their time to try to understand the generic problems of surgery. One plan is to produce a robot which can perform biopsies on brain tumours. The surgeon would align the drills, but the robot would make the hole, and remove pieces of tissue as samples. In this case the robot might be equipped with an expert system, so that it could work out the best route into the tumour, with the least possible damage to the surrounding, healthy tissue.

The robot for handling patients could resemble a conveyor belt, and slide the patient from their bed onto a trolley, or may echo a fork lift truck, with a number of "arms". Finlay says that under either design the robot will still need a degree of co-operation from the patient, who will have to move themselves into a position which the robot can cope with. It would have limited use for the patients who are most difficult to lift, because they are unable to co-operate. The robot would have to be able to work round intravenous drips attached to patients, some of whom may be amputees - with their centre of gravity in a different place - or have burns or other skin damage, which mean they have to be lifted with care. Nurses would program the robot with a template of the body shape and injury or disability of patients when they first assess them.

The fetch-and-carry robot will be designed to operate in a patient's home, which would be equipped with wires under the carpet to guide the robot by electromagnetic induction. This robot would move between "work stations", such as the cooker or fridge. (This first appeared in New Scientist, London, 28 January 1989, the weekly review of science and technology)

Planning for automation

Automation is still a term which conjures up mixed feelings. Some feel that it takes control away from people and others that it enhances human labour by eliminating boring tasks.

The fact is that automation is justified mainly by reducing costs. Ideally the return on an investment period is two years. After that the new machine should be profitable.

When comparing the cost effectiveness of a new automation process, companies should not alone compare it with the direct cost of the labour, but also the indirect labour costs such as supervision. Further benefits are the scrap level savings resulting from improved efficiency. Many automatic machines function with little or no supervision which means that two or three shift operations can be introduced thus increasing the level of production without increasing the level of labour.

When the products are required of a consistent quality, it may not always be possible for human operators to achieve the exacting requirements. In other cases, continuous on-line testing may be necessary to ensure that the product conforms to industrial standards. In both cases the production managers will require tight control of certain parameters and this control can best be provided by automation.

In industries such as those in the food and health-care sector, hygiene is crucial to preventing contamination and ensuring quality. Here automation processes can be designed using specially selected materials to provide a much more sterile system than can be achieved by manual operations.

When introducing an automation programme, working with a reputable indigenous automation company can have considerable advantages. Proximity facilitates easy interfacing and co-operation, regular progress monitoring, inexpensive delivery and rapid service. All of this has to be achieved without compromising quality, expertise or engineering integrity.

When briefing the builder of the automation process the client needs to supply all the information necessary to ensure that they achieve maximum benefits from the system including:

- Explanation of the existing method of operation;
- Description of quality, maintenance, safety and hygiene problems;
- Figures on current production rates;
- Samples of entire product range using existing processes;
- Outline of required production rates;
- Plans for product range;
- Plans for manpower levels;
- Consideration of quality, safety, hygiene and tolerance;
- Outlines of potential problems.

It is essential that the client confines himself to defining the problem rather than proposing the solution. Otherwise he may ignore some of the factors causing the problem, this limiting the capacity of the builder to tackle all of the issues. (Source: AMT, March 1989)

VIII. STANDARDIZATION AND LEGISLATION

Legislation

Computer microcode instructions judged within copyright

A Californian court has declared that microcode instructions on microprocessor chips can be protected by copyright. The decision, expected to be a landmark for microprocessor manufacturers, is likely to deter outright copying of microprocessor design.

Although computer programs were added to the US Copyright Act by Congress in 1980, the status of microcode - the set of instructions determining how a processor's components will perform a specific function - was unclear. As with any other program, a variety of instruction sets could be devised to achieve the same goal. The ruling puts microcode "squarely within the definition of 'computer program'", and therefore subject to copyright protection.

The ruling also ends a seven-year dispute between Intel Corporation, of California, and NEC Ltd., of Japan. Intel claimed that NEC's "V-series" of microprocessors infringe Intel's copyright of its 8086 and 8088 chips, used in the first generation of IBM personal computers. Although the court upheld Intel's right to copyright the microcode, it none the less absolved NEC of having violated that copyright, allowing both sides to claim victory in the case.

The first trial of the lawsuit was discontinued in 1986, when NEC objected that the judge owned a small amount of Intel stock. The judgement in the second trial declared that microcode can be protected by copyright, but found that NEC's microcode is sufficiently different from Intel's not to be a violation. Intel was also found to have forfeited its copyright by not requiring licensees to place notice of the copyright on their chips. NEC now has 11 per cent of the $7,000 million microprocessor market, compared with Intel's 26 per cent share, but NEC officials predict that the court's vindication of its practice will improve its sales. (Source: Nature, Vol. 337, 16 February 1989)

EC plans promise copyright chaos

Independent software developers could lose their rights to copyright protection, with a threat from the European Commission (EC) to reverse UK laws. The EC also plans to undermine the so-called shrink-wrap licensing system.

Present UK law automatically gives copyright protection to the independent contractor who writes the software - not to the buyer commissioning the work.

In a draft directive, the EC shows it intends to change this, and to give copyright ownership instead to whoever pays for bespoke software.

UK lawyers specializing in IT believe the EC is mistakenly trying to apply its laws for chip protection to software. In the process it could disrupt existing contracts between suppliers and users.

The Federation Against Software Theft (FAST) is among the industry groups lobbying against the EC's move. It believes the commission has slipped up with its treatment of shrink-wrap licences in the draft directive. With the shrink-wrap system, the terms of a software package licence are visible under the wrapping, and by breaking the wrapping it is assumed the buyer understands and agrees with the terms of the licence. (Source: Computer Weekly, 23 February 1989)

Akzo gets US superconductivity patent

Akzo, the international chemical firm based in the Netherlands, has become the first company from any nation to receive a US patent for one of the new high-temperature superconductors. The patent, No. 4,804,649, is for a process for making yttrium-barium-copper oxide ($YBa_2Cu_3O_x$) powder. The process involves using an oxalate reagent under basic conditions to co-precipitate yttrium, barium, and copper in a 1:2:3 molar ratio from an aqueous solution. The process was invented by Fawzy G. Sherif at Akzo's research centre in Dobbs Ferry, NY. Other researchers may still receive patents that are more fundamental and far-reaching than Akzo's. Last November, Massachusetts Institute of Technology said it expected to receive the first US patent in this field, but the Patent Office has not issued it yet. (Source: Chemical and Engineering News, 20 February 1989)

Standardization

Common EDI standards

Attempts to create a common EDI (electronic data interchange) standard for the US and Europe is causing users and industry standards bodies concern. The industry standard for EDI in the US is ANSI X.12, to which many firms have just begun migrating. In Europe, the industry standard is the Article Numbering Association's Tradacoms. The International Standards Organization has proposed a world-wide standard called EDI for Administration, Commerce and Transport (EDIFACT). US companies, which use the EDI standards particular to their respective industries, have just begun migrating to X.12 and may be unwilling to migrate to EDIFACT. These firms are using EDIFACT when dealing with overseas partners and retaining X.12 for domestic use. European companies, especially those in the UK, are also adhering to Tradacoms, but these companies are being enticed over to the EDIFACT standard by the creation of a single European market in 1992. Adoption of EDIFACT will position these companies to take advantage of the single market. (Extracted from Computerworld, 6 February 1989)

Emerging CASE standard

British software company, Software Sciences, has completed the porting of the fast-emerging international standard for computer-aided software engineering products, called the Portable Common Tool Environment (PCTE), onto Digital VaxStation and DECWindows systems. The standard allows PCTE-compliant CASE tools to be transferred easily from one machine to another. In Europe PCTE is already widely used in the research community; it is the subject of a pan-European development project; and it is currently being prepared by the European Computer Manufacturers' Association (ECMA) as a proposed international standard. (Printed with permission of DATAMATION[r] magazine[c] 1 January 1989, copyright of Technical Publishing Company, A. Dunn and Bradstreet Company, - all rights reserved)

Safety study urges voluntary standards

Safety critical software should be written to voluntary rather than mandatory standards, according to a group studying existing industry practices.

The year-long joint study by the British Computer Society (BCS) and the Institution of Electrical Engineers (IEE) will propose a development model and a technical framework for the development of safety critical systems.

The group issued interim findings at the end of September 1988, which highlighted the fact that only 15 per cent of the IT industry uses industry-specific standards. The rest rely on the Health and Safety at Work Act (1974), which obliges the designers of systems to make them as safe as possible. (Source: Computer Weekly, 30 March 1989)

PC makers get closer to 32 bit standard

IBM's rivals in the personal computer (PC) market are making headway in their attempts to

develop an industry-wide standard for 32-bit machines. They have announced that all the key aspects of the so-called Extended Industry Standard Architecture (EISA) have been settled.

This makes it almost certain that EISA-based PCs will appear by the end of the year.

The whole aim of EISA is to develop 32-bit PCs which can talk to each other, use common software and expansion boards while still remaining compatible with existing industry standard 8-bit and 16-bit PCs.

Engineering samples of chips needed for EISA machines will be available from Intel in the second quarter of this year with production quantities being shipped later this year. Samples of the EISA connector, designed to handle expansion boards for 32-bit EISA machines, and older 8-bit and 16-bit PCs, will be available in the second quarter from US connector makers.

The EISA connector carries a second row of contacts, for 32-bit boards, below the industry standard set of 16-bit contacts. The connector sports special stops preventing 8 bit and 16-bit boards from plugging into the 32-bit contacts and EISA expansion boards will be notched to get past these stops.

Next year should see an interesting fight between EISA and MCA-based machines. (Source: Electronics Weekly, 15 February 1989)

IX. RECENT PUBLICATIONS

URISA conference proceedings

Proceedings of the 26th annual conference of the Urban and Regional Information Systems (URISA) Association, held in August 1988, are now available. The conference, on the theme of "Mapping the Future", focused on the importance and use of automated information systems in planning and managing local government operations. The proceedings may be purchased as a complete five-volume set or as individual volumes.

Volume I: Land records; natural resources contains 14 papers on the use of advanced computer technology in the management of land records and natural resources data.

Volume II: Geographich information systems (GIS) includes 16 papers on GIS development and use in government.

Volume III: Microcomputers; information resources managment; systems integration; new technology presents 30 papers concentrating on these topics.

Volume IV: Infrastructure management; transportation; regional agencies; public administration; demographic, economic and attitudinal analysis; public information; research agenda group contains 36 papers dealing with these wide ranging issues.

Volume V, consisting of abstracts of the papers in the preceding volumes.

The cost of the proceedings is $US 55 for the complete five volume set. If purchased individually, Volumes I and II are $US 9 each, Volume III is $US 20, Volume IV is $US 22, and Volume V is $US 5. URISA is a non-profit organization which aims to provide ongoing education related to automated information systems within the government environment. For further information, please contact: Tom Palmerlee, Executive Director, URISA, 319 C Street S.E., Washington D.C. 20003, USA. (TP+1 202/543 7141). (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

OECD NGO directory updated

The Development Centre of the Organisation for Economic Co-operation and Development (OECD) has decided to update its two-volume Directory of Non-Governmental Organizations in OECD member countries. Last published in 1981, and now out of print for a number of years, the directory has been considered a useful tool by many development practitioners. The new edition is due to be published later in 1989.

As in the case of the 1981 directory, the new edition will cover non-governmental organizations (NGOs) active in the following two fields, perceived by the NGOs themselves as interdependent aspects of the development process as a whole:

- Development actions, i.e. financial, material, technical or personnel assistance in developing countries; and

- Development education, i.e. the education of public opinion in the OECD member countries on development issues.

Each organization's profile will offer general information on its overall operation, as well as specific information about development actions and development education. The profiles will be complemented by a series of simple and cross referenced indices.

The information gathered for the directory will be stored in a computerized data base at the OECD Development Centre, designed to provide selective information retrieval on request, following the publication of the directory.

For further information, please contact: Mr. Giulio Fossi, Head, External Relations, OECD, 94 rue Chardon-Lagache, 75016 Paris, France. (TP+45 24 82 00; TX 620160 OCDE PARIS). (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

ILO documentation for MICRO ISIS users

The Central Library and Documentation Branch of the International Labour Organisation (ILO) has produced the following documents, intended for users of the CDS/ISIS (Mini micro Version) software for bibliographic data bases:

- Bibliographic field description: manual for MICRO ISIS users is intended to help users of the software (produced by the United Nations Educational, Scientific and Cultural Organization (UNESCO)) who wish to create a data base similar to ILO's LABORDOC data base. It will also assist those who receive LABORDOC records in CDS/ISIS (Mini micro Version) format. The manual is available in English, French and Spanish.

  MICRO ISIS training course: data processing principles and applications (data bases for bibliographic records and serials, training material and training institutions,

addresses, and registration of mail), is an introduction to searching, printing, data entry, database definition and data exchange.

Copies of these documents are available, free of charge, from: ILC Library, 1211 Geneva 22, Switzerland. (TP+41 22/99 86 75). (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

Annual review of information science and technology

The 23rd edition of ARIST, the Annual review of information science and technology, published in 1988, examines critical developments in basic techniques and technologies, applications of technology, and the planning of information systems. Published by Elsevier on behalf of the American Society for Information Science (ASIS), ARIST provides timely coverage of, among other topics: information marketing for libraries; optical disks and CD-ROM; publishing and access; quality control in online data bases; psychometric measurement and information retrieval; office automation, and information and information technology management.

Priced at $US 79.50 (except to ASIS members, who pay $US 55.60), the 380-page book is available from: Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, the Netherlands; or, in the USA, Elsevier Science Publishing Co., Inc., P.O. Box 882, Madison Square Station, New York, NY 10159, USA. (Source: ACCIS Newsletter, March 1989)

Informatics for development: the new challenge

What impact will the dramatic technological strides being taken in the fields of computers and communications have on third world countries, and what can be done to ensure that this impact is beneficial? Held from 1-3 October 1987, the Tokyo meeting of the North South Roundtable on the Informatics Revolution addressed this question from both the developed and developing countries' point of view, and identified priorities for international co-operation. Asserting that the acquisition of information technology is not an option but a necessity for all countries, the Roundtable underlined the need for cost effective and appropriate applications in developing countries.

Published in 1988, and edited by Khadija Haq, this 251-page paperback brings together papers presented at the Tokyo meeting. It is available, price $US 10, from: Special Assistant to the Executive Director, North South Roundtable Secretariat, P.O. Box 2006, Islamabad, Pakistan. (Source: ACCIS Newsletter, March 1989)

Providing access to United Nations data bases

Many database producers within the United Nations system would like to make their data available to a wider public, and need information on how to do so. Providing access to United Nations databases: a guide for United Nations data base producers is a new ACCIS publication aimed at units which are considering making their computerized data available, via on line services, to member States and their United Nations system colleagues.

The 90 page publication is in two parts. The first identifies issues to be considered in framing access policies, while the second contains information about the data base access policies of United Nations organizations which identified themselves to the ACCIS Secretariat as having data bases.

Providing access to United Nations data bases: a guide for United Nations data base producers is an edited version of a report submitted to ACCIS at its meeting in September 1987 by its Technical Panel on Database Access (TP/DBA). Chaired by Mr. A. Filippov of the International Atomic Energy Agency (IAEA), TP/DBA's initial task was to review current trends in the fields of data base access and propose guidelines for the dissemination of information provided by the United Nations system in machine-readable form.

Following the decision of the ACCIS Steering Committee that the production of guidelines for the whole system was an unrealistic goal, the Panel was requested to prepare a compendium of existing data base access policies within the United Nations system, and a list of issues for consideration in framing such policies. The publication is available (ISBN 92-1-100342-3), free of charge while stocks last, from the ACCIS Secretariat. (Source: ACCIS Newsletter, March 1989)

Register of development activities published

The first edition of the Register of development activities of the United Nations system, covering development activities current in 1987 and carried out by 33 United Nations system organizations, has just been published. This publication, which represents the coming to fruition of one of the most important components of the ACCIS work programme, contains within its 752 pages information on over 20,000 activities for social and economic development.

The publication of this first edition of the Register is the culmination of five years of intensive effort. It was undertaken in response to a request by the Economic and Social Council in resolution 1982/71, and the General Assembly in resolution 37/226. Responsibility for producing this Register was given to ACCIS by the Administrative Committee on Co-ordination.

The Register is intended to give a comprehensive picture of United Nations system development activities, and therefore its criteria for inclusion had to be broad. The principles established meant that activities reflecting measurable development activity, carried out at comparable reporting levels, were included. In the final analysis, however, it was the organizations themselves which decided what a development activity is, in the context of their particular field of operations.

The underlying data base management system used for the Register data base was UNESCO's CDS/ISIS (Mini-micro Version 2). Additional programming was necessary for certain types of data validation, compilation of reports and photocomposition by the ACCIS Secretariat using its own microcomputing facilities. This in-house photocomposition considerably reduced the production costs of the printed version by obviating the necessity of having to recheck every item photocomposed from a magnetic tape by an outside printer.

While the Register is capable of improvement in future editions, the main question which its publication raises is whether it meets, however imperfectly, an actual, perceived need and is, or can become, a useful tool for its users. Discounting the preparatory work carried out by the Technical Panel, and efforts within agencies to gather data, the cost of implementing the Register was roughly equivalent to the cost of two Professional staff members, both working over a period of three years. Does the Register justify this cost, and is it worth pursuing? The answer lies in the hands of the users.

The Register of development activities of the United Nations system 1987 is available, price $US 30, from United Nations Sales Sections in Geneva and New York. United Nations Sales Number: GV.E.88.0.4. (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

DIALOG courses for on-line searchers

DIALOG, Inc., the on-line host which provides access to over 300 data bases on almost every conceivable subject, is running courses in information retrieval from the DIALOG system for both beginners and more advanced users in a number of European cities. Courses will be taught in either English or French. Readers who might be interested in attending one of these courses should contact DIALOG Europe, P.O. Box 1881, Oxford OX1 5AX, United Kingdom. (TP+44 865/730 275). (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

International tariff information on floppy disk

Eurocalc, produced by the Eurodata Foundation, is a data base on floppy disk which offers speedy access to information on international tariffs for data and voice communications in Western Europe. The data base covers all tariffs mentioned in the Eurodata Foundation Yearbook and Voicebook, two annual publications which provide a complete country-by-country picture of data and voice communications in Western Europe. The Yearbook also has an appendix on Japanese and North American data communications tariffs. The Eurocalc data base, which can be used on any PC-compatible microcomputer, has the capability to convert currencies, and displays data in spreadsheet format. Never before, the makers claim, has it been possible to cost and compare routes so quickly.

Eurocalc operates with standard working numbers - a process which opens up new approaches to network and services costing. It is available by annual subscription, covering the original disks, published in April 1988, and an updated set published in October 1988. For futher information, contact: Eurodata Foundation, 54 Fetter Lane, London EC4A 1AA, United Kingdom. (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

More on Development Data Bases Service

In addition to information given in the September 1988 issue of the ACCIS Newsletter on the Development Data Bases Service offered by the International Development Research Centre (IDRC), readers should take note of the following:

- IDRC's clients are all non-profit organizations;
- For access to United Nations data bases through this service, permission is required from each organization concerned, before access can be given by IDRC;
- The data bases listed in the article represent only a selection of those available.

For further information on this service, readers should contact: Development Data Bases Service, The Library, International Development Research Centre, P.O. Box 8500, Ottawa, Canada. (Fax: 613 238 7230; Cable: RECENTRE; TX 053 3753). (Source: ACCIS Newsletter, Vol. 6, No. 5, January 1989)

New studies from ITU

In many countries, particularly from the developing world, telecommunications have often received scant attention in the allocation of scarce resources for socio-economic development.

The International Telecommunication Union (ITU) has undertaken special efforts to show that telecommunications cannot be overlooked in the development process. As part of these efforts, it has published three economic studies (available in English, French and Spanish from the ITU Sales Service, Place des Nations, CH-1211, Geneva 20, Switzerland):

Telecommunications and the national economy (33 Swiss francs). The ITU says that good telecommunications are not a result of, but a pre-condition to, overall economic growth and development. The study shows the relationship between various economic and telephone-related indicators with respect to the gross domestic product (GDP) per capita of a population and the economic benefits resulting from telephone calls made from a single line at various levels of the GDP. It also suggests areas for possible future research.

The benefits of telecommunications to the transportation sector of developing countries (45 Swiss francs). The improvement of the transport system is a prime objective of third world countries because the health and buoyancy of national economies rely to a great extent on well organized and efficient transport systems. For example, it has been found that the costs of transporting goods can be substantially reduced, provided adequate telecommunications facilities exist. The following annual savings were estimated:

- $US 10 million through reduction of delays caused by breakdowns;
- $US 1.5 million on account of the increase in the number of return loads;
- $US 160,000 from the reduction in losses of perishable goods.

The cost of installing the telecommunications facilities required would represent approximately 10 per cent of the above savings and the operating costs would amount to some 1 per cent of the annual benefits, leaving substantial net benefits to the country.

Contribution of telecommunications to the earnings/savings of foreign exchange in developing countries (37 Swiss francs). The study is centred on Kenya, whose economy offers a representative mix of the agricultural, industrial and service sectors, typical of a developing economy. It concentrates, through sample case studies, on the impact of shortcomings in the telecommunication services on the performance of export-oriented businesses of 20 selected companies offering a cross-section of the three above-mentioned sectors.

The purpose of the study was to determine whether investment in major telecommunications projects could improve a developing country's foreign exchange position.

(Source: Development Forum, No. 9, March/April 1989)

Properties of amorphous silicon (second edition)

INSPEC, the Information Division of the Institution of Electrical Engineers, announces the publication of the second edition of Properties of amorphous silicon.

The second edition reviews major advances in amorphous silicon R&D and provides a new perspective on the earlier edition of this publication. It contains some 200 specialized reviews from over 50 researchers of international reputation. The foreword is written by Professor P.G. LeComber of the University of Dundee, Scotland and the introduction by Dr. H. Fritzsche of the James Franck Institute, University of Chicago, United States of America.

The contents include evaluated numerical data on all the various forms of amorphous silicon, including glow-discharge-deposited, sputtered, CVD, photo-CVD, evaporated and ion-implanted. The alloys (a-SiC, a-SiGe, a SiN, etc.), microcrystalline silicon and superlattices are also examined in detail.

This publication will be of extensive interest to research managers, specialists and even newcomers to amorphous silicon work. It may be purchased, or further information obtained, from the following address. Prices UK 140 pounds sterling and outside UK 150 pounds sterling. INSPEC Marketing Department, Station House, Nightingale Road, Hitchin, Herts. SG5 1RJ, United Kingdom. (Source: INSPEC Information News, April 1989)

Dictionary comes up on screen

The 20 volume second edition of the Oxford English Dictionary is published - and thanks to computers it has taken just five years to produce, compared with the 70 years needed for the first edition.

In addition, the use of computers has opened up new markets for the 500,000 plus definitions, 2.4 million quotations and 60 million words which make up the 22,000 pages.

The volumes were helped by a donation of a 4341 mainframe worth 1.3 million pounds sterling by IBM, a 289,000 pounds sterling government grant, plus software development by Waterloo University in Canada, supported by a $1.3 million grant from the Canadian Government.

Waterloo University developed software which put different parts of an entry into the appropriate fonts, capital letters, italics and so on.

Data entry, involving 350 million characters, was done by a bureau, International Computaprint.

Oxford University Press used IBM's standard SQL data base, which now holds the revised version of the first edition, the supplement, plus new words and meanings as they are discovered.

The version launched is in book form, but Oxford University Press is preparing a CD ROM version for launch in 1991. (Source: Computer Weekly, 30 March 1989)

Lucrative licensing

Electronics companies can generate a highly profitable stream of revenue by licensing their technology, according to a new report published in the United States.

The report, Technology Licencing in the Electronics Industry, reveals Texas Instruments received some $191 million from new licensing revenue in 1987 and stands to make $300 million in 1990. Polaroid is seeking more than $6 billion from Eastman Kodak, GM Hughes and the US Government for using Kodak Technology claims the report, which was compiled by Saratoga-based Electronic Trend Publications. (Source: Electronics Weekly, 25 January 1989)

X. SPECIAL ARTICLE

The production of intelligent products in developing countries

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ABSTRACT

The technical developments in the field of microelectronics will lead to a new spectrum of manufacturing products which integrate a mechanical subsystem, the microelectronics technology and the required control software into coherent products of improved functionality and reliability. These "intelligent" products will play a dominant role in the markets of the future since they will replace most of the "conventional" products of related functionality produced in the past and at present. Although not visible from the outside, a substantial part in the production labour of these "intelligent" products will be related to the required design and software effort. The manufacture of these products will be accomplished in highly automated factories. After presenting the characteristics of intelligent products, this paper discusses the distinct steps which have to be taken in order to produce such an intelligent product. In the final section some policy actions are considered which can be taken in developing countries in order to promote the production of intelligent products.

1. Introduction

The dramatic progress in the area of microelectronics technology does not only impact the "classical" electronics industry, such as computers, telecommunications, industrial control and consumer electronics, but opens up a new class of "intelligent products" which integrate a mechanical subsystem with a computer controlled subsystem into a compact unit fulfilling a specific user need. These intelligent products will enhance and replace the "conventional products" (i.e. those products without microelectronics control) of related functionality.

Recent developments in microelectronics technology and the design of integrated software/hardware systems have opened these new opportunities for product development in the area of intelligent products. Ten years ago, the design and construction of a special purpose computer tailored to the characteristics of a given application was a major and expensive project. Today, with the availability of standard microprocessors, standard peripheral chips and high level VLSI design tools, the implementation of such a project has lost some of its difficulties. Tomorrow, at a time when the VLSI design technology will have matured even

further, the construction of an integrated hardware software solution with application specific functionality will be an accepted practice in the area of real time control systems for the volume market.

This paper about the production of intelligent products in developing countries is organized into three major sections. First the characteristics of intelligent products are discussed and the future significance of these products for the high technology market is considered. The next section, the main part of this paper, concentrates on the design of these products and evaluates the advantages and disadvantages of the different implementation alternatives. In the final section policy actions and recommendations for developing countries relating to the production of intelligent products are presented.

2. Intelligent products

The significant decrease in the cost of microelectronic systems has led to a multitude of new embedded computer applications which interface directly to a user population unfamiliar with computer technology. The resulting products are destined for a growing mass market with important economic implications. We will refer to these new products by the term "intelligent" product.

2.1 Product definition

Let us introduce the concept of an intelligent product by giving some concrete examples:

- An automatic scale with an integrated microcomputer to perform the calibration, the weighing, the conversion and the calculation of some consequent value, e.g. the price, of some merchandise.
- An industrial controller including the control valve, the computer and the control software.
- A washing machine with a microcomputer for the optimal control of the washing cycle in order to minimize the use of energy, water and detergents.
- A traffic light including sensors and a microcomputer in order to perform an improved traffic control.

An intelligent product is an autonomous embedded system which performs a specified service for its users. It generally consists of a mechanical subsystem, some sensors and actuators, a control subsystem with the appropriate functionality and a user interface.

2.2 Properties of intelligent products

In the following section we will analyse some of the important characteristics of an intelligent product.

Focus on genuine user needs

The most important property of a good intelligent product is its focus on a genuine user need. The ultimate success of any product depends on the relevance and quality of service it can provide to its users. The first step in the planning for an intelligent product is thus the identification of the user needs this product is to satisfy.

Optimal resource utilization

Because of their inherent information processing capabilities, intelligent products can provide the intended service with a minimal use of physical resources, such as energy, water etc. In times, when physical resources are more and more limited, this property of intelligent products is also of increasing macroeconomic importance. In designing intelligent products care must be taken that the internal use of electrical energy by the electronic components is also minimized, e.g. by the use of low power integrated circuits or by the employment of solar power. This latter technology, if viable, is of particular importance for developing countries since it helps to reduce the operating costs and avoids all problems associated with batteries and their appropriate disposal.

Minimization of the mechanical subsystem

The number and complexity of the mechanical parts, which are contained in an intelligent product is minimized. This helps to reduce manufacturing costs and increase the reliability of the product. Almost all control functions are carried out by the smart control system integrated in the intelligent product.

Functionality determined by software

The functionality of an intelligent product is determined by the integrated software (in its widest sense). The effort required to develop this software can be substantial and amount to a significant fraction of the overall development cost of such a product. Normally this software will be contained either in a read only memory of a microcomputer or in the design of a logic network. The product is then mass produced and distributed over standard marketing channels. After the manufacture of the product any correction of a software error or change of the software is very difficult, if not impossible, to realize. The quality standards for the software which is integrated in such an intelligent product are thus extremely high.

Simple to operate

An intelligent product will be utilized by an untrained user population with no computer expertise. Every action required by the end user to operate such a product must be designed from the point of view of the user need in relation to the overall system functionality and not from the "computer" viewpoint. It is therefore necessary to design special, easy to operate user interfaces, both in hardware and software. General purpose terminal interfaces are not suited for these applications. Ideally, the use of an intelligent product should be self-explanatory and not require any training or reference to an operating manual.

Ability to communicate

Although most intelligent products can provide the specified service autonomously, an intelligent product is often required to interconnect with some larger system. In the above example of the automatic scale it might be requested to provide an interconnection to a cash register. The protocol controlling the data transfer should be simple and robust. Generally, an optimization of the speed of transmission is not required.

High dependability

The control system and the mechanical subsystem of an intelligent product (i.e. the machine which is to be controlled) form an integrated functional unit, i.e. a product. The reliability of the control system must be optimized in order not to compromise the reliability of the total product. Such an optimization of the hardware reliability requires the minimization of the chip count. This is achievable only by an integrated software/hardware design. From the point of view of dependability, a VLSI solution for the control system is the best alternative.

Integrated diagnostics

The maintenance of an intelligent product should not require any special skills or tools. Intelligent products incorporate their own self-diagnosis software and can be maintained by an untrained worker replacing standard modules. In many instances the product is designed for the best reliability possible and has to be discarded in case of internal failures.

Mass production

Successful intelligent products are designed for a mass market and consequently for mass production. The mechanical subsystem, as mentioned before, is as small as possible in order to simplify the manufacturing process. In many cases the intelligent product will be assembled by highly automated robots in order to maintain a uniform and high quality level and to reduce the manufacturing costs. The initial investment in such a production facility can be substantial.

Significance of intelligent products

As has been pointed out previously, a large fraction of the development effort for an intelligent product is related to the software development and to the set-up of the automated production facility. From one point of view, the marketing of intelligent products can thus be seen as a form of marketing of software. However the distribution of software via intelligent products has a number of obvious advantages over the marketing of standard software packages.

While the manufacturing of intelligent products is highly automated and not labour intensive, the distribution systems for these products must be set up carefully. The three key areas of concern determining the success of an intelligent product are thus product development, production set up and distribution.

Tangible product for the mass market

An intelligent product is a tangible product which can be marketed on its own. Since the integrated software/hardware product is produced by a single source, there are no questions of responsibility in case of problems at the hardware/software interface. Thus the customer will have an increased confidence in the product.

No special user skills required

The potential market for intelligent products is not constrained by the limited computer education of end users. On the contrary, the simple user interface of intelligent products will make such a product easier to use than comparable conventional products. There is no special know-how required on behalf of the customer to perform the integration of hardware and software at the user site, as is the case with the distribution of standard software products.

Know-how protection

The most significant investment during the implementation of a computer application is in the area of software development. If the software is integrated with the hardware then this investment can be protected much better than if the software is sold separately. At the moment, the adequate protection of software products is still an open question.

3. The production of intelligent products

In this section we will distinguish between three distinct phases in the production of an intelligent product, the design phase, the implementation phase and the manufacturing phase.

The design and implementation of an intelligent product is quite different from the conventional software design or the manufacture of a new piece of electronic hardware. Hardware and software of an intelligent product have to be designed in close consideration of each other in an integrated fashion. It is important to distinguish clearly between the system design phase and the implementation phase. In the system design phase the requirements for the product have to be established and the specification of the product, including its user interface and the functionality and performance of the control system have to be developed. In the implementation phase the appropriate microelectronics technology for implementing the specified design has to be selected. A well-defined baseline between these two phases avoids the duplication of effort, in case a new implementation technology is chosen.

If the different implementation alternatives are supported by an integrated design environment, the switchover from one alternative (e.g. software on standard microprocessor) to another (e.g. a part of the functions in gate arrays) can be realized without extra overheads. These new implementation options have been opened by the achievements in the area of VLSI design technology in the last 10 years.

Starting from the seminal work of Mead and Convay (Mea80) the development of VLSI design tools has reached a state where it is possible to design application specific VLSI chips of moderate complexity within a period of weeks. At the moment a considerable effort is under way to integrate these design tools with the classical software engineering environments. In the not too distant future, it will be possible to consider the design of a VLSI solution as one of a number of alternative implementation strategies for a given system functionality. The integrated software/hardware design of the future will start with a computer-aided requirement specification. These requirements will be checked for completeness in relation to established standards and for internal consistency. In the following phase the system functions and the system architecture will be specified. Finally an implementation strategy will be selected.

3.1 Product design phase

The product design phase for an intelligent product can be partitioned in the requirements specification and in the architecture design phase. At the end of the product design phase, the architecture of the new product including the

external interfaces are fully specified. However, no decision has been made yet in relation to the implementation technology of the control system.

3.1.1 Requirements specification

The first activity in the development of an intelligent product is a feasibility analysis. Since such a feasibility analysis must be performed for any kind of investment it will not be discussed further in this context. The result of the feasibility analysis is a market analysis and a first level specification of the functionality, the design, manufacturing and marketing cost of the new product, presented in the form of a detailed cost-benefit analysis for this project.

The requirements analysis takes the feasibility analysis as its starting point. It must investigate the following topics:

(1) Market penetration.

Analysis of the key markets for the intended product and specification of the product characteristics (functionality, reliability, maintenance strategy, acceptable price) required in these markets.

(2) Critical user needs.

Identification of the critical user needs in relation to the intended product. Description of the typical system user, its background experience, expectations and training requirements.

(3) Required system functions.

A complete analysis of all required system functions, covering the mechanical subsystem as well as to the control subsystem. The system functions should be classified in necessary functions, important functions and comfort functions. This classification is needed for the subsequent architecture design phase.

(4) Interfacing requirements.

A detailed description of the requirements on all system interfaces which are given by the environment of the new system. The requirements on the man-machine interface are of particular importance, since ease of use by the intended user is a determining factor for the success of an intelligent product.

(5) Competing products.

Analysis of competing products, including a description of the environment, in which these products operate. Evaluation of the strong and weak points of the competing products.

(6) Safety requirements.

Critical failure modes of the intended product. Analysis of the consequences of system failure to the user. Reliability and maintainability requirements of the new system, including a description of the maintenance strategy. Rules, regulations, policies and other critical aspects of the intended application.

(7) Statement of all assumptions.

Analysis of the project in respect of the criticality of these assumptions.

Once the systems requirements have been established, they must be validated. There are four criteria for validating the requirements:

- Consistency:

  Is there a conflict between some of the requirements?

- Completeness:

  Are there any functions which have not been considered? Are there any constraints which may have been overlooked?

- Validity:

  Are the requirements sufficient to cover the critical user needs? What are the key requirements in the intended market and are they covered by the product specification?

- Realism:

  Are the requirements realistic considering the given market environment? Is it possible to design a product of the required functionality for a price which will be accepted by the market?

3.1.2 Architecture design

The architecture design is concerned with the process of going from the statement of the requirements to the development of the system architecture, i.e. the specification of the subsystems, their interfaces and their interaction. The result of the architecture design is a document called the architecture specification. This document contains a complete description of all subsystems, such as the mechanical subsystem, the control subsystem etc., including a detailed specification of all subsystem interfaces.

As has been mentioned before, this paper is mainly concerned with the analysis of the control subsystem. Therefore we will focus our attention on the specification of this subsystem. We propose that the control system specification consists of three sections (describing the control system from three different viewpoints): (i) the (static) structure of the control system, (ii) the dynamic behaviour of the control system and (iii) the performance of the control system.

Structural description

The structural description is concerned with the partitioning of the system, i.e. identification of the different subsystems and a detailed description of the interfaces between these subsystems. Since from our point of view the interfaces of the control subsystem to the rest of the architecture are of special significance, we will concentrate our discussion on this particular interface.

The interface description must discuss the external view of the logical and physical appearance of the interface. On the physical level, this comprises the electrical and mechanical outlay of the connections and the coding of the signals. At the logical level, all objects which are visible at the interface between the subsystems, including their attributes and relationships must be described. Furthermore those internal objects, which are visible from the interface must also be described. The inputs used to create, update or

change these objects have to be identified together with their domains.

The structural properties of the interface can be expressed in a connectivity diagram. The connectivity diagram depicts the input and output ports of the control system, including the name, type and coding of the corresponding data elements.

Behavioural description

The behavioural description specifies the input/output behaviour at the interfaces. It contains a detailed specification of the stimulus for an action and the processing steps which have to be executed as a response to a stimulus. An action is normally started if a predicate or some input values and/or the real time (the stimulus condition) changes to "true". This stimulus condition has to be specified in the behavioural description.

Given the level of abstraction and the granularity of operations, we can distinguish between subsystems with internal state and subsystems without internal state. If a subsystem contains no internal state, then the action itself, i.e. the behaviour, can be described in the form of truth tables, decision tables or mathematical functions. In theory, these stateless subsystems can be implemented by logic networks without internal memory.

For subsystems with internal state, the outputs are a function of the current state and the current input. At a given level of behavioural description the internal state space (the registers) and the state transition functions have to be separated. State transition functions and output functions (which take the state as input, but do not contain any internal state) can be described in the same form as "stateless" subsystems. The internal state space which is relevant at the given granularity of operations has to be specified. The overall behaviour of subsystems with internal state can be represented in some form of state diagrams or state transition tables.

Performance description

The performance description concentrates on the timing properties of the interface. The timing of signals on the specified signal lines, the maximum response time of computations, the minimum interval between successive computations etc. have to be specified in the performance description.

Test strategy

The detailed procedures for the acceptance test of the product are part of the design specification. These tests must cover the functionality of the control system as well as its performance and reliability.

3.1.3 Design tools

The effectiveness of any design methodology can be significantly enhanced if it is supported by an appropriate set of software tools, i.e. a design environment. We distinguish between architecture design tools, analysis tools, implementation tools and management tools (Kop86). The architecture design tools support the system analyst in the requirements specification phase and the architecture design phase of a real time application development. The analysis tools can be used for an analysis of a given architecture design, e.g in respect to timing and reliability and a comparison of different designs. The management tools support the project management and documentation.

In present industrial practice, development teams for alternative implementation technologies (e.g. implementation by a microprocessor with the appropriate application software or implementation by an application specific VLSI chip) use different sets of specification, design and analysis tools. However, considerable research is in progress to integrate these different design tools and the design data bases into a coherent toolset so that the duplication of efforts for the implementation of the same functionality with different implementation technologies is eliminated. However, such an integration can only be successful if the design engineers are experienced in both software and hardware design.

3.2 Implementation phase

Given the control system specification there is a wide spectrum of different implementation alternatives for the control system of an intelligent product. At one end we can select an off-the-shelf microcomputer and at the other end a custom made VLSI circuit. In this section we will analyse four implementation alternatives, a microcomputer implementation, a gate array implementation, a semicustom VLSI implementation and a discrete component implementation with MSI (Medium Scale Integration) packages.

The critical parameters determining the selection of the optimal implementation technology for the implementation of the control system of an intelligent product are task complexity, processing speed, reliability, power consumption and production volume.

Task complexity

Figures 1(a) and 1(b) show the qualitative dependence of the design effort and the marginal manufacturing cost for the mentioned technologies as a function of the task complexity.

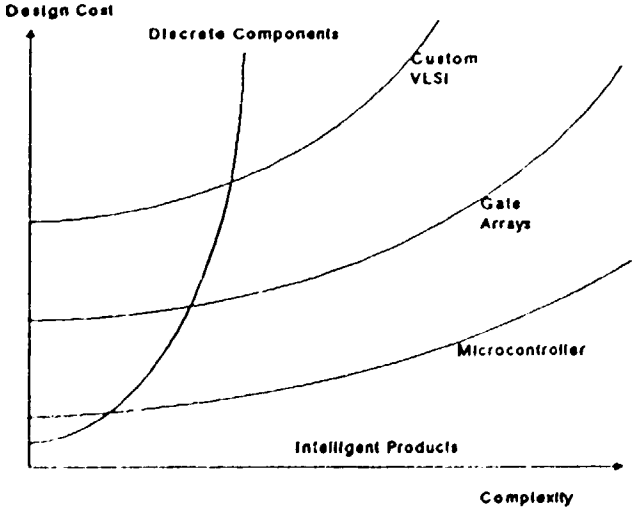

Fig. 1(a). Design cost as a function of task complexity

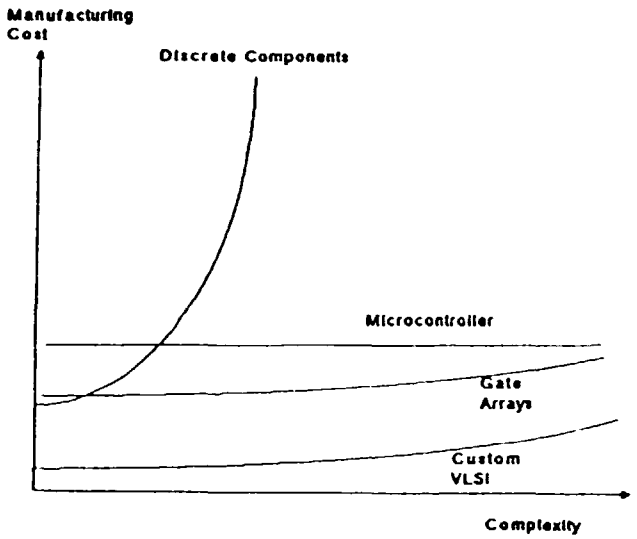

Fig. 1(b). Manufacturing cost as a function of task complexity

From these figures it is evident that the discrete MSI component implementation requires the lowest effort for very simple products. However the design and production effort increase sharply as the complexity increases. Since, by definition, the control system of an intelligent product is not very simple, this implementation technology will not be discussed any further in this report.

Processing speed

Tasks are realized by software (firmware) in the case of a microcontroller, but by logic networks in the case of gate arrays and custom made VLSI chips. It is evident that a logic network with a gate delay of a few nanoseconds is orders of magnitude faster than a microcontroller, where the execution of a single instruction takes about a microsecond. Considering the complexity of even dedicated and simple operating systems, the response time of a microcontroller application will at best be in the order of milliseconds.

A full custom VLSI implementation has the highest performance and reliability (the smallest chip size), but requires the highest implementation effort. On the other end, the off-the-shelf microcomputer requires the smallest implementation effort (with the highest flexibility concerning changes) but gives us the lowest performance. The speed of a gate array implementation is much faster than the speed of a microcomputer, but slower than that of a custom VLSI implementation.

Reliability

In a first approximation, hardware reliability is a function of the number of pins and connections of a system. The reliability of the control system is thus optimized if the chip count and the number of connections are minimized. A full custom VLSI implementation dedicated to the intended control task gives us the best reliability. A single chip micro-controller solution with integrated read only memory (ROM), random access memory (RAM) and analog as well as digital inputs and outputs will also result in a good reliability of the end product. However multiple chip implementations will require many extra pins and connections and thus reduce the overall mean time to failure.

From the point of view of implementation robustness any system which minimizes the amount of internal state information is to be preferred over an implementation which contains a significant amount of internal state. If the same functionality is realized by a logic network versus a stored program implementation, the logic network will result in a more robust system.

Power consumption

The power consumption of a dedicated VLSI implementation in a low-power technology, such as CMOS, will be less than that of a functionally equivalent gate array or microcontroller implementation. It depends on the overall product characteristics, whether the power consumption is a critical parameter in the selection of the implementation technology.

Production volume

A qualitative comparison of the initial design effort and the marginal manufacturing cost for the different implementation technologies is given in figure 2. It has to be pointed out that significant efficiencies are achieved if the implementation of the control system can be kept on one, or at most a few chips. Going from one chip to another causes duplication of circuits as well as larger and more power-consuming circuits, resulting in additional delays and cost. Furthermore, the negative effect of additional connections on the overall reliability of the system has to be considered.

Table 1 presents an overview of the characteristics of the different implementation technologies. In battery-powered intelligent products, the expected power requirements can be of overriding concern. In these applications a low power (C-MOS) application-specific VLSI solution can be the preferred alternative. In other applications, where the system is to be connected to a power source, the other considerations can be more important.

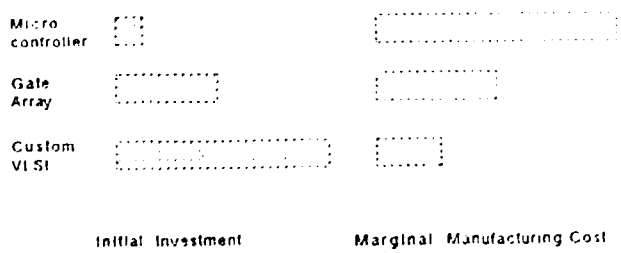

Fig. 2. Initial investment and marginal manufacturing costs for different technologies

Table 1. Comparison of implementation technologies

Criteria	Micro computer	Gate array	Semicustom VLSI
System development time	short	medium	long
Flexibility	high	medium	low
Processing speed	slow	high	highest
Chip size	large	medium	small
Power consumption	high	low	very low
Know how requirement	medium	high	highest
Initial investment	low	medium	high
Unit cost low volume	medium	high	highest
Unit cost high volume	medium	lower	lowest
Reliability	medium	higher	high

3.2.1 Microcomputer implementation

The most interesting alternative for the implementation of the control system of an intelligent product is a solution containing a complete computer including the required input/output interface on a single chip. Such a chip is called a microcontroller.

A microcontroller is an off-the-shelf VLSI chip with on-chip CPU, RAM, ROM and process I/O. It can be considered as a standard "system on a chip". The specific functionality of a microcontroller is realized by application software stored in the ROM. Only the recent advances in VLSI technology have made it possible to economically produce chips of the complexity needed for microcontrollers. A typical state-of-the-art microcontroller has a powerful 16 bit CPU which runs at about 10 Mhz speed, provides 8 Kbyte ROM and 256 byte RAM memory on chip, has 64 digital input/output lines and 8 analog input channels and a serial communication link. In the operating mode it has a power dissipation of about 100 mW and in a standby mode, where the contents of memory are maintained, a power dissipation of 100 µW.

The software development for microcontrollers is very similar to standard software development. Many microcontrollers come in different versions for program development and production. The program development versions support RAM or EPROM memory for the storage of the program code so that the software can be easily modified. There are standard software development and debugging kits available from most microcontroller suppliers. In the production version the application software is contained in a ROM memory and cannot be modified any more. Extensive tests of the application software have to be performed before it is committed to ROM.

When the required performance can be achieved by an off-the-shelf microcontroller, the electrical power dissipation is not a problem and the production volume for a particular version of the product is not high (e.g. less than 10,000), then a microcontroller based implementation is the most economical alternative both from the point of view of design and the point of view of production.

3.2.2 VLSI implementation

A custom VLSI implementation of the control system should only be carried out if it is not possible to find off-the-shelf components of the required functionality. Even if only less than half of the functionality of a well tested standard component is used, it might be more cost-effective than the design of a new custom chip.

If, for whatever reason, a microcontroller implementation of the control system is not feasible, then a VLSI solution must be considered. A VLSI chip designer has several choices, each of them offering trade-offs between chip density and chip design time. At the one end is the standard gate array approach and at the other end the full custom design of a VLSI chip.

If the task of the control system is implemented in the form of a logic network in VLSI, the transformation of the behavioural specification into a logic network specification has to be performed. Although considerable research effort is devoted to this interesting topic, at the moment this transformation cannot be accomplished automatically. However, there are many CAD (Computer Aided Design) tools available today which support the engineer in the generation of the physical design representation (mask generation) once the logic network has been specified.

It can be expected that some time in the future new development tools, called silicon compilers, will be available which perform the translation of an application domain-specific high-level behavioural specification into the logic specification and further on into mask representation required for the production of the VLSI chip. A silicon compiler has to contain a knowledge base which understands the physics of the devices and all design rules of a technology so that the detailed geometrical mask shapes can be built up from the high-level structural and behavioural description of the required system.

The implementation of the control system in the form of a logic network is the best way of protecting the application know-how, i.e. the software.

Gate array implementation

Gate array technology is based on the concept of having a fixed basic pattern of logic gates on an integrated circuit which is then "programmed" by customized on-chip wire connections in order to produce the logic network of the intended functionality. The main advantage of gate arrays over microcontroller implementations is a speed improvement of three orders of magnitude.

Gate arrays have become popular because of the fast turnaround time of the semiconductor foundries and the availability of powerful design and simulation tools. A complex gate array can now be designed and developed, and prototype samples produced in the same time frame as it takes for the production of a printed circuit board. On the other hand, every production run of a gate array results in significant costs for the customer. Therefore the customer must check his design very thoroughly by extensive tests and simulations before it is committed to production.

From the point of view of the semiconductor manufacturer, gate arrays are a mass product. Only a few customer masks are required at the end of the manufacturing process, all other masks being standard. Since the responsibility for the correctness of the customer masks is in the hands of the customer, the semiconductor manufacturer does not require skilled design engineers. The complexity of gate array-based control systems is increasing steadily. Systems with 10,000 and more gates are becoming quite common.

The main disadvantage of gate arrays is the large chip size because of the necessary spacing between every pair of adjacent columns of gates required for the wiring of the chip. As a rule of thumb, the gate array chip size will be about five times larger than the size of a custom designed logic network of the same functionality with all consequent effects in reliability, production cost and power dissipation.

Custom VLSI implementation

The implementation of a given functionality by standard cell arrays is the next logical step for semicustom component design. A standard cell is a

predefined and pretested circuit, which performs the defined function. There are standard cells available for all kinds of digital functions (e.g. adders, registers etc.) and analog functions. It is possible to combine digital and analog functions on the same chip in order to avoid the problems of interchip connections. Provided the available cell library is sufficient for the given task, the VLSI designer has to place and interconnect the cells under the guidance of a CAD system. Normally, the CAD system will also contain facilities for the simulation of the cells, so that the design can be checked before it is committed to production.

In the fixed image standard cells (Dec86) a set of fixed sized cells is arranged into an array separated by wiring channels. Sometimes a predefined I/O path configuration and a power distribution system is provided by the design system. The next generalization is the variable image cell. If all variable image cells are of the same height, then a regular structure of the chip is achieved by interleaving an array of cells with an area for the wiring. The most general form is the full custom design. Such a design requires a very high engineering effort and should only be considered if a large mass production (in the millions of chips) is foreseen.

3.2.3 Manufacture

The added value in the market for intelligent products is not in the manufacture of the microcontroller or the silicon chip, but in the product design, software development, assembly and marketing of the product. It is therefore expedient to buy the off-the-shelf microcomputers for the control system or to take advantage of the services provided by silicon foundries in many different countries.

If a particular intelligent product is successful and a mass market develops, the assembly work should be highly automated in order to guarantee a sustained high level of product quality and to stay competitive in the international market place. Only products with the highest quality attributes, which are manufactured at internationally competitive costs can compete on the world market.

4. Policy actions

A high-technology industry, such as the production of intelligent products, can only succeed if a conducive infrastructure is established and maintained by appropriate policy actions. In this section three areas, where policy actions by the public sector are necessary in order to support the growth of high-technology industries such as the production o intelligent products will be discussed.

4.1 Provision of training facilities

Looking at the speed of change in the field of information technology, it is of paramount importance to realize the important long term trends in their early phases in order to take appropriate actions in the educational system.

Only if engineers of the required background in software and hardware are trained in a given country will the industry be in a position to take advantage of these new trends. The most important long term action relates to the establishment of courses of study on integrated software/hardware design techniques at the trade schools and at the university level for interested students. These courses must be backed up by appropriate laboratory exercises.

Teaching software and hardware technology without the possibility of practical work on a machine is a dangerous undertaking. Since the lectures tend to become too theoretical, the student will not grasp the elementary concepts and might shy away, instead of developing a positive attitude towards this new technology.

Therefore any education initiative in this field must be supported by an initiative to provide the necessary computer equipment and software for the practical training and access to a silicon foundry.

4.2 Support for the start-up of small high-technology companies

In any society you can find talented people willing to take the risk and benefits of becoming entrepreneurs in the field of high technology. The policy in the field of technological development must provide an economic and political climate so that these young entrepreneurs will succeed in the founding and operation of new companies.

In many industrial countries the operation of new "high-technology industrial parks", where young entrepreneurs can find the organizational and legal support for the operation of a new company, is well established. Often these industrial parks are affiliated with a research laboratory or a university to provide contacts and access to the technical infrastructure for product development. It is felt that a similar organization should be set up by the public sector in developing countries.

The start up phase is a very critical period for a newly founded high-technology company. In this phase new products have to be designed and developed without any income from older products which have been introduced in the market already and contribute to the cash flow. In this limited phase public support through research and development contracts for prototype product development can be of significant importance to the financial viability of the newly founded company.

4.3 Marketing support

Normally, entrepreneurs are fascinated by the technical characteristics of their new product and do not pay sufficient attention to the development of the market. It is particularly important to support new companies in this field. Established organizations, such as the economic division of large banks or the import/export branches of trading houses can be (financially) encouraged to advise and co-operate with newly-founded small technological companies in this critical area of marketing. Also, the procurement policy of the public sector should favour newly founded high-technology companies formed within a country.

Summary of recommendations

Let us summarize the recommendations for actions by the public sector in this high technology field as follows:

(1) Establish a core group of experts with sound expertise in the following fields: software

engineering, hardware design and implementation, application know-how, application software development, organizational, marketing and legal skills.

(2) Establish a training programme for computer engineers and teachers at the university level. Introduce courses on software development, VLSI design and process control into the vocational training schools. All courses must have a substantial section devoted to practical laboratory work. These training activities should be initiated by this expert team.

(3) Initiate a programme for the financial, organizational and legal support of small companies. Provide these small companies with research and development funds for the start-up phase.

(4) Encourage existing organizations, e.g. banks or trading houses, to co-operate with newly founded small high-technology companies in the area of product marketing. Provide financial incentives for such co-operation.

(5) Identify an application area which is at the centre of the national priorities, which coincides with a genuine user need and which can be effectively supported by some intelligent product. Provide funds for a research project in this area.

(6) Initiate a pilot project in the selected application area with an intelligent product destined for the end user market. Involve the established expert group on the understanding that a new company is to be formed. Closely monitor the progress of this project. It is important to provide a good design and an excellent, i.e. very simple user interface for this pilot product.

(7) Ascertain that the acquisition of intelligent products by the government and other public or semi-public agencies is open to and favours these new local high-technology companies.

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