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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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Issue No. 32 August 1990

Special article in this issue: Readers will be interested in reading an article by Professor Erik Baark of the Institute of Social Sciences (Denmark) on computer software policy and development in the People's Republic of China.

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.

The *Monitor* is published four times a year and distributed free of charge to individuals and institutions on an approved mailing list which includes at the moment 1300 entries. The *Monitor* has been published since 1982 and has built up a sound reputation both in developed and developing countries.

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I. NEWS AND EVENTS

Commercial information network to foster South-South co-operation

Chambers of Commerce and Industry (CCI) of Latin America and the Caribbean have concluded at a recent meeting here that a trade information network is a vital tool in promoting South-South co-operation. The objective of a CCI meeting held in April 1989 was to improve co-operation between the chambers and other business organizations in the region. Delegates reviewed numerous trade information networks offered by private organizations and United Nations agencies, including data on training and expertise maintained by the INRES-South data base. The participants concluded that the existing infrastructure of the Ibero-American Association of Chambers of Commerce (AICO) would serve as a good foundation for building a region-wide trade information system which would include all Latin American and Caribbean countries, members of the Group of 77.

AICO submitted a paper describing its network and examining possible forms of co-operation with the projected world information network, which would link all developing countries to one another. AICO, which exists in many Spanish- and Portuguese-speaking countries, is sponsored by the Bogota Chamber of Commerce. It caters mainly to small and medium-sized enterprises and disseminates information on supply and demand for goods and services that will lead to direct commercial exchanges between suppliers and customers in the region. It publishes a weekly International Bulletin of Trade Opportunities in English and Spanish, and also issues a bulletin which gives price quotations for raw materials and commodities. (Source: UNDP Focus, Winter 1989)

New electronic trading network

The London International Financial Futures Exchange (LIFFE) offer the first electronic futures trading network and became operational as of November 1989. The Automated Pit Trading (APT) system will help LIFFE lengthen its trading day; at first it ran from 4.30-6 p.m. (London time), with a 7-8 a.m. session scheduled for 1990. The system may eventually operate throughout the entire trading day, according to R. Barton of LIFFE. The APT system will also help LIFFE to compete against the Chicago Mercantile Exchange (to offer Globex network 1990) and the Chicago Board of Trade (to offer Aurora network 1990). The APT system involves two Sun Microsystems host workstations linked to Sun user workstations with a 64 Kbit/s transfer link; machines and trading software cost LIFFE about $2.5 million. LIFFE has also been working on other information systems to increase competitiveness including Trade Registration System (TRS), to aid in trade-matching and resolve discrepancies; Price Reporting System (PRS), to aid in processing price changes faster; and Clearing Processing System, to let trading firms get debt and revenue information. These new information systems were developed to handle increased trade volume at LIFFE (annual increase 75 per cent per year since 1982) and to give LIFFE an advantage over other exchanges. (Extracted from Networking World, 20 November 1989).

Traders act to thaw IT cold war

A key group of East-West traders has met to agree to a plan that could lead to the dismantling of a 40-year barrier against high tech exports to the Soviet Union.

Acting unofficially, the group is believed to be scheduling a major conference for September 1990 to take place in the Black Sea port of Yalta.

Against a background of improving international relations, the event will be the first step in a world-wide campaign to scrap the embargo on exports enforced by the Paris-based organization Cocom, which regulates IT trade by Western countries to Eastern bloc countries.

The proposed alternative is based on the use of a commercial end-user licence. The list of technology with potential military use will be much reduced and sales will be allowed after presentation to trade ministries of certificates identifying the ultimate user, the place of installation and confirmation of a non-military application. (Extracted from Computing, 26 October 1989)

Old technology, new application

Old technologies in new applications greatly intrigued the International Electron Devices Meeting in Washington, D.C. These included vacuum tubes, bipolar silicon, biCMOS technology, silicon as a performer against gallium arsenide, and the once-discarded silicon-on-insulator (SOI) technology.

Vacuum technology expanded from its erstwhile paper or two-to-an-entire-session as vacuum microelectronics retrieved the vacuum-tube switch's speed advantage without surrendering semiconductor compactness. Etched cathode points - vacuum field emitters - provide cold cathodes over which grid and anode arrays can be built. The devices are presently at the scale achieved by discrete silicon transistors in the early 1960s, and further shrinkage to the micron or submicron level is clearly in the works. Thermionic vacuum ICs also perform well as cathodes but suffer the same power drain as the classical vacuum tube.

The heterojunction structures that give GaAs its performance edge over Si can be mimicked with a silicon-germanium combination. Newly discerned properties of fully-depleted thin-film (under 100 nm) SOI devices eliminate second-order effects that harry CMOS structures. Bipolar silicon can exploit processing techniques heretofore the preserve of CMOS for significant speed and density increases. BiCMOS research suggests it may provide the only path to higher densities without invoking a totally new transistor structure. (Extracted from Electronics, December 1989)

Universal agricultural thesaurus discussed

In a meeting on 3 May 1989, at the United States National Agricultural Library, Beltsville, Maryland, representatives from the National Agricultural Library (NAL), Commonwealth Agricultural Bureaux International (CABI), and the Consultative Group on International Agricultural Research (CGIAR) initiated discussions on the need for a universal agricultural thesaurus.

Staff from FAO AGRIS, CABI, CGIAR and NAL participated in a follow-up discussion meeting in October 1989 in Washington, D.C. and decided that a comprehensive universal agricultural thesaurus and gateway system would help researchers and scholars find information on specific topics in the multitude of agricultural data bases available today. The detailed, scientifically sound, multilingual vocabulary would provide a consistent way of describing the major activities and concerns in agriculture and related disciplines; list systematically the taxonomic names of the most important plants, animals, and micro-organisms, and identify a common terminology for areas of interest for which no standards currently exist, for example, to describe agro-climatological regions. The gateway would provide an interface between existing retrieval systems and the comprehensive thesaurus; enable all users to take advantage of the enhanced linkages within the thesaurus to facilitate access to older materials with differing descriptors, and help all users with existing data bases to take advantage of the enhanced thesaurus.

Major beneficiaries would be developers and users of project data bases, agro-climatological information systems, agro-ecological information systems, geographic information systems, bibliographic data bases and genetic resources data bases. The major issues which will be considered in the development of this thesaurus are governance and management, form and content, systems and funding.

For further information on these discussions and the follow-on activities, contact Pamela Andre, Chief, Information Systems Division, National Agricultural Library, Beltsville, Maryland 20705 USA. TP+1 301/344 3813; Fax+1 301/344 3675. (Source: ACCIS Newsletter 7(4), November 1989)

Rural development information system

The Rural Development Information System (RUDIS) is based on a research project, begun in 1981 at the University of Ibadan (Nigeria), whose goals included: production of information resources suitable for use by non-literates, emergence of a prototype information support system for rural development projects in Nigeria and Africa, formulation of a programme of training library and information personnel for services in a non-literate environment, and giving an African orientation to library and information sciences.

The activities of the RUDIS project include the following:

- A small experimental library project near Ibadan to develop and test the methodology;
- Field surveys of the information environment of non-literates in Nigerian villages;
- Graduate courses are being conducted at the University of Ibadan to prepare students for research exploration of the information needs of rural non-literates.

A model research project is envisaged that can be adapted to other communities and tested. Research materials and publications are also planned. Further information can be obtained from Professor B.O. Aboyade, Department of Library, Archival and Information Studies, University of Ibadan, Ibadan, Nigeria or c/o FID/CT Clearinghouse, School of Information Studies, Syracuse University, Syracuse, NY 13244, USA. (Source: Newsletter on Education and Training Programmes for Information Personnel, Vol. 11, No. 1, Spring 1989)

More on DRAMs

Six leading Japanese manufacturers of DRAM chips have signed a draft agreement with the EC on minimum prices for chips.

The five-year agreement follows two years during which there have been intense levels of allegations made against the Japanese that they were dumping products on the European market.

Existing and future generations of DRAMs and minimum pricing for them are covered in the agreement, which sets minimum prices at production costs, plus 8 per cent.

NEC, Mitsubishi, Hitachi, Fujitsu, Toshiba and Texas Instruments in the Japan base have signed the agreement and another five are expected to do the same, which would include Matsushita and Oki. (Source: AMT, October 1989)

IFIP issues world-wide warning on computer viruses

In view of the potentially serious and even fatal consequences of the introduction of "virus" programs into computer systems, IFIP urges

- All computer professionals, worldwide, to recognize the disastrous potential of computer viruses
- All computer educators to impress upon their students the dangers of virus programs
- All publishers to refrain from publication of the details of actual virus programs
- All computer professionals not to knowingly distribute virus code, except for the purpose of legitimate research in a controlled environment and all developers of virus detection and prevention systems to stop distribution of virus code for test purposes
- Governments, universities and computer systems manufacturers to devote more resources to research into and development of new technologies for protection of computer systems
- Governments to take action to make distribution of viruses a criminal offence.

The IFIP General Assembly (GA) passed the preceding forceful resolution at its meeting in September in San Francisco. With the identification of hundreds of computer virus programs and even more variations on these, the disastrous implications for computer systems must be recognized by all countries. The consequences of "viral attack" on computer systems include serious economic and personal loss and could potentially become a threat to human life, for example, in computer-controlled health care systems and industrial installations. The social and economic losses due to virus infiltration into computer systems are large. Those losses and their effects are becoming, moreover, of international significance as computer networks take on global information roles in many enterprises.

Prof. William Caelli (Australia), chairman of IFIP's Technical Committee on Security and Protection in Information Processing Systems (TC11), supported by the chairman (effective in September) of the TC on Relationship between Computers and Society (TC9), Prof. Klaus Brunnstein (Federal Republic of Germany), proposed the resolution to the IFIP Technical Assembly (TA). The TA supported it and brought it to the GA, which adopted it.

Attention was drawn to the growing number of virus programs (and similar programs, such as "worms" and "Trojan horses") being published in inexpensive, widely available books. Such code may easily be used and adapted for illicit purposes. They also noted that in some cases, actual virus programs are distributed with virus detection and protection software packages, in order to test and demonstrate those packages. This practice must stop, IFIP urged, simply because it is too easy for such test viruses to be further copied and disseminated, even inadvertently, or for them to be modified further, with unpredictable results.

All IFIP member societies are urged to publicize this resolution to their memberships and governments. (Source: IFIP Newsletter Vol. 6, No. 4, December 1989)

Criminals profit from technology

Computers offer criminals considerable opportunities for fraud, often with little chance of being caught. With massive amounts of data now travelling across frontiers, transferring millions of pounds every few seconds, technology seems to bring richer pickings with every new development.

One estimate puts computer fraud in the UK alone at about £400 in 1988, but no-one knows for certain how great the problem is. Victims of fraud often keep quiet about their losses for fear of a loss of reputation, or because they do not want to encourage copy-cats.

As Europe's trade barriers succumb to increasing integration and pan-European systems become more common there is a need for a common European approach to computer fraud, according to the experts.

One such expert is Hendrik van Brummen, from the Dutch Ministry of Justice. Speaking to a conference organized by the Commission of the EC, van Brummen said that "harmonization of laws is an absolute necessity".

He said 60 per cent of data bases accessed by users in the Netherlands are located outside the country's borders and international computer crime is growing fast.

He recounted one fraud involving agricultural export subsidies. By gaining access to the Dutch customs computers the criminals were able to avoid having their fraudulent exports and imports of meat, picking up various subsidies at each stage, checked by the customs authorities.

The Dutch have launched a major programme to equip their police with a better understanding of computers and their usefulness in crime.

But without similar schemes elsewhere and intense international co-operation van Brummen fears that the problem will be like trying to hit a moving target. (Source: Computer Weekly, 14/21 December 1989)

A new line in 'neurocomputers'

At a conference in Moscow, experts in non-linear studies decided to establish an international centre in Pushchino, USSR, to co-ordinate work in the development of neurocomputers. The Moscow workshop, Neurocomputers and Attention, was organized by the Academy of Sciences of the USSR and the Centre for Nonlinear Studies (CNLS) of the University of Leeds with the aim of working out a coherent strategy for modelling higher brain functions and designing large-scale neurocomputers.

According to Arun Holden, director of the CNLS, participants at the meeting were attempting to bridge the gap between attention modelling and neurobiology. The Soviet scientists introduced the concept of an "attentional neurocomputer", and although most Western scientists regarded the idea as a good one, they did not think Soviet technology was sophisticated enough to realize it. The planned international centre was decided upon as a way of combining the different Soviet and US approaches, which should greatly speed up the development of a neurocomputer. (Source: Nature, Vol. 341, 12 October 1989)

Amstrad named in Moscow

UK computer maker Amstrad could gain from a Soviet plan to import £625 of computers from educational uses after 1990. Amstrad was named in Moscow as one of the companies manufacturing in the Far East which would be targeted if the Soviets go ahead with their proposed purchase of at least half a million computers for education establishments. Moscow will spend the next 18 months looking at the plan, which if adopted would severely dent the USSR's hard currency reserves.

Companies manufacturing in the Far East would be preferred by the Soviet Union because they offer cheaper computers than Western manufacturers, which the Soviets cannot make themselves in sufficient volumes. (Source: Electronics Weekly, 8 November 1989)

Europe shrugs off memories' advances

European computer makers have given a cool response to suggestions that US Memories, the IBM-backed DRAM memory chip-making consortium, would be asking them for support.

Moves to recruit European sponsors follow the failure of the consortium to convince enough US firms to sign up for an equity stake in return for guaranteed share of the output.

No official invitations have been extended to European computer makers but the indications are that most companies would be uninterested.

At the moment US Memories is backed by IBM, DEC, Hewlett-Packard, AMD, Intel, LSI Logic and National Semiconductor. The consortium needs some $500 million to get off the ground and each sponsor is being offered stakes at a rate of $5 million for each 1 per cent up to a maximum of $50 million for 10 per cent.

IBM has licensed its 4Mbit DRAM technology to US Memories. But the company has also licensed that technology to Micron Technology and is in discussions with Cypress Semiconductor. (Source: Electronics Weekly, 22 November 1989)

How green is your computer supplier?

Increasing numbers of people are being driven to action by the efforts of the environmental lobby which has recently brought to our attention a series of environmental issues: damage to the ozone layer by chlorofluorocarbons - CFCs; the problem of global warming caused by the release of hydrocarbons into the atmosphere and deforestation; acid rain; water pollution - the list, unfortunately, goes on.

The computer industry is by no means blameless. The extent of its guilt ranges from the toxic waste pumped into rivers by semiconductor manufacturers and the ozone depletion caused by CFCs released from computer room cooling systems and cleaning solvents, to the waste of environmentally costly printout paper.

Industry in general is under pressure to change. In 1987, the Montreal Protocol, sponsored by the United Nations Environment Programme, recognized the threat of CFCs and established a set of international rules to phase them out. It recommended a 20 per cent reduction of 1986 levels in CFC use by 1994 and a 50 per cent reduction by 1998.

CFCs are used extensively in the computer industry as a cleaning agent in the manufacture of printed circuit boards, and as a refrigerant in the cooling systems crucial to computer installations where large amounts of heat are generated.

Commonly used in such applications are CFCs 11, 12 and 113, all with serious ozone-depletion potential. According to a Friends of the Earth report "Alternatives to CFCs", CFC 11 has an expected atmosphere lifetime of 75 years and CFC 12 is expected to linger in the Earth's atmosphere for at least 110 years.

Alternatives to CFCs are being researched, both by the chemical giants and CFC users, but it could take years to fund viable replacements for industry. Meanwhile interim measures are in force.

One pioneering technique is the recovery of CFCs from computer room cooling systems. Unisys claims to be the first company to recover CFCs from a system involving computer facilities. Last April, it successfully recovered the CFCs used in the Open University's computer room air conditioning system during refurbishment to prepare for the installation of a new mainframe. The refrigerant gases were pumped through the university's redundant air conditioning system into a heat exchanger, then into cylinders when it was returned to the CFC manufacturer ICI.

Normally, the upheaval of a cooling system such as this would result in several hundred kilograms of CFC pollution. Unisys is recommending the process to its other customers, and says more projects are on the boil.

Unisys uses refrigerant R22 or HCFC 22 where possible. R22 has only 5 per cent of the ozone depletion level of CFC 11 or 12. However, Friends of the Earth regards its use as only a medium-term solution to the refrigerant problem and believes it may soon be regulated under the Montreal Protocol.

AT&T has gone a step further. In August 1989 it announced plans to eliminate all emissions of CFCs from its manufacturing process worldwide by 1994.

Together with US chemicals company Petroferm, it has developed a substitute for circuit cleaning agent CFC 113 made from oranges and wood pulp. The company says in the applications where it can be used, it is cheaper, and works as well as, if not better than, CFC 113. The one drawback is that it cannot be used for vapour degreasing.

However, low solids fluxing equipment, developed by AT&T and based on a system from Sono-Tek, allows some circuit board cleaning processes to be by-passed altogether, making it a superior alternative to CFC 113, both economically and environmentally.

Meanwhile, water-based cleaning processes are also being examined by various companies involved in board manufacture. ICL's plant at Kidsgrove has reduced its use of CFCs by 30 per cent using an aqueous cleaning method.

Unfortunately many alternatives to CFCs are not ideal. They are often more expensive, hard to get or are unable to be used exclusively as a CFC substitute. Water, for instance, is an excellent candidate as a successor to CFCs in electronics cleaning applications. It is cheap, non-toxic and ozone friendly. The downside is its high surface tension which reduces its ability to clean complex surfaces and makes its removal more difficult. Similarly, R22, as used in refrigeration, costs twice as much as CFCs 11 and 12, and its toxicity has been questioned.

Water is used in some cleaning processes and its disposal is causing another headache for environmentalists. It enters a board-maker's plant clean, but in washing the copper flux off circuit boards for instance, it can end up depositing traces of copper back in the river or sea.

Copper can be a problem. It is a powerful biocide which, in concentration, can kill quite a lot of lower life forms such as bacteria and marine worms. Higher life forms, such as fish, then move away from what has become an area starved of food, so creating a sterile environment.

Computer companies may be on the way to solving the pollution problem, but how do they fare on the ecology front? Printout paper is used in vast quantities in computer facilities. Indeed the concept of the paperless office is ironic in such paper-heavy environments.

National Semiconductor has two solutions to the problem. It has converted to a new type of computer paper made in Sweden which uses only 50 per cent of the virgin wood pulp needed to make paper by traditional methods. The listing paper is bleached without using chlorine and is actually 5 per cent cheaper than the paper the firm used before.

The company also sends its used cardboard packaging and computer printout paper for recycling as part of its environmental policy. Computer listing paper is very high-quality and is much sought after by paper merchants who will pay up to $100 a ton for it. So computer firms can make money while salving their consciences. If a company uses environment-friendly listing paper, it's a small step to using 100 per cent recycled paper in the office and even high-quality recycled letter headed paper for external use.

Computer vendors for their part are responding to this "every little bit helps" idea.

NatSemi has converted its company car fleet to run on unleaded petrol, and claims even its site-cleaning contractors use only environment-friendly products.

Unisys has withdrawn the CFC-propelled products it supplies, and has installed a water-based fire suppressant system at its logistics centre at Milton Keynes, replacing the halon-based system.

ICL has a policy to use CFC-free materials where available and has banned smoking in company offices. DEC is "breaking new boundaries" with vendors insisting on higher standards from suppliers to ensure environmental safety. Hewlett Packard insists that all new company cars can run on unleaded petrol.

IBM, while on a large scale supporting the aims of the Montreal Protocol, on a small scale has ensured that locally purchased packaging and polystyrene cups in the UK contain no CFCs, and it is taking care to avoid the use of CFC-based aerosols.

In an ideal world where everyone had always been green, such efforts would not be required.

But the wheels of industry must keep turning. And in making concessions, computer vendors have shown that the wheels can turn without crushing everything in their path. (Source: Computing, 7 September 1989)

Castrol flux cuts CFC consumption

Castrol, the chemicals company, has come up with a product which it says could cut the electronics industry's consumption of ozone-destroying CFC chemicals by up to 55 per cent.

Called Interflux 2005, the product is a flux which the company says contains less than two per cent solids. This means that it leaves no residues on assemblies after soldering and makes cleaning, for which CFCs are often used, unnecessary.

The company says although other "no-clean" fluxes are already on the market, these are better described as "low-clean", because they still leave limited residues. The new flux conforms to British and international standards, and Castrol points out that not only will it reduce pollution, but also cut costs, by eliminating certain preparation stages, as well as the cleaning process. (Source: Electronics Weekly, 1 November 1989)

Reducing CFC use in electronics

The use of chlorofluorocarbon solvents as a cleaning agent in the electronics industry could be side-stepped by a soldering process developed by Airco Gases (Murray Hill, NJ) and Multicore Solders (Hemel Hempstead, UK). Circuit board makers use CFCs to clean flux residue from the boards after electronic components have been soldered into place. Flux helps to establish a good contact during soldering, but the residue is corrosive and, if left in place, can lead to electrical shorting.

The new soldering process eliminates residue and thus avoids the need for a CFC cleaning step. The method makes use of a solder paste and a proprietary, reactive mix of three gases that serves as a fluxing atmosphere. Costs for the process should be similar if not less than those with previously used methods. (Source: Chemical Week, 13 December 1989)

Fibre optic growth puts imaging in the picture

The potential bandwidths offered by fibre optic networks could cause the replacement of text-based applications by digitized images within five years.

Bruce Smith, president of California company Network Equipment Technologies (NET), says network speeds in two years from now are expected to be in the 4-6 Gbits per second range.

To put this in context, local area networks based on Ethernet and Token Ring run at between four and 16 Mbits per second, 1,000 times slower than the speeds envisaged by Smith.

While the ramifications of such increases in speed are huge, users will have to come to grips with them or risk lose out to more competitive firms.

Image-based applications are likely to be the first to take advantage. Smith points to American Express, the credit card company, which has done away completely with text in its billing system. Digitized images of bills are stored and sent throughout the Amex network, and facsimiles of these are sent to customers.

The efficiency gains cannot be estimated, but given the comparative ease of handling pictures rather than text, it is not difficult to understand the attraction.

As for investment in high-speed networks, Net says banks are particularly good candidates, since new services can be offered and transaction processing costs can be reduced.

The company says one unnamed bank saved $1.2 million in communications costs alone in the first year, which meant investment was paid back in less than a year.

Similarly, large retailers can reduce point of sale credit verification times, improve reporting of on-line sales status, and quickly take advantage of new service opportunities in local markets. (Source: Computer Weekly, 12 October 1989)

First Arab Conference on Electronics in Arab Countries: Status and Perspectives

The market for electronics products in the Arab region is increasing and is expected to increase even more in the future. Hence it is only reasonable that the countries of the region should develop adequate technological capabilities to partially satisfy the needs of the market and, through regional co-operation, a solid electronics industry base.

Realizing the growing importance of the electronics industry, technologies and applications, the co-sponsoring agencies have called for the First Arab Conference on Electronics in Arab Countries: Status and Perspectives, as part of a larger drive to promote investment in electronics industries in Arab countries.

The objectives of the conference are:

1. To promote interest in electronics industries and technologies in Arab countries and to review the status of these industries and their future prospects.

2. To review the activities and research efforts undertaken in Arab countries in electronics, particularly applied research efforts that may lead to viable investment opportunities.

3. To circulate information about innovations developed world-wide in electronics industries and technologies, and to consider ways and means of transferring these innovations to Arab countries, and of adapting them to local needs.

4. To consider modalities for regional co-ordination and co-operation between institutions and firms in the field of electronics in Arab countries; and to formulate recommendations on the role of national, regional and international institutions in promoting these industries and enhancing the development of capabilities related to electronics in Arab countries.

The Conference deliberations will concentrate on issues related to the electronics industry and technology, including the following:

1. Status of the electronics industries in Arab countries and future prospects.

2. World-wide innovations in the electronics industry and technology.

3. Research projects undertaken in Arab countries in the field of electronics.

4. Recommendations relating to the role of national, regional and international institutions in enhancing the development of capabilities in the electronics industry and technology in Arab countries.

A comprehensive regional paper on "The electronics industries in the Arab countries: status and perspectives", based on country papers prepared by relevant national institutions will be presented, as well as papers prepared by international experts on the latest innovations in electronics industries and technologies, with emphasis being placed on those that are more relevant to Arab countries.

The Conference which is scheduled to be held from 7 to 8 May 1990 at the Exhibition Palace near Algiers, Algeria, is sponsored by:

United Nations Economic and Social Commission for Western Asia (ESCWA)
United Nations Industrial Development Organization (UNIDO)
Federation of Arab Scientific Research Councils (FASRC)
High Commission for Research (HCR), Algeria
National Enterprise for Electronics Industries (ENIE), Algeria

For further information, correspondence should be addressed to:

Mr. K. Jabbar,
UNESCWA, P.O. Box 27
Baghdad, Iraq.
Tel: 5564282. Tlx.: 213303 IK
Telefax: 556-9437 or through UNDP offices

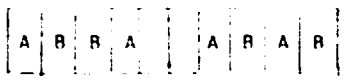
International Olympiad in Informatics
by Mr. Peter Bollerslev (Denmark)*

As one of the many pre-events to the third International Conference on "Children in the Information Age" in Sofia, Bulgaria, an international Olympiad in Informatics for children under the age of 19 was held from 16-20 May 1989, organized by the Bulgarian Ministry for Science, Culture and Education. Thirteen nations participated in the Olympiad: 7 from Eastern European countries, 3 Western European, 2 Asian and 1 African.

The participants formed teams of three, but the competition was primarily individual. The competitors could use their own native languages, since the team leaders had to be able to speak and understand at least one of the official languages of the competition: English and Russian. Many programming languages were available for the programming part of the problem. Participating countries proposed, in advance, a problem for the Olympiad. The one chosen for this year's competition was proposed by China:

Given 2 x N boxes in line, side by side; two adjacent boxes are empty, and the other boxes contain N-1 symbols "A" and N-1 symbols "B".

Example for N = 5:



Exchanging rule: The contents of any two adjacent non-empty boxes can be moved into the two empty ones, preserving their order.

Aim: Obtain a configuration where all As are placed to the left of all Bs no matter where the empty boxes are.

Problem: Write a program that:

1. Inputs from the keyboard the initial state as a sequence of As and Bs and zeros (for empty boxes), and models the exchanging.

2. For a given initial state, finds at least one exhcanging plan which reaches the aim or reports that such a plan does not exist. The output should contain the initial state, the intermediate states after each step, and the final state.

3. Finds a plan reaching the aim with a minimal number of steps.

Results: Present at least one solution for the example mentioned above.

One participant, a Bulgarian boy, delivered a perfect solution and obtained a score of 100. There were five runners-up, who received scores of 95. They came from the Federal Republic of Germany, USSR, Bulgaria, Czechoslovakia and Hungary. One of the five was a girl.

This year's event was sponsored by UNESCO and was declared to be the first Olympiad in Informatics. An organizing committee for further Olympiads was formed, and the next one will take place in Greece in 1991, and in 1992 the Olympiad will be organized in the FRG by the International

* Vice-chairman of TC 3.

Bureau of the Gesellschaft für Mathematik und Datenverarbeitung. (Source: IFIP Newsletter, Vol. 6, No. 4, December 1989)

Conference on automation and related computer applications and workshop in industrial automation and robotics
6-11 October 1990 (Baghdad, Iraq)

The objectives are to present the results of recent research and development in the application of computers in automation. This covers automation in industry, offices, education, laboratories etc.

The scope:

1. Automation
2. Information processing
3. Computer-Aided Design (CAD)
   Computer-Aided Manufacturing (CAM)
   Computer-Assisted Learning (CAL)
   Computer-Aided Testing (CAT)
4. Pattern Recognition
5. Expert Systems
6. Natural language
7. Computer vision
8. Robotics
9. Control Systems
10. Man-Machine Interface.

Workshop

The workshop aims at presenting latest developments in industrial automation and robotics. It covers both hardware and software systems, highlighting future trends in those fields.

Over six days, such areas as robot, machine vision, automation and related topics will be covered by lectures given by specialists invited from different countries.

The number of participants is limited, with priority being given to early applicants and to those working in the field. Application forms must be submitted before 1 July 1990.

Sponsored by the Electronics and Computers Research Centre in Baghdad, the United Nations Economic and Social Commission for Western Asia (UN/ESCWA) and the UNESCO Regional Office for Science and Technology for the Arab States (UNESCO/ROSTAS).

Correspondence outside Iraq:

Mr. K. Jabbar
UNESCWA, Palais des Nations
CH-1211, Geneva 10, Switzerland
or via United Nations Development
Programme Office
Telex: 5564282 Baghdad, Iraq, 213468 Iraq
Telefax: 5569437 (Baghdad, Iraq)

Europe split over chip strategy

Evidence is emerging of deep splits between the member States of the European Community (EC) over what to do about Europe's electronics industry.

The Governments of Britain and Eire are believed to have opposed moves to implement the microchip anti-dumping deal negotiated between the European Commission and 11 Japanese electronics companies.

Meanwhile, the French and Dutch Governments are opposed to British-inspired moves to lower the tariffs levied on commodity microchips imported into the EC.

Large European chip makers (Dutch-based Philips, Federal Republic of Germany's Siemens and the Franco-Italian SGS-Thomson Microelectronics combine) have a lot of political clout both with their own Governments and with the Commission.

They say that unless Europe supports its chip makers, the continent will fall behind in the difficult-to-catch-up chip technology business. Eventually, European equipment-makers will be totally dependent on Japanese technology and suffer as a result.

So far they have won most of the arguments. The anti-dumping deal with the Japanese sets a floor-price for 256Kbit, 1Mbit and 4Mbit DRAM memory chips as well as the forthcoming 16Mbit devices. The deal provides a single minimum price for all manufacturers and is calculated to include manufacturing costs and a small profit margin.

But European-based computer makers and consumer electronics companies are upset. They fear that they will have to pay more than they would otherwise have to for what they regard as basic raw materials. They point out that these costs will be passed on to consumers in the form of higher prices.

Essentially, European consumers will be subsidizing European chip makers and guaranteeing the profits of large Japanese corporations which will be reinvested in advanced technology.

Their pleas are most sympathetically heard by the governments of countries with significant electronic equipment industries and with no indigenous chip champions - countries such as the UK, Ireland and Spain. A number of these countries are reported to have withheld their support for the deal at a meeting of the Commission's anti-dumping committee. However, the deal, agreed in principle back in August, will almost certainly go to a meeting of the ministers from EC member States, where it is likely to be approved on a majority vote.

The situation over important tariffs is just as confusing. On the surface nothing has happened: the Commission has merely circulated a few ideas about how to approach international negotiations for the General Agreement on Tariffs and Trade. Some of these ideas affect tariffs which just happen to include tariffs on commodity microchips imported into the EC.

But behind the scenes, the UK and Irish Governments are specifically pushing for the tariffs on imported chips to be reduced from 14 per cent at the moment to 4.9 per cent, the same as the tariff levied on computers and board-level products.

They argue that the present system encourages equipment makers to assemble their goods overseas and then import them into the EC paying a 4.9 per cent tariff rather than manufacturing within the EC using imported components which incur a 14.9 per cent tariff. They want to encourage equipment makers to set up plants in their countries and so create jobs.

Companies making margin-sensitive, memory-hungry personal computers are particularly sensitive to these tariffs. It is these high-volume manufacturing operations that they want to attract since they will bring the most jobs.

Ironically, it may be the big US multinationals that help Europe get out of its hole. They are anxious to be seen as good corporate citizens and part of that means manufacturing in Europe using European-sourced components.

These big companies are already starting to lean on their suppliers to set up in Europe. (Source: Electronics Weekly, 11 October 1989)

II. NEW DEVELOPMENTS

A small, small, very small diode

Two recent experiments have shown that it may some day be possible to build electronic devices as small as a few atoms across.

P. Bedrossian's team at Harvard University's Lyman Laboratory in Cambridge, Massachusetts, and a group at IBM's T. J. Watson Research Centre in Yorktown Heights, New York, have independently reproduced the essential features of a tunnel diode in structures that consist of only a few atoms. However, although the existence of these structures shows that atomic-scale electronics may be feasible, the researchers caution that it will be many years before practical development catches up with laboratory demonstrations.

Normal-sized tunnel diodes are important in a number of applications that require high-speed circuitry, such as fast switches used in digital signal processing and high frequency oscillators used in microwave instruments. Their value depends on an unusual property called negative differential resistance: As the voltage across the diode increases, the induced current goes down, at least for a certain range of voltages. A diode switch can be turned on by a low voltage and off by a high one. Tunnel diodes are very fast because electrons need to travel only a short distance in them.

As with all electronic devices, trying to diminish the size of a tunnel diode by simply decreasing its dimensions soon runs into a fundamental limit. Once a device gets small enough, quantum effects start to dominate its electronic behaviour, and it begins to act very differently. So the two groups did not actually shrink a tunnel diode; they mimicked it with a new, atom-sized structure in which negative differential resistance is produced by quantum effects instead of electronic effects.

Both groups created the atomic-scale tunnel diode effect by bringing the tip of a scanning tunnelling microscope down near the surface of a boron doped silicon crystal. A voltage applied between the tip of the scanning tunnelling microscope and the crystal created a tunnelling current between them. When the microscope was positioned over certain sites on the surface, the tunnel diode effect appeared - the current dropped as the voltage increased.

The spots on the surface that exhibit this negative differential resistance seem to be isolated defect sites. Instead, the essential requirement for the tunnel diode effect is the presence of localized quantum states on the surface of the sample and on the probe of the scanning tunnelling microscope. Such localized states are usually found over defect sites on the surface and at the tip of the probe, which consists of only one or a few atoms. (Source: Science, Vol. 246, 8 December 1989, p. 1251)

Assembling microchips in line

Du Pont (US) has produced a new range of thermoplastics for the assembly of microchips in a line. This system of attaching the microchips in a line with a ribbon is called Pitac. It is able to reduce production costs by about 25 per cent against the classical methods. This system is also able to reduce any losses and the problems related to using liquid adhesive systems. Although the biggest chemical company in the US, Du Pont has also established itself on the printed circuit boards market as well as the semiconductors market. (Extracted from Usine Nouvelle, October 1989)

Gigabit storage hard disk drive

IBM has developed an experimental hard disk drive that holds a gigabit (a billion bits) of data on a single square inch of disk surface. This would lead to development of hard disk drives that boost current drive capacity 20-fold. In the showing, data was recorded and read at a data rate of 3.5 million bytes/second. Gauged error rates were adequately low - one in a billion, dropping to one in 10 trillion if standard error-correction codes are used - to comply with the strict data-integrity demands of the computer industry. To realize gigabit storage density, several advanced components were merged, including experimental thin-film recording heads and disks.

IBM has also developed two experimental optoelectronic chips that can exchange data at 1 billion bits/second. The gallium arsenide chips use quantum-well technology to create the light pulses. As a receiver, the chip holds 50 times more optical and electronic components than previous chips. It also holds 8,000 transistors. Optoelectronic uses pulses of laser light for carrying data. (Extracted from Information World, 18 December 1989)

Neurocomputer recognizes English

Mitsubishi Electric (Japan) has built a prototype optical neurocomputer that recognizes letters written in English. It scans the letters and identifies them by comparing them to data in its memory bank. The system has a special digital-learning algorithm that gives it the ability to process optical data. According t Mitsubishi Electric, it is the first optical neurocomputer that can recognize all 26 English letters. US equivalents can only identify 50 per cent at best. (Extracted from Asian Wall Street Journal, 11 December 1989)

Fastest pnp transistor

IBM has developed the world's fastest pnp transistor, as its cut-off frequency, 27 GHz, is twice that of similar device frequencies. Such a transistor can allow CMOS power levels while a bipolar process outperforms ECL technology; this could completely alter the design of high-speed logic and memory circuits. IBM is considering the implementation of the technology in high-speed logic circuits, but the technology is only in the experimental state, and is not expected to be ready for application for several years. Integration of complementary npn and pnp devices on a single chip is made easier with the transistor as the new technology uses a fabrication process used in making npn circuits. ECL technology has provided designers with the necessary speed, but requires high power consumption and cooling.

Digital designers are not the only ones to gain from the development, as A-to-D and D-to-A converters, amplifiers and other linear functions can be designed to have the precision, bandwidth and speed necessary for real-time processing of a wide variety of signals. An ion-implanted base 80nm wide

and an optimized emitter create a shallow emitter-base junction, while a heavily doped subcollector is used to prevent the base from stretching at high current densities. The transistor has a breakdown voltage of 7 V, making it suitable for digital applications. (Extracted from Electronic Engineering Times, 11 December 1989)

Fastest transistor yet

Hughes Research Laboratories (Malibu, CA) claims it has fabricated what it believes to be the world's fastest transistor. The device operates at up to 250 gigahertz, or 20 times faster than the best speed yet recorded. Researchers said the device could prove to be valuable in superfast digital circuits and ultra-low-noise amplifiers. The firm also said the new transistor could lead to development of satellite and other communications links that show greater capacity and security per channel, while at the same time reducing the size and weight of receiver antennas. (Extracted from Wall Street Journal, 6 December 1989)

BiFET technology combines HBT with MODFET

Matsushita Electronics has developed a gallium arsenide bipolar field effect transistor (BiFET) integration technology that combines the large current-driving capability of heterobipolar transistors (HBT) with the low power consumption of modulation-doped FETs (MODFET). Propagation-delay dependencies on load capacitance vis-à-vis the conventional GaAs buffered FET logic were favourably obtained. The propagation delay remains under 200 ps up to the maximum load capacitance of 0.7 pF. The BiFET gate also dissipates 16.7 per cent of the power of an ECL gate made entirely of HBTs. (Extracted from Electronic Engineering Times, 20 November 1989)

Fabrication of Si/SiGe heterojunction bipolar transistor

Collaborative work in the Federal Republic of Germany has led to the fabrication of a heterojunction bipolar transistor (HBT) with a base doping (10^{19} cm^{-3}) 20 times greater than the emitter doping concentration. This is claimed to be the first demonstration that a silicon-based HBT operates satisfactorily even if the conventional ratio of emitter-base doping concentrations is inverted. Such high-base doping can reduce the base resistance, so it is potentially attractive for improving the switching speed of future ICs.

The Si/SiGe heterostructure is a candidate to meet the desired doping behaviour that provides an additional energy barrier to holes injected from the base to the emitter. The $Si/Si_{0.8}Ge_{0.2}$ device had emitter, base and collector contacts at the wafer surface. The low current gain of a comparable homojunction silicon transistor is increased by a factor of about 80 by the emitter heterojunction to give a current gain of 17. This increase is attributed to the band gap difference of 114 meV.

This work was undertaken by the Institute für Elektronik, Universität Bochum, Bochum, in collaboration with the AEG Research Centre Ulm, Ulm. (Reprinted with permission from Semiconductor International Magazine, September 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, IL, USA)

Cell library builds ASICs with 0.4-ns gate delays

A new cell library from Siemens AG and Toshiba Corp. makes it possible to design application-specific integrated circuits with gate delays of 0.4 ns, improving by 33 per cent the performance of the previous Siemens-Toshiba library. CMOS line widths were trimmed from the 1.5 μm of the Advancell-C library to 1.0 μm for the new Advancell-D. Advancell-D encompasses more than 250 cell types – ranging from basic functions, input/output cells, and 74-series-compatible macrofunctions to compiled random-access and read-only memory cells and programmable logic arrays. Following a 1986 agreement, Munich-based Siemens and Tokyo-based Toshiba are developing Advancell libraries and second-sourcing each other's products. The ASICs target applications in data processing and data communications, consumer and automotive electronics, and industrial control. (Source: Electronics, December 1989)

Gate array with an 80 ps processing time

Fujitsu has produced a gate array with an 80 picosecond processing time, with an access time 10-20 picoseconds quicker than conventional chips. The product's integration is 39,000 gates/chip, the highest for any bipolar semiconductor produced in Japan. Production for 1990 should reach 100,000 units. There will be two versions in the EVH series, with different voltage requirements. (Extracted from Japan Economic Journal, 30 September 1989)

Lasa paves way for home-made gate arrays

Do-it-yourself gate array-making is on the way thanks to a robot minifab developed by Californian start-up Lasa Industries.

Blank gate array chips can be turned into working silicon sporting two layers of metal interconnections within a few hours. The machine is aimed at electronic sub-contractors and chip companies who want fast turn-around gate arrays and prototypes to work with.

The minifab, a 2 m high rectangle with a 2 m^2 footprint, uses a robot arm to move blank gate arrays between five different process chambers. The minifab is fed from a cartridge of up to 10 blank unlidded gate arrays and gets its instructions from a tape produced by a computer-aided design system.

An argon laser etches out the interconnection paths on the blank chip in the first chamber before the chip is moved on to a vapour deposition chamber. The laser is used to heat tungsten hexafluoride gas so that 2-micron wide paths of tungsten are deposited in the etched pathways.

An insulating layer of silicon chloride is laid down in the third chamber by passing chlorine gas over the chip and heating it with the laser.

The chip then goes back to the first two chambers to have a second layer of tungsten interconnections embedded into it. The two layers of metal are themselves interconnected by vias which are added in a fourth chamber using the laser. The chip gets a hermetically sealed lid in the last chamber before popping out of the end of the machine.

The minifabs cost around £3 million each.

Lasa was founded four years ago by National Semiconductor veteran Dan Dooley. In 1988, the company set up in Livingston with the help of the Scottish Development Agency. (Source: Electronics Weekly, 25 October 1989)

Polysilicon edge sealed LOCOS process for VLSI fabrication

A group at the Institute of Microelectronics, Sofia, Bulgaria, has developed an isolation process that is claimed to eliminate the basic problem with LOCOS isolation, namely wasted space due to lateral oxidation under the oxide mask. This elimination of the "bird's beak" formation is attractive for increasing the packing density in VLSI devices.

The process employs a simple polysilicon sealed pad oxide local oxidation process in which the oxidation mask has a polysilicon frame formed along the perimeter of a conventional mask pattern by a self-aligning technique. Only three technological steps (thin oxide etching, polysilicon deposition and directional polysilicon etching) have been added to the standard LOCOS technique, so it is one of the simplest solutions for isolation in VLSI devices.

The basic idea in this SOLO (Sealed Pad Oxide Local Oxidation) process is to prevent oxidant species diffusion under the nitride mask by using sidewall masking of the initial oxide with polysilicon. Layer thicknesses and process parameters can be chosen so that field oxide penetration under the nitride mask is eliminated. Adequately large polysilicon spacers are achieved by reactive ion etching in a sulphur hexafluoride plasma. The process duration produces a layer in the thickness range 50 Å to 250 Å after etching.

Experimental test chips were fabricated to study isolation quality and device characteristics using a conventional process. The high temperature treatments were at 900°C, except for PSG reflow at 1000°C. The gate oxide thickness was 400 Å. (Reprinted with permission from Semiconductor International Magazine, September 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, IL, USA)

Sticking gold to diamonds

Physicists at the University of North Carolina at Chapel Hill have developed a new technique for causing gold to stick to the surface of diamonds. The technique, used at room temperature, promises to have major applications in laser technology and the microelectronics industry, the scientists say.

The new technique involves chemically cleaning diamonds and then subjecting them to a beam of argon ions for 15 minutes at room temperature. Gold is then sputtered onto the diamonds where it stocks as a thin film far more strongly and with smoother and more uniform thickness than with other methods and metals. The process is expected to improve adhesion of other metal films like tungsten and titanium to diamonds. In the future, it also should be useful in microelectronic circuitry because gold has very low electrical resistance. (Reprinted with permission from Semiconductor International Magazine, September 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, IL, USA)

Designs on accessing 256 K chips

A US company has developed a 256 Kbit DRAM which can be accessed every 100 ns for 10 years. Ramtron's designs will now be passed to ITT Semiconductor for production under an agreement signed last year.

Ramtron bases its devices on ferroelectric techniques, also used for modulating light beams and piezoelectric applications. The company now holds 16 patents for ferroelectric technologies.

Ferroelectric effects have nothing to do with iron or ferrous materials. Elements inside certain crystals line up in opposite directions when an external electric field is applied. These elements, called dipoles, will be held in place by the rest of the crystal after the field is removed.

Used as the dielectric in a capacitor, the ferroelectric material can be used to produce memory devices. Ramtron's first devices were non-volatile SRAMs with two capacitors, one on each side of a flip-flop. When the power is removed, one side of the flip-flop will be at high voltage, and will charge one of the capacitors. The other will be uncharged.

When the power is restored, less current flows through the charged capacitor, and the flip-flop returns to its original state.

Used as a storage capacitor in a DRAM, the ferroelectric device is charged and discharged every time a bit is read. However, it can provide permanent data storage, because the ferroelectric capacitor remains charged when the power is turned off.

Ramtron's breakthrough came when it developed a thin-film ceramic, based on lead-zirconate-titanate (PZT), which could be used in standard semiconductor fabrication processes. The PZT layer is added on top of existing semiconductor circuitry.

The endurance of the ferroelectric RAMs (FRAMs) depends on the number of times data is written and rewritten to the cells. There is a tendency for the dipoles to become "stuck" by keeping their previous orientation when an electric field is applied.

In SRAMs, the capacitors are only charged when power is lost, so the endurance of 10 billion cycles achieved by early devices was adequate. For a DRAM used in a circuit running at 10 MHz, the capacitors will be charged and discharged every 100 ns. To be useful, devices must have a life of a million billion cycles. Ramtron believes that it can now achieve this performance.

Ferroelectric devices have a number of other characteristics which are of use to board designers. PZT films have survived radiation doses of over a million rads and dose rates up to 100 billion rads/sec. Other substrates could also be used in place of silicon, such as GaAs and silicon-on-sapphire.

Ramtron has already designed non-volatile SRAMs with up to 16 Kbit capacity and DRAMs with 4 K and 16 Kbit of storage. The devices will be produced by ITT with feature sizes of 1.2 m and Seiko Epson in sub-micron processes. Prototype devices should be available to circuit designers some time next year. (Source: Electronics Weekly, 22 November 1989)

X-ray chip-making device takes market by storm

Computer giant IBM, which will be taking delivery of Oxford Instruments' first X-ray source for chip making in 1991, has confirmed that it also has options with Oxford for a number of the machines worth $25 million each.

Chip makers world-wide will need to use X-ray lithography in the next decade if they keep cramming

ever more transistors onto chips. Each machine could supply enough X-rays to drive 20 chip-making lines.

IBM intends to use X-ray lithography to make 64 Mbit DRAM memory chips and high-performance processor chips.

Oxford Instruments is one of the few companies in the world that can make the X-ray sources, called compact synchrotrons.

Japanese heavy engineering combines Sumitomo Heavy Industries and IHI have developed similar technology and US giants Grumman and General Dynamics are working on it. A Japanese consortium is also developing production machines. (Source: Electronics Weekly, 1 November 1989)

New generation transputer chip

Inmos has developed a new generation transputer chip that will process data 10 times faster compared to current transputers, helping to speed scientific processing. The transputer is now the most widely used processor for scientific applications and offers parallel computing that rivals supercomputers in speed at a much lower cost. The new 32-bit H1 transputer can handle over 100 million instructions/minute and could carry out 200 million operations/second on decimal numbers to many significant places, making it ideal for numerically intensive scientific processing. The H1 chip is produced using two layers of metal over the chip to serve as communications links to other computer components. Inmos has reduced the price of its chips by 40-70 per cent, which will make it less costly to use multiple processors in parallel to speed computing operations. Inmos has introduced a new T400 transputer model that costs only $20. This 32-bit chip can handle 10 million instructions/second and is equivalent in power to models costing twice as much. (Extracted from New Scientist, 16 September 1989)

Largest digital neural network microchip

Hitachi has developed the world's largest digital neural network microchip, using a large-scale integration (LSI) device. It implanted over 576 "neurons" representing similar components of the human nervous system on a 5-inch diameter silicon LSI. Using a time-sharing technique, only 100 synapses are needed to link an equal number of neurons, compared to 10,000 with the old method, and Hitachi was able to use a digital circuit that is less vulnerable to noise interference than analog circuits. The chip will be incorporated in advanced models of neural computers that can analyse input (e.g. visual data) thousands of times faster than current mainframe computers. (Extracted from Wall Street Journal, 18 September 1989)

New BiCMOS DRAM chip

Hitachi America has developed the first BiCMOS 1 Mbit DRAM chip with an access time of 40 ns, by using a different structure, but as a result gave the new chip 16 address pins instead of 8, found on conventional DRAMs. The chip will not gain recognition as it cannot replace existing chips, so there will be very limited use for it, but there may be applications for the new chip in the new 80486 microprocessor. There are two forms of the chip, the HM574256 organized as 256 K x 4 bits, and the HM571000, organized as 1 Mbit x 1 bit. Prices are expected to end up somewhere between the DRAMs and SRAMs. In addition, Hitachi is continuing to develop these chips and expects to make significant steps in developing 30 ns access times for the 1 Mbit DRAMs and denser 4 Mbit DRAM products by 1990. (Extracted from Electronic Engineering Times, 25 September 1989)

Fujitsu's analog neural chip

Fujitsu has developed a neural chip that is a true analog of neural activity. The MB4442, developed by Fujitsu's Artificial Intelligence Laboratory, deals with data that is entirely analog. The control area, a few digital registers, and a D-to-A converter are the only digital portions of the chip. Although just one neuron is patterned, the chip has a fan-in/fan-out of 1,000 for link-up to additional chips, and it operates at 70K connections/second. The chip's die dimensions are 5.3 mm-x-3.8 mm and sits on a 20-pin DIP dissipating 200 mW with 1,100 transistors arranged into 520 gates. Analog weights are held externally in RAM, and then applied to the analog data stream after on-chip D-to-A conversion. Since weights are stored externally, learning has to occur prior to downloading weights to RAM. Learning is accomplished via a procedure termed pseudo-impedance control. The chip will be marketed at the start of 1990 with robotics applications targeted. (Extracted from Electronic Engineering Times, 21 August 1989)

Transputer programme bears ASIC chips

Multiprocessor ASIC chips could be one result of the SGS-Thomson programme to use the Inmos Transputer as a core cell for semi-custom chips.

But the prospect of desktop parallel processing computers at Amstrad prices is some years away. Inmos reckons it will be at least a year before it has first commercial availability of standard cell devices incorporating Transputer cores.

The Transputer which will first be used as a standard cell core is the low cost T400 - the $20 cheap version announced in September 1989. Since buying Inmos, SGS-Thomson has cut prices on other versions of the Transputer in a move to establish it more widely in commercial markets.

Inmos does not see the move to use the Transputer for standard cell purposes as a move away from promoting the Transputer as a stand-alone micro.

The prospect of Transputer-based ASICs offers considerable opportunities for entrepreneurs wanting to buy ready-made boards to perform high-tech functions at High Street prices. (Source: Electronics Weekly, 1 November 1989)

The chip race speeds up

One of the goals of reduced instruction set computer technology was to execute one instruction per clock cycle. Nowadays new microprocessor architectures, billed as the successors to RISC, are pushing past what once seemed the absolute limit, and executing two, three or more instructions per cycle.

Intel is using such techniques in its 860 and 960 families, aimed respectively at the workstation and the embedded systems markets. The 960CA is rated at 66 million instructions per second when used with a 33 MHz clock. Still faster versions are promised.

The 32-bit microprocessor is a relatively new feature of this market. They are very different from the simple 8-bit microcontrollers which suffice

when the application basically consists of testing which buttons have been pressed and working out which motors should be running. These 32-bit devices can do serious computations on large volumes of data, under real-time constraints.

Market research company Dataquest predicts that sales of 32-bit embedded microprocessors will grow from $210 million in 1988 to $750 million in 1993, an annual increase of 30 per cent. Most of this growth, Dataquest believes, will be in applications that involve the handling and processing of images.

Complex instructions, which took many cycles to execute, have been excised from instruction sets. The remaining instructions are decoded by custom logic, avoiding the use of microcode. (The current Inmos Transputers, which do have a microcode store, are in this respect not typical RISC processors.) A pipeline, holding several instructions at different stages of completion, ensures that with each machine cycle, work can begin on a new instruction. Smart compilers, and a carefully-managed storage hierarchy, ensure that a RISC processor runs close to its maximum potential speed.

If RISC was all about what a processor can safely lose, subsequent developments have been about what can safely be put back. Intel's 960 architecture, for example, brings back some of the complex addressing modes which RISC banished. But in the high-speed 960CA there is little time penalty, because while one of the chip's three separate pipelines handles memory transfers, another carries on with arithmetic and logical operations on register contents. The third pipeline manages branches, subroutine calls and returns.

The Intel chip's r[illegible]-time credentials are strengthened by the impressive speed with which it can respond to interrupts, using on-chip resources. Intel claims that it can save its execution state and service a high-priority request, typically in less than 750 nanoseconds. Fast context-switching was always a strong point of the Inmos processors, but Intel's performance will take some beating. (Extracted from Computing, 19 October 1989)

Philips achieves breakthrough in GaAs circuits

Researchers at the Paris-based Laboratoires d'Electronique Philips have made a discovery that could open the way for a new generation of gallium arsenide integrated circuits. The laboratory, which is part of Philips NV's international research organization, has demonstrated that metal-insulator-semiconductor FETs, or MIS FETs, using GaAs heterojunctions exhibit a negative differential resistance at room temperatures over a wide operating range. This discovery, the Dutch company says, paves the way for GaAs ICs with considerably simpler structures than are possible with conventional metal-semiconductor FETs. For example, an exclusive NOR port using MIS FET technology consists of just two resistors, a transistor and a load resistor. A similar port built with MES FET technology requires eight transistors and five load transistors. (Source: Electronics, September 1989)

Double gallium cell sets a new record for efficiency

Researchers in the US have produced solar cells with a record efficiency of 37 per cent. The cells contain two energy conversion layers, one gallium arsenide and the other gallium antimonide. The scientists, working at Boeing's High Technology Center in Seattle, are now exploring potential applications for these cells.

Boeing beat the previous record of 31 per cent efficiency, set by Sandia National Laboratories, by using gallium antimonide rather than silicon to make the second layer. In this way, the characteristics of the semi-conductor were more closely matched to the solar spectrum.

Solar cells generate a current when light excites electrons from a semiconductor's valence band to its higher-energy conduction band. The energy generated by each photon is the difference between the two bands (the band gap): 1.42 electronvolts for gallium arsenide but only 1.2 electronvolts for silicon. Silicon is cheaper and can use light at longer infrared wavelengths than gallium arsenide, but its smaller band gap makes it less efficient.

Sandia's trick was to make gallium arsenide chips transparent to photons whose energy is smaller than the semiconductor's band gap - photons whose energy the chip could not convert to current. This infrared light, at wavelengths longer than 900 nanometres, would then generate a current in a silicon chip behind the gallium arsenide. However, because silicon only absorbs wavelengths of up to 1,100 nanometres, it boosted efficiency from 27.2 per cent for gallium arsenide alone to only 31 per cent for the dual cell.

Gallium antimonide, which has a much smaller band gap of 0.72 electronvolts, can use light at 900 to 1,700 nanometres transmitted through the gallium arsenide. In its best solar cell, Fraas' (Lewis Fraas, solar cell project manager) group measured an efficiency of 8.1 per cent, more than double that of silicon.

Another innovation helped Boeing push gallium arsenide efficiency up, giving an overall efficiency of 37 per cent. Grooved covers from Entech, a company in Dallas, Texas, bend light away from the electrical contacts, which collect the flowing current, to strike active areas on the cells which are only 2.5 millimetres across. By placing covers over the gallium arsenide and gallium antimonide layers, researchers raised efficiency by 10 per cent.

Both types of dual-layer cells operate at many times normal solar flux. It is cheaper to build large collecting optics to focus light on to small solar cells than to make a large array of costly single-crystal solar cells. (This first appeared in New Scientist, London, 9 December 1989, the weekly review of science and technology)

New IC developed

Nippon Telegraph & Telephone has developed a GaAs integrated circuit capable of transmitting optical signals at 11.2 G-bits/second, compared to the previous record of 5 G-bits/second. In producing the IC it used a new "dense-packing technology" to greatly reduce the size of the transistor's gate, making the transistor three times more efficient. NTT previously developed a 1.6 G-bit optical transmission system that could send the equivalent of 23,000 telephone lines worth of information over an optical cable. It hopes the new GaAs IC will lead to optical cable systems of even higher capacity. (Extracted from Asian Wall Street Journal, 2 October 1989)

Nonlinear organic optical materials developed

Sumitomo Electric Industries (Tokyo, Japan) has developed nonlinear organic optical materials capable of reducing semiconductor laser wavelengths by half. The technology offers the potential for

increasing optical disk storage capacity fourfold. The work centres on two materials originally synthesized by researchers at the University of Osaka Prefecture (a yellow indole derivative) and the Tokyo Engineering University (a white dithiole derivative). Sumitomo plans to develop a commercializable optical pickup device incorporating the materials within two years. Initial product development work will focus on a CD-ROM device, but the technology is applicable to optical disks generally. (Extracted from New Technology Japan, October 1989)

Step towards useful superconducting products

Superconducting ceramic paste might be coated on silver foil to produce useful superconducting products, according to researchers at the Argonne National Laboratory. The superconducting ceramic is mixed with silver powder and methanol or isopropanol. This slurry is coated on the silver, which can be shaped as desired before firing. Silver in the slurry bonds to the silver foil to provide a secure anchor. The composites produced so far do not carry as much current as needed for practical applications, but this may be a step towards making useful superconducting products. (Extracted from Science News, 16 September 1989)

New IC packaging method

Digital Computer has developed an integrated circuit packaging method that packs a computer's battery of chips and circuits inside a 5 inch square area. The technology reduces the distance that signals must pass between chips to the width of a hair without excessive heat build-up. The advance will enable the chips to process data at twice the speed of conventionally packaged computer chips. DEC is expected to use the technology in a VAX mainframe it is introducing and to build its next generation of mainframes around the technology - computers as powerful as the best IBM has to offer, but at half the cost of IBM models. The technology is applicable across the entire expanse of supercomputer to personal computer machines. Computer experts anticipate that it will be some time before the technology is in widespread use. (Extracted from USA Today, 26 September 1989)

CNET claims breakthrough in laser power efficiency

France's Centre Nationale d'Etudes des Télécommunications (CNET) claims it has achieved the lowest current density yet - 640 A/cm^2 - for lasers emitting light at a wavelength of 1.55 μm. The lasers, based on opto-electronic quantum-well technology, were developed at CNET's Bagneux laboratories near Paris. The improved power efficiency stems from the new-found ability to grow indium phosphide epitaxial layers that are a few tenths of an angstrom thick. The fabrication process has also yielded practical quantum-well devices in GaAs/InGaAsP lasers grown on InP wafers by metal-organic vapour-phase epitaxy at atmospheric pressure. CNET workers have built their new lasers into distributed feedback (DFB) structures, which they say have 6-mA threshold currents and 2-MHz line widths for an optical power of 2 mW - an order of magnitude lower than that for nonquantic DFB structures. (Source: Electronics, December 1989)

New semiconductor material patented

IBM has patented a new semiconductor material that can operate at higher temperatures than materials developed previously. The range of materials, composed of thallium, calcium, barium, copper and oxygen, is superconductive at 125 K (-148°C), compared to the previously developed 1-2-3 materials that become superconductive in liquid nitrogen at 77 K. Because materials should be superconductive at twice the temperature of the coolant to provide a margin of safety, the temperature difference is significant. The new combination would nearly meet these goals when cooled with liquid nitrogen. Superconductors, which conduct electricity totally without resistance, may be important to the development of a wide range of electrical/electronic devices from pocket-sized mainframe computers to gravitated railways. (Extracted from New York Times, 30 September 1989)

Superconductors take the noise out of radio communications

High-temperature superconductors could benefit communication systems and other signalling devices that work in the radio and microwave sectors of the spectrum. This is the finding of George Peterson of AT&T Bell Laboratories in Murray Hill, New Jersey, who has made resonators using superconducting ceramics. The shape of radio signals from his resonators are between 10 and 100 times as sharp as anything their all-copper counterparts can produce.

Resonators are tubes that contain a central wire or coil of conducting material. They are used in devices that generate or receive radio signals. Resonators that work at highly precise frequencies will be particularly useful in radio communications, astronomy, medicine and the military.

Peterson thinks that the materials reduce the signal's noise by a factor of 100 or more, and compress the bandwidth of the resonating frequency by a factor of 10 or more. The result is a much sharper signal.

At low frequencies, superconducting resonators can be much smaller than conventional ones. A superconducting 10-megahertz resonator will fit into one hand, whereas an all-copper version would be the size of a barrel, according to Peterson. At high frequencies, however, the difference in size between a conventional resonator and a superconducting one is negligible, he says. He has made resonators for frequencies up to 1.5 gigahertz.

No superconductor has zero resistance at radio frequencies, but Peterson says that the ceramics have much lower resistance than copper. Although the power of his resonators is limited - no more than 4 watts - it is enough for most radio receivers.

The success of the laboratories' superconductors is partly due to a process developed by ICI Advanced Ceramics at Runcorn in the UK, which strengthens the normally fragile ceramic superconductors. A group at ICI, led by Derek Birchall, devised the process to strengthen other ceramics, demonstrating the technique by making a spring of cement 10 years ago.

ICI made superconducting antennas in 1988, and coils of superconducting wire have been used in motors. Other groups used the materials to help to detect magnetic fields in the human body and to make Josephson junctions - ultrafast switches for computers. (This first appeared in New Scientist, London, 18 November 1989, the weekly review of science and technology)

New superconducting material

A material consisting of yttrium, barium, copper and oxygen acts as a superconductor

above 200 K, according to researchers at Wayne State University and Ford Motor Company. However, the structure and composition of the material are not known. The researchers claim that their data showing that the material's resistance falls to zero at high temperatures are reproducible and stable. Because the superconductivity observed is filamentary in nature and is not a property of the bulk material, it cannot be proven in the usual way, in which the material is found to exclude an external magnetic field (the Meissner effect). However, complete electrical measurements have been collected that show that the loss of resistance is actually a property of the material. Although the Meissner effect was not observed, other associated magnetic effects were found at the same temperatures as the drop in resistance.

The highest transition temperature at which a bulk superconductor could carry a current with zero resistance is 125 K, which has been observed with a thallium-based copper oxide. If the transition temperature could be increased well above 200 K, dry ice could be used as a coolant instead of liquid nitrogen. Use of dry ice would be less expensive than liquid nitrogen. The researchers are still uncertain about the implications of their findings. If the material turns out to be a previously unknown Y-Ba-Cu-O compound with a much higher transition temperature, scientists could find a process to make larger quantities of the pure material. However, if the superconductivity stems from the interface between separate crystalline phases, the discovery might be more useful in terms of pure science than as a technological breakthrough. (Extracted from Chemical and Engineering News, 16 October 1989)

Large single lanthanum-gallate developed

Shin-Etsu Chemical (Tokyo, Japan) has developed single crystal lanthanum-gallate that may have potential as a superconducting thin film substrate. High-quality large diameter single crystal substrates with interatomic distances similar to that of the superconducting epitaxial thin films are thought to be essential to the manufacture of oxide superconductors. The Shin-Etsu $LaGaO_3$ crystal is 5 cm by 4 cm in diameter - twice the size of similar crystals being produced in the US. Shin-Etsu is a major manufacturer of lithium-tantalate and gadolinium-gallium-garnet single crystals used for magnetic bubble memories. The company plans to continue to research with the aim of further improving the crystals and manufacturing methods for making them. (Extracted from New Technology Japan, October 1989)

Calcium substituted superconductor

An enhanced type of calcium-substituted 1-2-4 yttrium-barium-copper superconductor with a 90 K critical temperature has been developed at the Superconductivity Research Laboratory (Tokyo, Japan). The crucial characteristic of the new technology is substituting calcium for 10 per cent of the yttrium part of the semiconductor. A spokesman for SRL said the use of hot isostatic pressing under high pressure made the replacement possible. The 1-2-4 holds oxygen even at up to 800°C. (Extracted from Metalworking News, 9 October 1989)

New milestones set with bulk, thin-film superconductors

Researchers probing single crystals and thin films of yttrium-barium-copper oxide ($YBa_2Cu_3O_7$) recently have achieved a couple of small but important milestones on the long and difficult road to making liquid-nitrogen-cooled superconductors technologically useful.

At AT&T Bell Laboratories in Murray Hill, NJ, a group has shown for the first time that a single crystal of $YBa_2Cu_3O_7$ can carry large supercurrents in a magnetic field. The researchers created tiny defects in a crystal by irradiating it with fast neutrons. They then measured the highest current it could carry at 77 K and 9 kilo-oersteds (0.9 tesla). The critical current density they found - about 600,000 amps per sq.cm. - is 100 times greater than for unirradiated crystals. Currents this large have not been reported previously in bulk $YBa_2Cu_3O_7$, although they have been seen in thin films.

The advance came about through an understanding of lattice defects and how they interact with magnetic lines of force. When an outside magnetic field penetrates a superconductor, it tends to form eddies of magnetic flux, or "vortices". These eddies create resistance to the flow of current unless they are "pinned" in place by defects known as pinning sites. But the defects that occur naturally in $YBa_2Cu_3O_7$ do not pin the vortices strongly enough to prevent them from being shoved aside by the current - a phenomenon known as "flux creep". Because energy is consumed in moving the vortices, the current eventually dissipates.

The Bell Laboratories' workers solved the flux creep problem by making the flux pinning stronger. By irradiating their sample with fast neutrons (those with energies over 1 MeV), they produced a high concentration of strong pinning sites. These firmly anchored the flux lines and allowed an impressively large current to pass unimpeded. However, the critical-current enhancement, achieved by R. Bruce van Dover, E. Michael Gyorgy, Lynn F. Schneemeyer, and two other Bell Laboratories' co-workers, along with two co-workers at the Royal Institute of Technology in Stockholm, must be considered preliminary. (Extracted from Chemical and Engineering News, pp. 22-23, 13 November 1989)

Electric charge technique deposits finely patterned thin films

The British National Physical Laboratory (NPL), Teddington, near London, has developed a simple, economical, single-stage technique for the deposition of finely patterned thin films onto a substrate. The process consists of writing an electric charge pattern onto an insulating substrate using an electron or ion beam. The thin film can be formed simultaneously by indirect vacuum deposition, although it can also be formed in a separate operation. The material is formed only on the areas which have been charged. It is claimed that the thickness of the film, which may be insulating or conducting, single or multi-layer, can be controlled precisely.

Preliminary work at NPL had shown that nucleation occurs at the charged sites on the substrate and that films build up only in the charged regions. Early work used an argon ion beam to create hard, very adherent zinc sulphide films of typical thickness 0.4 μm on glass substrates in about one minute. It is expected that oxygen or nitrogen ion beams can be employed to produce oxide or nitride films in a similar manner.

Very fine patterns have been written through a thin copper mask using thermal electrons from a hot

filament. Films of zinc sulphide evaporated in a separate operation were formed only on the charged areas. The natural oxidation of such metals and semiconductors as aluminium and silicon provides adequate insulation for a suitable charge pattern to be formed on them; the charge can be laid down at energies of a few eV which is inadequate to cause them to pass or tunnel through the thin oxide. Thickness variations of the deposited film can be produced directly by appropriate electric charge patterns.

Special instruments will have to be developed to produce submicron-sized artwork using focused charged beams for the writing. Fine charged lines have been written on silicon dioxide substrates in a scanning electron microscope employing various accelerating voltages and different spot sizes. The width and thickness of the resulting films closely corresponded with the writing condition. The electron microscope and the deposition facility were in two separated buildings and this often resulted in a large delay between the two operations. In one case, successful results were obtained with deposition about 48 hours after writing. Zinc sulphide lines 5 μm wide and 44 nm thick with sharp edges have been produced in this way.

The technique is said to be particularly suitable for producing thin film on sapphire electronic devices and defence-type electroluminescent screens, or even electronic circuits on superconducting ceramics. Aluminium vapour must be ionized before it will attach itself to the charged regions, but this is unnecessary for zinc. (Reprinted with permission from Semiconductor International Magazine, October 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, IL, USA)

British process silicon for biosensor fabrication

R. S. Sethi of Plessey's Allen Clark Research Centre, Caswell, Northamptonshire, England, says: "We are hoping to put all of the circuits for biosensors on to silicon wafers. Our biosensor is now the size of a calculator and we hope to market it in a couple of years' time."

These sensors can be based on a direct combination of biological and electronic parts. The "biological part" is a matrix-bound bioactive material, such as an immobilized layer of enzyme, antibody, antigen or living cells that is responsible for the very specific recognition of the species under test. The "electronic part" is a transducer on a non-biological substrate that effectively converts the changes in the biological layer into an electrical signal.

These microelectronic biosensor devices employ parallel metal tracks on silicon dioxide on a silicon chip. Systems based on three different measurement principles are under investigation. These are surface conductance, thermometric sensors that depend on the heat from biochemical reactions changing the resistance of the metal tracks and amperometric systems involving measurement of the current resulting from the application of a constant voltage across the electrodes in the presence of a product from the enzyme catalyzed reaction.

Sethi said that improved sensor devices are obtained by fabricating them on the back of the wafer and locating the silicon circuitry on the polished side. The only limit to the lifetime is that of the enzyme, typically 6-8 months if kept in a refrigerator. Sethi added that he expects the devices to be sold as solid state sensors on which a single drop of two solutions would be placed before use. These enzyme solutions would be refrigerated for storage to avoid lifetime problems. (Reprinted with permission from Semiconductor International Magazine, September 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, IL, USA)

US firm hits mark on measurement

An instrument for accurately measuring the thickness of the very thin dielectric films vital to the next generation of fast chips has been developed by Californian measurement specialist Nanometrics.

Dielectric films must get thinner as circuit geometries shrink to maintain consistent electrical properties. Typical thicknesses may range between 20 and 100 layers of atoms as line widths go below 0.35 microns.

Chip makers need to be able to measure the thickness of these thin layers if they are to make such chips.

Conventional optical techniques cannot cope with layers of this thickness because the wavelength of the light used is larger than the distance that is being measured. So Nanometrics has modified one particular technique to use deep ultraviolet light which has a shorter wavelength and can therefore measure thinner layers.

The technique makes use of the fact that the polarization of light changes when it is reflected off thin layers of material and that the amount of the change is related to the thickness of the layer and the refractive index of the layer.

The instrument reflects a very tight beam of polarized ultraviolet light off the surface of the chip under inspection. The polarization of the reflected light is measured using a combination of polarization analyser and photomultiplier light detector.

The instrument is capable of making spot measurements of the thickness of silicon dioxide and silicon nitride layers on polysilicon films. Furthermore, since the refractive index is also related to the precise chemical make-up of the layer the instrument can be used to figure out precise chemical compositions. (Source: Electronics Weekly, 22 November 1989)

Flat screen costs slashed by Irish

Northern Ireland researchers have come up with a way of etching tin oxide which promises to slash the cost of making high resolution flat screen displays used in electronic instruments.

They have adapted a machine used in the production of silicon chips so that electrodes can be etched into a layer of tin oxide which has been coated on a flat panel of glass. Tin oxide patterned with lines as fine as 4 microns has been produced with a modified reactive ion etcher machine which uses a mixture of chlorine and argon as the reactive gas.

Until now tin oxide has been extremely difficult to etch accurately and so display makers have preferred to use indium-coated glass despite the fact that it is far more expensive to make.

Flat panel displays are essentially sandwiches with electrode materials on the outside and the glass in the middle. Tin oxide and indium oxide are transparent and are therefore among only a few electrode materials that can be coated on the outer surface of a flat panel display.

Now that electrodes can be accurately etched in tin oxide as easily as they can be in indium oxide, manufacturers are likely to turn to tin oxide because it is cheaper and easier to deposit on to glass, according to researcher Jim Shields at the University of Ulster.

A highly difficult sputtering process is needed to coat the indium oxide onto glass and this means that most display makers buy in supplies of ready-coated glass from specialist contractors. But with tin oxide, manufacturers can do it in-house using a chemical vapour deposition process.

Several US manufacturers have already expressed an interest in licensing the University of Ulster technology. (Source: Electronics Weekly, 15 November 1989)

PPS capacitors for high temperature

Siemens claims that it is one of the first European manufacturers to develop a metalized-film capacitor with a polyphenylene sulphide (PPS) dielectric. It can be used at operating temperatures as high as 125°C without voltage derating and without operating time-limits.

The type BS2729 series of capacitors comes in two voltage ratings: 50 V DC with capacitances from 68 to 330 nF and 100 V DC with values from 22 to 100 nF.

Although polyester capacitors will operate at temperatures over 100°C, most of them can only withstand such heat for a limited period of time. With the PPS dielectric, temperatures and time restrictions are overcome. All capacitors in the series are made in stacked film technology.

The maximum pulse rate is 200 V/µs for the 50 V series and 250 V/µs for the 100 V series. Maximum dissipation factor is 0.0015 at 1 kHz and 0.002 at 10 kHz. (Source: Electronics Weekly, 15 November 1989)

VME gets faster with performance

Potential performance gaps at the top end of the VME market could be bridged by a new development from a US board-maker.

The system, developed by Performance Technology, will effectively double the speed of VME systems, by allowing them to handle data in 64-bit chunks, rather than the current maximum of 32-bit.

The probable successor to VME, Futurebus, will allow systems to go faster than is presently possible, but is unlikely to be widely available for two to three years.

So Performance's 64-bit system could be just the thing for designers of real-time control and other ultra-fast applications. The company has already demonstrated configurations which shunt data at up to 60 Mbyte/s.

The system uses the bus' 32 address lines to carry data, as well as the standard data lines. Because these lines are used only for a small proportion of the system's working time, this virtually doubles the effective data rate.

It also means that 64-bit boards can be plugged into existing VME racks. (Source: Electronics Weekly, 15 November 1989)

Japan closes in on a parallel inference machine

Eight years into the ten-year, $400 million Fifth Generation Computer Project, the Japanese appear close to coupling symbolic programming with advanced parallel-computing techniques. The project's core effort to build a Parallel Inference Machine with about 1,000 processors is on schedule, two to three years away from completion, say officials at Tokyo's Institute for New Generation Computer Technology (ICOT). Systems and software developed using ICOT's KL1 high-level logic programming language will be debugged on a 64-processor system in Tokyo. ICOT officials demonstrated a 16-processor version last month at Argonne National Laboratory in Argonne, Ill. But ICOT will not meet its goal of producing by 1992 a computer capable of reasoning. And natural-language comprehension will not come until after 1992, concedes Kazuhiro Fuchi, ICOT's managing director. (Source: Electronics, November 1989)

The DIY super buy!

DIY supercomputing will soon be possible using a new computer which features programmable hardware as well as software.

Dr. John Gray, director of Edinburgh-based Algotronix which has been set up to make the new computer, claims that it will be more flexible than application-specific integrated circuit (ASIC)-based machines. These are only suitable for one type of computation, but the new computer can be reprogrammed electrically to do other types.

Configurable array logic (CAL) forms the basis of the new machine. This is essentially a cellular array with 1,000 cells, each of which can be programmed to store, calculate or pass on data, with the user configuring them for the required purpose.

Another key feature of the custom supercomputer is that the chips interconnect with their nearest neighbours to make an arbitrarily large structure, according to Gray. He envisages that it will come into its own in areas such as computational fluid dynamics, cryptography and image and signal processing.

ASICs will still have the edge in terms of speed, though the new computer will beat conventional machines because it does not use the van Neumann paradigm, on which serial computers are based. To give an idea of its processing power, in cryptography, half a million encryptions could be performed a second, maching the fastest custom chip available today. (Extracted from Electronics Weekly, 11 October 1989)

III. MARKET TRENDS AND COMPANY NEWS

Market trends

Multi-media growth forecast

Sales of multi-media hardware and software will be $17 billion in 1994 against $440 million in 1989, according to the Information Workstation Group.

Multimedia involves the integration of audio, graphics, text and video images into applications software designed for desktop or personal computers. The forecast given covers a wide range of products and services, including 16-bit video game machines and consumer videotext information services. Applications that use full-motion video are excluded from the forecast. Digital video interactive (DVI), a standard supported by Intel, IBM and Microsoft, is expected to become popular initially in the business market and move down to the consumer market. A competing standard called compact disc interactive, supported by Philips Telecommunications, Sony and Matsushita Electrical Industrial, will initially become popular in the consumer market and move up to the business market, according to IWG. (Extracted from Computerworld, 4 September 1989)

A flat 1990 forecast for Europe

The forecast season is in full swing. One closely watched estimate, the annual study of European electronics markets from Elsevier Advanced Technology of Oxford, UK, has taken on added importance among managers of American companies as the economic unification of Europe draws closer. Going counter to the optimistic estimates, Elsevier expects 1990 to be a flat year, with growth of just 2 per cent in real terms, down from the 1989 figure of 4.4 per cent. But recovery will come in the early 1990s, says the study, with an average growth of 5.1 per cent a year over the period 1991-1993. The total market will reach $225 billion in 1993. The fastest-growing national market in 1989 was Spain, hitting 7.4 per cent compared to 4 per cent in the UK and 5 per cent in the FRG. Spain's growth rate will continue to lead those of its neighbours, averaging 6 per cent a year for 1991 to 1993, when its market will reach $13 billion. Scandinavian countries, with the exception of Finland, are depressed, with growth well below the European average. Norway in particular was badly affected by falling oil prices; over the period 1987 to 1990, Elsevier estimates its market for electronic products will have decreased by 7 per cent. (Source: Electronics, December 1989)

PCB assembly expands

The market for printed circuit board assembly equipment is expected to rise to $343 million in Europe by 1993. There is an increasing trend towards mixed technology, according to a report published by Frost & Sullivan.

The mixing of surface-mount and conventional assembly equipment has come about as a result of a lack of availability of certain surface-mount components. In 1989, there was a shortage of surface-mount transistors, but this shortage has now been overcome.

There is also an increased cost and difficulty of handling some of the surface-mount components, even when they are available. This means that, although surface-mount technology can stand by itself in certain markets, it is probable that mixed technology will continue for a number of years to come.

This conclusion corrects the view that by the 1990s virtually all assembly onto PCBs will be through surface-mount technology. (Source: Electronics Weekly, 15 November 1989)

Neural brainstorm will pull in $120 million in 1990

Neural networks will be a $120 million market in 1990, a Wescon technology session was told.

According to Tom Schwartz, president of Schwartz Associates which commercializes advanced technology, sales of neural network products are growing fast towards an annual sale of $865 million in 1993. Currently the market splits: 55 per cent contract work; 30 per cent hardware; 10 per cent software and 5 per cent education.

Stimulating market growth would be the imminent announcement of a major joint venture in neural networks between ICOT and MITI.

The technology is costly. Only two companies offer source code for neural nets at "reasonable prices" said Schwartz, by which he meant something less than six or seven figure numbers. As for hardware, for $25,000 you get a system with 500,000 interconnects capable of 10^7 interconnects per second which will give you the equivalent intelligence of a worm.

However there are great potential benefits. Don Specht of Lockheed said that using neural nets to detect submarines had resulted in speed performances 200,000 to 1 superior to using a VAX. (Source: Electronic Weekly, 22 November 1989)

SIA sees chips in downturn

The falling price of dynamic RAMs will cause negative growth in the world semiconductor market next year, according to the US Semiconductor Industry Association (SIA).

However the brunt of the downturn will be felt in the United States where the market is forecast to dip 3.5 per cent in 1990. Other parts of the world will get increases of 1 or 2 per cent.

But when all sales are related in dollars, a stronger US dollar will cause Japan to drop.

Japan will still be the largest consumer of semiconductors with a market worth $19.1 billion in 1990 compared with $19.2 billion. The US drops from $14.7 billion to $14.2 billion.

Europe is a brighter market growing from $9.1 billion to $9.2 billion this year. The rest of the world grows from $6 billion to $6.1 billion.

The hot market in 1990 will be field programmable MOS logic, says the SIA. It forecasts a 22 per cent growth for this sector in 1990. (Source: Electronics Weekly, 4 October 1989)

SOI may dominate CMOS in the 1990s

J. N. Ellis of Plessey Research Caswell, Towcester, Northants, UK, feels that silicon-on-insulator (SOI) technology is a strong contender to be the dominant CMOS technology of the 1990s.

Thin-film SOI offers a technology route for increasing the chip density beyond the capability of LOCOS or trench isolation. In thin film FETs true threshold voltage scaling can be achieved for the first time. SOI offers increased control of punch

through and keeps the 5 V supply option open at 0.5 µm and perhaps beyond, while allowing a change to 3 V to be made with less impact than on bulk processes.

The very high implanted oxygen ion dose of about 2 times $10^{18}/cm^2$ at 150 or 200 keV makes the SOI starting material very expensive, but overall process costs are similar to bulk silicon owing to simplifications that are possible. SOI will become a mainstream technology as the cost of solving evolutionary problems grows in other technologies, since SOI is directly shrinkable to the limits of photolithography and to the silicon volume needed for the appearance of the energy gap. There are almost no isolation constraints until the devices are so close or small that direct tunnelling may occur. (Reprinted with permission from Semiconductor International Magazine, October 1989. Copyright 1989 by Cahners Publishing Co., Des Plaines, Il., USA)

Supercomputers to rise to new levels

Supercomputers are expected to be taken to a new level by the year 2000, led by smaller chip-feature sizes and multi-chip bonding. Fine-grained to coarse-grained architectures are expected to fill applications for everything from economic forecasting to scientific visualization. Research continues in combining parallel-processing hardware and algorithms that can be disassembled, analysed and later reassembled. Interconnection technology is also driving the supercomputer technological advances. One approach has been to use whole wafers for mounting complete computer systems. X-ray lithography and other technologies will undoubtedly also drive the supercomputer to reach smaller sizes. (Extracted from Electronic Engineering Times, 20 November 1989)

Future uses of CAE tools

Computer-aided engineering tools will be used in the 1990s to drive the designs of the new generation of microprocessors. High-level representations will be used more and product cycle times will be reduced with the use of CAE tools. Large-scale design will require the use of new tools. RISC and CISC models designed in the 1980s will be built upon, but new design methods will be needed to improve upon their performance. Next-generation microprocessors will require extensive memory and more chips will be devoted to caches and multi-level caches, staged-memory buffers and queues. By the end of the 1990s, 5 million basic transistors will probably be put on a chip, and they will have processor cycle times in hundreds of nanoseconds. (Extracted from Electronic Engineering Times, 20 November 1989)

Advance of graphics systems

Personal computer graphics boards within the resolution range of 1,024 x 768 attempted to prove the amount of high-resolution available with each was the greatest in 1989. The biggest competitors were the IBM 8514 standard and the Texas Instruments TIGA. PC graphics are now advancing to resolutions of 1,280 x 1,024 and higher. Medical and military imaging and analysis are using the higher resolution for specific applications. In addition to increasing the resolution performance, companies are actively pursuing greater imaging speed and depth. Advanced features such as frame buffers are being added to increase the performance of graphics systems. (Extracted from Electronic Engineering Times, 11 December 1989)

Analysts predict ASIC price fall

Custom chip users can look forward to cheaper chips and improved service in 1990, but it will be a tough year for vendors. The application specific integrated circuit (ASIC) market is not expected to grow at all in 1990, according to market watching consultants BIS Mackintosh. High-performance chips are expected to be the best sellers, but strong marketing will be needed even for products such as BICMOS and advanced ECL gate arrays and standard cell devices.

Despite a predicted volume growth of 4 per cent BIS Mackintosh expects average ASIC prices to fall by about 4.5 per cent. Even more drastic cuts are in prospect for older, simpler devices.

The world-wide market grew by about 55 per cent between 1987 and 1988, but is expected to contract to only 11 per cent growth this year and zero in 1990. The consultants attribute this to further slowing in the economies of the US and its major trading partners.

Between 1991 and 1993 an upturn in the market to 13.5 per cent growth per year should be seen, which is larger than for semiconductors in general. This corresponds to an increase in the world market from $4 billion in 1989 to nearly $6 billion by 1993. (Source: Electronics Weekly, 11 October 1989)

Laptops rule Tokyo trade show

1989's Tokyo Data show revealed that, in Japan at least, the laptop market is perhaps the only niche that is still developing at a substantial pace.

NEC, Sharp, Epson, and Okidata all displayed laptops with standard-matrix colour displays that will be released in late 1989, while Sharp, Panasonic, Mitsubishi, and Hitachi exhibited prerelease versions of active-matrix colour LCD displays, which have much-improved intensity and clarity over current colour displays.

So far, the Portable Macintosh is the only computer containing an active-matrix display marketed in America.

Active-matrix colour displays are currently limited to eight or 16 colours, but this appears to be an equitable trade-off in display capability compared to a larger selection of lukewarm but perceptibly weaker colours.

All of the displays shown provided VGA compatibility, except the NEC model. Ricoh even had a prototype that delivered a resolution of 640 by 640 pixels in 16 colours installed in a 16-MHz 386SX laptop.

The Sharp 286 AX active matrix is scheduled for release next summer. Sharp also displayed an extremely thin active-matrix display that features high speed and superb display characteristics, but no release date was slated.

Several new systems were also introduced. (Extracted from Infoworld, 30 October 1989)

Forecasting for future trends in unknown markets

The increasing availability of market analysis for the computer industry means companies can and do make strategic decisions on the basis of reports. The scale of a company's response to this data can vary from stimulating a rethink, to adopting a completely new approach.

Market analysis can be used in several different ways. The simplest application is establishing the present position of a product or product group and associated factors: for example, when a software product depends on hardware. A company supplying personal computer software would certainly want to understand the nature of the installed base of pcs. This type of information is most critical in niche applications, where the final profitability is highly volume-sensitive.

Market analysis can also highlight product trends. No product remains static, and suppliers and users need to know how fast, and in what way, the market is evolving.

Another category, and undoubtedly the most interesting, is estimating the demand for new products. It is also the most difficult. Market analysts have to predict how decision-makers will react to a product that does not yet exist. An added complication is that some products depend on a critical mass for their success. The key is to try to discover what goes on in decision-makers' minds.

One of the first tasks in any study is to identify the market or product segments. Unfortunately, most markets do not come neatly parcelled into distinct segments, so they have to be carefully characterized. This tends to be arbitrary, and different industry watchers rarely agree.

In fact, differences in definition are probably the main cause of disparities between different market figures. Even when a segmentation is clear, it can rapidly erode through technological change. A few years ago the workstation and pc market could credibly be regarded as distinct. In 1990, however, the situation is rather different. The Intel 80486 chip, combined with increasing clock speeds, will fast close the gap from the PC side. The workstation suppliers, by contrast, are naturally expanding their product range at both the top and the bottom. By the middle of the next decade the distinction between desktop pcs and workstations will probably be non-existent. These trends play havoc with any attempts to quantify future usage.

Despite the myriad of forecasting techniques, there are only two real groups: mathematical forecasting and judgemental forecasting. The precise mix of these techniques, and the way in which they are applied, are known in market analysis parlance as the methodology. Most companies use a combination of the two techniques.

Most methodologies start off by forecasting the market as a whole, and then focus on narrower sub-segments. The broad segments frequently contain several different products: in other words, they are aggregated. Mathematical techniques are most appropriate for such aggregations.

At a bulk level many markets are predictable and change slowly. For example, an aggregated quantity such as firms' total spending on IT would probably grow year on year at a roughly constant rate in the short term, and not be greatly influenced by changes in technology or the economic climate.

There are standard s-shaped curves, such as the Gompertz, for forecasting. They represent the product life-cycle and show how markets for new products initially grow slowly, then enter a rapid growth phase and finally mature asymptomatically to a ceiling where the market is saturated. The ceiling is the maximum product units that could ever be used.

The difficult bit is to work out what the ceiling should be. It is easy to get it wrong, especially where technical progress makes old assumptions invalid. This is particularly true for all those office products which are now entering the home. Suddenly the ceiling is in a higher order of magnitude.

After forecasting the behaviour of the market as a whole, the next task is to split it into individual product segments to show the division of users between them. When this is applied over a period of time, the effect is to model the migration between different segments. This is one of the most difficult parts of market forecasting.

There is no substitute for talking to users and suppliers. Though some suppliers hesitate to give anything away, others will go so far as to supply printouts of the last year's shipments by country and product type. Still others deliberately set out to mislead by giving over-optimistic figures, in the hope that their market share looks more impressive.

This sort of face-to-face interview is used for in-depth investigation and normally requires the interviewer to have a fair degree of technical knowledge. An alternative is a telephone survey of users, using a highly structured questionnaire. Telephone interviewers are more likely to be trained in languages than in electronics or computing, so a massive amount of effort goes into constructing questionnaires which they can use without really understanding the subject-matter.

The closer one gets towards individual products, the more important it is to understand the dynamics of product segments and the factors which affect their supply and demand. The emphasis must be on understanding rather than curve fitting. After all, individual product life-cycles might be fairly short compared with market life-cycles, which may last several decades. These understandings get incorporated into parameters in the forecasting models.

An example might be the migration between one product and another, such as the steady migration of software applications from third generation languages to 4GLs. To model this process one begins by estimating the proportion of new applications being written in a 4GL both now and in the future.

The current value can often be determined through field work, but future values must be educated guesses. Although parameters cannot be known precisely, if intelligence is applied sensible limits can be devised. In the software case, the maximum proportion of software applications which could in theory be written in a 4GL could be estimated on technical grounds. In more complex models, parameters have to be estimated through a cascade of other parameters, each representing an individual judgement.

In market analysis, as in most other activities, you usually get what you pay for. Well-researched, reliable analyses based on all the significant driving forces can be expensive. But the business decisions which they influence can be massive. (Source: Computing, 30 November 1989)

The rise of the PC

The spread of the PC has revolutionized the whole nature of computing, or information technology as it has become known during the 1980s. Managers, professionals and clerks depend on them, and children learn about them at primary school along with their ABC.

A decade ago, this was by no means inevitable. The leaders of the still very new market in the UK were Apple, which is still sold exclusively through distributors, and Commodore with the Pet. Tandy was the other major player, taking advantage of its retail network to pioneer the idea of consumer sales. These products had proprietary operating systems and were primitive by today's standards, with eight-bit addressing and typical memory size of 16 Kbytes.

The event that persuaded business to take the personal computer (or microcomputer as it was then more commonly called) seriously was the launch of the IBM PC in the US in August 1981, but from that moment on it has been the fastest growing sector of the systems market.

The PC has made the fortunes of many companies, including the three UK pioneers who all feature in the 1989 Datamation Top 100 with Apple in 12th place, Tandy in 29th and Commodore in 54th. Other predominantly PC companies that feature strongly are Compaq (24th), Zenith (39th), Amstrad (59th) and two software companies, Bill Gates' Microsoft (66th) and Lotus (82nd), headed by Jim Manzi.

The PC story has not meant undiluted commercial success for everyone, though. In business, however, the PC went from strength to strength. The original eight-bit PCs were succeeded by 16-bit systems, which achieved market dominance during 1983, and then by 32-bit systems, which started to appear in 1986. In the process PC vendors introduced features which have subsequently become standard on all types of computer, such as colour displays, graphics, windows, icons and mice.

Processor power increased more than tenfold, from around 2 MHz to today's threshold of 33 MHz. Hard discs were added, with maximum capacities today exceeding 1 Gbyte. Screen resolution improved dramatically.

As a result, the original applications - spreadsheets and word processing - have been joined by data base processing, desktop publishing and graphics-based applications. PCs are also now in widespread use as systems development tools.

The advance of the PC has been built on progress in computer technology which has continued at much the same speed as in the previous two decades. The maximum capacity of a memory chip in 1979, for example, was 64 Kbits, whereas today it is four Mbits, a 64-fold growth in 10 years, or a compound growth rate of 50 per cent a year.

We can translate this technology growth rate into systems performance by considering the largest IBM mainframes available then and now. In 1979 the top-of-the-range model was the 3033MP, rated at a little over 8 mips. Today the most powerful system IBM offers is the 3090/600J, rated at around 120 mips. Performance growth is thus around 30 per cent compound per year.

IBM does not publish a list price for the 600J, but it probably costs a little over twice the 1979 cost of a 3033MP. This yields an improvement in price/performance of around 22 per cent a year compound.

Not all of IBM's 1979 mainframe competitors have been able to sustain the rate of technological improvement necessary to remain competitive. Indeed, the Bunch (Burroughs, Univac, NCR, CDC and Honeywell) has effectively disintegrated.

The first two have merged, but the combined company only ranks fifth in the world. Honeywell has withdrawn altogether, while NCR and CDC are specialist companies that do not have transaction processing mainframes in the 3090/600J class.

In the minicomputer market, the decade has been marked by the success of DEC in the mid-range sector, where it has taken over a market previously dominated by small mainframes, especially IBM mainframes. DEC's achievement has been such that it is now the second largest company in the whole industry. This success has been built on the 32-bit VAX range, a new arrival at the beginning of the decade consisting of just one model.

As the decade has progressed, DEC and its fellow mini-makers have in turn come increasingly under threat from the PC and workstation suppliers. They have responded by moving up-market, and this year we have seen three mainframe-class minicomputer launches, from DEC itself, Pyramid and Tandem.

In the mainframe arena, the chief consequence of the increasing power levels has been the rapid growth of on-line transaction processing. The groundwork for this advance was firmly laid during the 1970s, but even mainframe users only averaged around 10 per cent on-line work in 1979. Today it forms the bulk of the workload for both mainframes and minis.

The growth in transaction processing, with the accompanying acquisition of more and more on-line disc storage, has made the question of accessing all that data one of the major technical problems of the decade. The solution has been the relational data base (rdbms).

The rdbms concept was published in 1970, and systems based on it started to appear in the mid-70s, but it has only been in this decade that the relational approach became firmly established. IBM again provided the stimulus with the launch of DB2 in 1983, though the most successful rdbms companies have been Oracle and Ingres, which both started selling to DEC VAX users. Oracle is another newcomer to the Datamation Top 100, occupying 90th place.

Another major technical problem has been applications development, with backlogs of several years being the norm. Here there has been comparatively little change throughout the decade, contrary to some 1979 predictions.

Then it was felt that third generation languages were virtually obsolete, and it was forecast that Cobol would die the death within 10 years. In fact Cobol remains the most widely used programming language in 1989, and the technical skill that is overwhelmingly most in demand in job advertisements. Fourth-generation languages have been growing in popularity, but nothing like as quickly as expected.

The symbol of this failure is The Last One, an applications generator launched by DJ AI in 1981 which derived its name from the vendor's expectation that it would be the last program you would ever need to buy. In fact the hype surrounding the launch was the last we heard of either product or vendor.

The most successful language of the decade is probably C, an academic curiosity in 1979 but a mainstream product 10 years later. C is the most widely used of all PC development languages, and is very popular with commercial software developers.

The growth in the use of C is linked to that of Unix, which has also enjoyed enormous growth during the 1980s, and has established itself as a de facto standard for multi-user systems.

So much so that many commentators are talking about the total demise of the financial problems currently besetting successful 1970s companies like Data General, Prime and Wang.

Although the disappearance of proprietary systems is more likely to be a facet of the next decade or even the one after, there is no doubt that the advance of standardization is one of the major characteristics of the 1980s. It started with the PCs, where de facto standards such as Z80 processor chips and CP/M emerged with eight-bit systems at the beginning of the decade.

The 8086 and MS-DOS followed on the 16-bit systems, and Unix is now doing the same higher up the power spectrum. Although all of these are proprietary products that have become standard, Unix has been the subject of energetic formal standards-making initiatives, such as the Posix interface which is now an IEEE standard. Similarly the Ethernet local area network, initially a Xerox design, has now been formally standardized.

The standards-making bodies have also developed many of their own standards during the 1980s, particularly in the field of open systems interconnection (OSI), where they have been able to build on the ISO seven-layer model formulated in the late 1970s.

Apart from Ethernet, major OSI standards now in widespread use include X.400 and ODA. Subsets of the OSI standards have been developed by user initiatives for manufacturing (Map) and office (Top) applications.

The growth in transaction processing and in local area networks has stimulated rapid progress in telecommunications, especially in the UK where the Government has led the world in changing the legislative infrastructure to facilitate new developments.

It seems strange now, but in 1979 British Telecom did not exist: national telecommunications in the UK were managed by the Post Office.

A decade later, BT not only exists, but has competition in the form of Mercury Communications.

During the 1980s, the liberalized (and eventually privatized) British Telecom has converted the whole of the trunk work from analog to digital operation, and introduced a wide range of digital communications services. This is a remarkable feat when it is remembered that in 1979 only 5 per cent of exchanges were electronic.

The major new services are PSS, which arrived at the beginning of the decade, Kilostream and Megastream, and most recently ISDN. That service, though, will more properly belong to the next review of the decade. (Source: Computer Weekly, 14,21 December 1989)

Company news

AEG and Siemens enter joint power semiconductor venture

Competition in world power semiconductor markets will increase when a joint venture by the FRG's AEG AG and Siemens AG gets off the ground in 1990. Under Eupec - for European Powersemiconductor Co. - AEG and Siemens will pool their development, fabrication and marketing efforts in the power semiconductor field. Along with basic devices such as thyristors and power diodes, Eupec will make gate turn-off devices, Darlington power transistors, modular inverted-gate bi-polar transistors, and high-voltage diodes for X-ray equipment, TV sets, and microwave ovens. Eupec will be based in Warstein-Belecke in the state of North Rhine-Westphalia. (Source: Electronics, December 1989)

Siemens starts to make RISC micro

Siemens is set to become the first European company to be able to offer locally-made microprocessors and commodity memories.

The company has just run a 24-wafer batch of the MIPS reduced instruction set computing (RISC) processor and a similar batch of the floating point co-processor.

An advantage of the MIPS RISC consortium is that pin and function compatibility is maintained for one version of the micro at each level of integration. That means a Siemens MIPS processor or co-processor is interchangeable with one from ENC, IDT, LSI Logic and Performance Semiconductor, so providing customers with true alternative sources.

Siemens has retained the right to develop variations of the basic MIPS architecture and to sub-license these to other companies. According to John Mashey, a Vice-President of the company which originated the MIPS chip (Mips Computer Systems) the MIPS rating of RISC chips has doubled every year since 1986 and will continue to do so.

In commodity memory Siemens is now manufacturing 2.5 million 1 Mbit DRAMs a month, and it is believed to be in small-scale production of the next generation of 4 Mbit DRAMS. (Source: Electronics Weekly, 25 October 1989)

Du Pont steps up superconductor R&D

Du Pont is stepping up superconductivity research by teaming up with the US Department of Energy's Los Alamos National Laboratory and the electronics manufacturer Hewlett-Packard.

Under a three-year $11 million agreement, the three organizations will focus on the development of thin-film high-temperature superconductors for electronic components. They will pool resources in basic and applied research, materials production, and processing and electronics applications.

The agreement is believed to be one of the largest collaborative research and development

programmes concluded between US government laboratory and industry.

Separately, Du Pont has also established co-operative superconductivity research agreements with the other two Department of Engery pilot centres, Argonne National Laboratory in Illinois and Oak Ridge National Laboratory in Tennessee. (Source: European Chemical News, 13 November 1989)

New applications development environment

IBM will announce an applications development environment which, according to sources, will automate the entire development life-cycle. Reportedly called AD/Cycle, the evolutionary strategy will support every phase of the development life-cycle, from requirements analysis to building, designing, testing, producing and maintaining applications. In addition to protecting user investment in IBM applications development tools, skills and data, AD/Cycle will offer central control of application development, according to a draft announcement letter sent to third-party vendors. The announcement of AD/Cycle will reportedly also include new products, such as the long-awaited repository. The repository, scheduled for the first-quarter of 1990 availability, will initially be available in a plain vanilla version that will later be enhanced.

IBM Corp. also is "close to production" on a second-generation reduced-instruction-set-computer processor, says John A. Armstrong, vice-president of science and technology for IBM. Code-named America, the superscalar processor comprises six chips with a total of 6 million transistors and is built with the same 1.0- m CMOS technology in IBM's 1-Mbit dynamic random-access memories. The chip set also contains a memory-instruction cache, a branch processor, a data cache, an integer chip, and a floating-point chip that meets the Institute of Electrical and Electronics Engineers standard for a 64-bit multiply and add operation. The processor, presumably to be used in IBM's RT PC workstation, executes up to five instructions per clock cycle. (Extracted from Computerworld, 4 September 1989 and Electronics, November 1989)

Philips backs SPARC

Philips, the Dutch electronics company, has recently announced its intention to join the world-wide SPARC consortium. SPARC stands for Scaleable Processor ARChitecture, and the consortium are committed to establishing it as the standard for reduced instruction set computing (RISC).

SPARC is an open architecture that can be developed by different semiconductor manufacturers using a range of technologies. This scalability enables SPARC processors to power the complete spectrum of computer systems. If SPARC is adopted as a leading industry standard the result is that all SPARC based machines will be able to run the application software. According to promoters of the standard, more than 750 software applications have already been developed for SPARC, which they claim is more than the total available for all other RISC platforms combined.

Philips involvement with the consortium coincides with the announcement of a new licensing agreement with Sun Microsystems. Sun who conceived the SPARC architecture will licence Philips to develop and market SPARC processors and build them into embedded controllers for a variety of applications. These will include products in the EDP, industrial, military and telecommunications fields.

SPARCS International is an independent non-profit-making corporation, supported by companies interested in the future of the SPARC standard. It is based in Sunnyvale, California, and is chartered with the responsibility of controlling and maintaining the SPARC standard. (Source: AMI, October 1989)

Samsung enters RISC market

Samsung Semiconductor has gained its first foothold in the reduced instruction set (RISC) market, with an agreement covering Intergraph's Clipper microprocessor.

The two companies have announced a strategic partnership giving Samsung the right to manufacture and market the Clipper world-wide. Intergraph gets an undisclosed payment up-front, royalties, and a much needed boost for a marketing strategy which has been hit by increasing sales of rival SPARC processors.

Samsung will be looking to invent new Clipper peripherals and to develop the architecture for embedded processing. The two companies are to share data bases and fabrication masks, each having the right to manufacture the other's future Clipper products.

Samsung is to announce the location of its European wafer fabrication facility early in 1990. The company will start with an assembly operation before moving on to full-scale production.

Samsung has also started sampling its 4 Mbit DRAM to selected customers and is also close to prototyping a 1 Mbit SRAM. (Source: Electronics Weekly, 13 December 1989)

Fujitsu advances fast custom logic

Fast custom logic is poised to leap forward in both speed and device size in 1990. Fujitsu will introduce its latest gate array, currently in its prototype phase, which combine the largest number of very fast gates on a single chip.

Fujitsu's chip is a gate array device based on emitter coupled logic (ECL) which is much faster than traditional CMOS but consumes significantly more power. The device will give designers nearly 39,000 usable gates, each of which has a loaded propagation delay of 250 ps.

The drawback of using ECL devices is the power consumption. Fujitsu's 33 mm square package dissipates typically 30 W which presents a significant heat problem for systems designers.

The 300-pin device has 17 cooling fins and needs a chilled air flow during operation. The fins stand 30 mm above the board.

A total of 38,948 gates are available and larger devices are likely later in the year. It will cost about $1,600 in volumes of 10,000s. (Source: Electronics Weekly, 15 November 1989)

SGS-Thomson plans US transputer production

SGS-Thomson is planning to manufacture Inmos Transputers in its American plant at Carrollton, near Dallas, as well as continuing production in the UK at Inmos' Newport factor

The US factory will make the military specification 16-bit and 32-bit devices, and a new low-cost variant of the current commercial specification 32-bit processor, for civil products. A possible application is civilian-grade GPS satellite navigation receivers for small boats and similar uses.

Inmos is now designing the next generation of Transputers which could achieve an instruction throughput of 100 MIPS (million instructions per second) or 10 times the speed of current devices.

To achieve this the current clock rate will be doubled to provide 20 MIPS, and the remaining 80 MIPS will come from design improvements. Silicon should be available in 1991. (Source: Electronics Weekly, 6 December 1989)

IV. APPLICATIONS

What parallel processing technology can do

Current interest in Transputers is largely prompted by its relevance to parallel processing which is on the increase.

There are a number of ways of breaking a problem down into bits, but in general, they fall into two categories.

The first type is aimed at existing data bases and uses a master program to break down the operations into chunks that can be handled separately. This usually involves selecting subsets of data, whether a number of records in a data base, or elements in a matrix.

The chunks of data are then given to a number of "worker" processes, which go away and do the sums. When a worker finishes, it gets more data, and so on until all the data has been processed. The results are then collected by the master process, and reported in the usual way.

Applications which can benefit from this approach are those operating on large matrices of data, performing functions such as matrix inversion, Fourier transforms and so on. These include stress analysis, image processing, graphics and signal processing.

It is much cheaper to link 10 Transputers together than to try to build a processor 10 times as fast. And even if signals were transmitted at the speed of light throughout a system, that is without any delays at the logic gates and so on, there would still be a finite limit to the number of instructions that could be processed in a given time. Linking processors in parallel overcomes this problem.

Yale has used the master-worker technique to search a data base of DNA sequences, where each worker is given a pair of DNA sequences to compare. Using an Intel iPSC-2 hypercube, Yale reduced the search time from just under four hours on a single processor to just over four minutes with 64.

The second way of "parallelizing" a problem is to build a trellis of processes, where each node of the trellis attempts to calculate a state based on the states of inferior nodes. When it has enough data to go on, it generates a new state.

As a result, the nodes one level up the trellis may recalculate their own states, and so on. As well as passively waiting for data, nodes may send queries down the trellis requesting an update.

An example could be a traffic control system. The first level of nodes would collect the traffic movement data, and control the lights and signals. The next level up would take local decisions to minimize traffic delays. A further level would then monitor higher level detail, such as the effect of roadworks in one area causing jams in another.

This approach has two very important characteristics. First, it is transparent - it is easy to figure out what each part of the trellis does, because the structure of the trellis reflects the problem it is trying to solve.

Second, it is locally comprehensible - if we want to change or add a node, it is only necessary to understand the node's immediate neighbours.

It is not just the ability to solve existing problems faster that makes parallel processing an exciting prospect. It may allow totally new ways of solving problems, which could not be considered with more conventional techniques. It may be, for example, that parallel systems are required to run neural networks for real-world applications with an acceptable response time and cost. (Source: Computing, 19 October 1989)

Prototype translation system at the European Community

As the portentious year of 1992 looms on the continental horizon, the paperwork and translation work continues to pile up at an ever-accelerating rate at the European Commission, the administrative arm of the European Community (EC). Promising to speed the Commission on its way to 1992 by speeding up the time-consuming and tedious translation of technical documents of the EC's 12 member countries is a prototype system that the Community is set to unveil during 1990.

Written in Prolog to run on UNIX workstations, the EC's Eurotra system took more than seven years to develop. The project, which cost approximately $30 million to develop, is considered the most ambitious machine translation effort ever undertaken. It also has the potential to save much more money than it cost. Those cost savings from Eurotra become apparent when looking at the numbers. Every year, the Commission's workforce of roughly 1,000 translators turns out an estimated one million pages of text. On a daily basis that means that only five to seven pages actually get translated. That daily rate is expected to rise dramatically thanks to Eurotra, which will not displace workers. By doing an initial rough translation, the system will take away repetitive, tedious work, accelerate the translation process and reduce cost.

That translation process was slow indeed with Systran, the machine translation system the EC has used since 1976. The sluggish system also had another drawback. It could only handle translations between English, French, German and Italian. To be effective, any machine translation system must be able to work as well in Danish, Dutch, Greek, Portuguese and Spanish - the other languages spoken in the EC member nations.

In 1983, when the European Community consisted of 10 member countries, translations between seven languages, or 42 language pairs, were needed. After Spain and Portugal were admitted to the EC in 1985, translation requirements exploded, as did the complexity of the Eurotra project. To tackle the requisite 72 language pairs, the original 5 1/2-year time-frame was extended to seven years, and the budget for Eurotra was inflated by approximately $7 million.

From the outset, the EC was aware that no generalized machine translation system could completely cover all subject areas. The prototype system, which acknowledges these limitations, was therefore restricted to one subject area, telecommunications.

This was not an arbitrary choice. The telecommunications field was picked because the EC already had a data base containing well-established multilingual terminology in this subject area. However, the single-subject system seems to be a short-term solution.

The telecommunications data base currently contains 12,000 terms, a number that may mushroom to 15,000 once it is updated with the latest telecommunications concepts. Nevertheless, the telecommunications topic is still tricky in terms of terminology.

The inner workings of the prototype Eurotra system are even more complex than the telecommunications terms it is trying to translate. Eurotra's stratified transfer model operates in three phases. First comes the analysis of the source language, followed by a transfer to the target language and then a synthesis in that same language. Eurotra starts by analysing the source text in stages. As it proceeds through those stages, the representation of the text becomes increasingly more abstract. The Eurotra framework contains seven such levels of representation.

Eurotra's core software and debugging tools are written in Prolog. The menu-driven facilities and stand-alone utilities, as well as the data base and text-handling subsystems are all in the C language. Once the rules for a certain level are written, they are compiled into Prolog statements that can be run with a specially written program that performs conversion from one level to another. The system also makes use of standard UNIX utilities.

Eurotra runs on a variety of UNIX machines, including workstations from Hewlett-Packard Co. and Sun Microsystems Inc., which are scattered throughout the Commission's Belgian facilities.

The system consists of five major components: the rule compiler, the rule interpreter, the data base, the text handling subsystem and the user interface. The rule compiler compiles a file of linguistic rules into Prolog clauses. Written in C, the compiler uses UNIX utilities such as a parser generator and a lexical analyser. Using the compiled linguistic rules, the interpreter maps the structure and features of the text from one level to the next. An associated generator refines and modifies the output of the translator.

Eurotra's data base, which supports Structured Query Language, stores linguistic rules or lexical items. Still under development, the data base will ultimately contain an on-line dictionary of approximately 20,000 rules. The text-handling sub-system serves as the interface between the actual text and subsequent stages of the translation process. The original sub-system, which had a number of limitations, is now being replaced by a more comprehensive system based on the Standard Generalized Markup Language (SGML).

The final Eurotra component is the user interface. Users have a choice between two interfaces - the menu system, designed to furnish novice users with easy access to the system, or the command interpreter. The command interpreter provides all of the menu features plus extra capabilities, such as a tracing facility that enables a user to see the order in which rules are executed.

Although only a prototype at this point, Eurotra is none the less a powerful system that will provide EC Commission users with full facilities to develop and test their own programs. The applications software alone comprises about 300 source code modules. (Reprinted with permission of DATAMATION® magazine©, 1 November 1989, copyright by Technical Publishing Company. A Dunn and Bradstreet Company - all rights reserved)

A firm FDDI standard has vendors scrambling for a piece of the action

After two years, systems integrators are finally starting to get what they need from the Fiber Distributed Data Interface: a full complement of products from a growing crowd of network equipment vendors.

By early this year, the complete 100-Mbit/s FDDI network standard may well be in place, buttressed by interoperable network bridges and routers, VMEbus interface boards to systems on the network, and function-rich network-management protocols. Original-equipment manufacturers can even look forward to FDDI chip sets that will compete with Advanced Micro Devices Inc.'s SuperNet set.

The FDDI standard is based on the use of fibre-optic cable as a transmission medium. An FDDI network is configured as two active, counter-rotating rings; each ring can be up to 100 km in circumference, and stations can be up to 2 km apart. The cost of an FDDI-to-Ethernet connection, which only a year ago was $25,000, fell to about $12,000 when Fibronics International Corp. of Hyannis, Mass. introduced a router product that offers dual local-area-network interfaces.

Interoperability testing for FDDI products is not yet in place and neither is testing of large networks of 100 or more nodes. The Advanced Networking Group will eventually address the interoperability problem with its testing centre. Testing large networks is a more difficult knot for the Advanced Networking Group to unravel, mostly because there are not many large FDDI networks in operation.

Optical components are just as critical as chips to FDDI. To solve compatibility problems, three electronics giants - AT&T, Hewlett-Packard and Siemens - announced an international multisourcing agreement. The companies have agreed to define a common package and pinout for FDDI transceiver components. Another major player in the FDDI optical component market is British Telecom & Du Pont Technologies Inc. of Wilmington, Del. BT&D has just announced a transceiver that is fully FDDI compliant. It will be available in early 1990. (See figure on page 29.) (Extracted from Electronics September 1990)

Paperless trading

Paperwork accounts for up to 10 per cent of the cost of world trade today. The lack of paperwork, in the form of late arrival of necessary export documents and other forms essential for the flow of cargoes, can cause marked delays in the shipment of goods across national boundaries. Those facts provide two solid reasons for Electronic Data Interchange (EDI), according to advocates of the technology. EDI substitutes the time-consuming and resource-intensive physical movement of trade documents such as bills of lading, invoices and letters of credit with the transmission of computer data over public communications networks in internationally agreed formats.

But while international pressure for the use of EDI is mounting, Asian countries are finding that introducing paperless trading is far from easy. Local conditions and technical difficulties conspire to make the start of a technology that reshapes the business a complicat.' affair.

Pressure to adopt EDI is mounting on manufacturers, traders, banks and shippers world-wide. Organizations such as customs authorities in industrial nations are promising to give preference to goods processed by EDI over those accompanied by paperwork. Both UK and US customs authorities have stated that they will process 80 to 90 per cent of their trade documentation electronically within three to five years, and that anyone presenting paper documents will be sent to the back of the queue. Larger trading concerns in the US and Europe are also using EDI as a criterion for choosing trading partners.

Advocates of EDI say that it provides faster turnaround of orders, increased cash flow and reduced inventory. Savings to individual companies and whole economies from switching to EDI will mount impressively, according to experts.

Certainly costs can mount up fast with the present approach to documentation. Preparing documents and transmitting them back and forth makes up just one segment of the cost. Another is the expense of warehousing goods destined for export while the paperwork catches up with them. Trade paperwork currently costs the United States $US 7 billion a year, while the European Community spends a staggering $US 10 billion annually to process its trade documents manually.

Each transaction can be simplified. Without EDI a simple order will involve the passing of contacts and confirmations first from buyer to supplier and then the other way. At least two formats for the trade information will be defined by the buyer while a third is defined by the supplier. With EDI, a predefined contract format is used; no written confirmation is required, and no re-keying of the sales contract is needed.

In addition to saving paperwork this also speeds fulfilment of orders. Banking services to overseas traders also stand to benefit from EDI.

Current conservative projections suggest that at least 400,000 companies world-wide will have implemented EDI by 1995. Already, some 2,000 organizations in the UK use EDI, as do 500 in continental Europe, and about 10,000 in the United States. In May 1988 five major ports in Japan began to use the system. Singapore officials have said that its Tradenet EDI network services, introduced earlier this year, may be extended to its partners in the Association of South-East Asian Nations, including Thailand, which has begun using EDI for customs clearance at some of its major ports.

Meanwhile, the world-wide market for EDI systems is growing at a rate of 40 per cent a year. According to the US research group Link Resources Inc., EDI generated $US 30 million in 1986 - a small fraction of the $US 200 million expected to be the value of the world market for EDI next year. At that point, says Link, the market will begin to expand by 50 per cent per year. The EDI bandwagon is already rolling, and in coming years it can only move faster. (Source: Asia Technology, October 1989)

Synthetic diamonds in applications

The Japanese are becoming increasingly interested in diamonds - but for reasons that have nothing to do with aesthetics. Diamond possesses qualities that engineers find highly attractive. First, it has the same crystal structure as silicon, the fundamental element of the semiconductor industry; it also has certain advantages over silicon from the electronic engineer's point of view, such as being able to withstand higher temperatures, high doses of radiation and other stresses. Add the fact that diamond is the hardest mineral known, and it is clear that semiconductors made of diamond should be well-suited to the harsh environment of outer space.

At least three Japanese companies have accomplished the first step in creating diamond semiconductors - using light-emitting diamonds in electronic displays.

Working in collaboration with Professor A. Hiraki of Osaka University's Faculty of Engineering, researchers at Osaka Diamond Industrial Co. have shown that natural diamonds can be made to emit intense blue light by creating small nicks in their crystalline structure. The next step will be mass production of the light-emitting diamonds for use in outdoor applications, such as traffic signals and advertising displays. The immediate advantage of the discovery, Osaka Diamond officials explained, is that the treated diamonds are cheaper to manufacture than existing substances used to produce blue light, such as silicon carbide and zinc selenide, even though the diamond's light is brighter.

Canon and Sumitomo Electric have also developed thin films of artificial diamonds that emit blue light. The basis of this work is chemical vapour deposition (CVD), a method of producing diamond film under low pressure by breaking down a compound that contains carbon. Researchers have used several raw materials for this process, including sake; but methane gas has been the most common.

CVD is actually the key to the new interest in diamonds. The only method used until now to synthesize diamonds involves very high pressures and .emperatures. Even GE, the American giant that invented the high-pressure technique in 1955, is working hard on CVD technology which, it says, offers a "dramatic departure" from conventional methods.

"The significant part of CVD technology," says Kazuo Ohka, director and manager of Asahi's R&D Division at Chiba, "is that it can deposit diamond as either a thin or a thick film, and we can cover an area up to 4 in. by 4 in. Synthetic diamonds created by an earlier technology are more expensive

to produce, and are limited to 4 mm in size." (However, Sumitomo Electric Industries has announced that it can mass-produce plate-shaped synthetic diamonds with sides measuring up to 12 mm in diameter.)

While several facilities are attempting to develop diamond semiconductors, notes Ohka, "they are still not successful because of the difficulties in devising a method of growing synthetic diamonds epitaxially".

The second obstacle, continues Ohka, is fabricating a particular type of diamond semiconductor. While some natural diamonds have p-type qualities, and p-type diamond semiconductors can be synthesized, none has yet produced a practical n-type diamond material. The effort by Sumitomo Electric illustrates the difficulties; one of the materials that it produced fulfilled most of the needs, but had too high an electrical resistance to be practical.

P-type diamond semiconductors, for example, are made by doping diamond with the element boron. "To produce an n-type semiconductor, we have to dope with nitrogen or phosphorus," explains Ohka. "However, the crystalline structure of diamond, while similar to that of silicon, is also denser. Because of this, the spacing between diamond atoms is tighter and there is less space for dopants to be accepted." Thus the same qualities that make diamond tougher and more reliable than silicon also make it difficult to work with. The prognosis: Ohka estimates that diamond semiconductors will not be available for about five years.

CVD diamond will find other applications before that, in heavy industry. Idemitsu Petrochemical Co. Ltd. has developed durable machining tips made from a ceramic coated with a thin diamond film. The new technology solves a common problem of tools that combine diamond with ultra-hard alloys - the fact that the diamond coating tends to separate from the base material.

The drawback to any diamond tool is that, at high temperatures, diamond chemically interacts with iron. This will limit the market for diamond thin-film tips to machining precious metals, titanium and alloys - a market estimated at only $US 38.5 million. There is also the question of existing patents held by other firms on ceramic/diamond thin-film tools.

Tools coated with the films have longer lives, superior electrical properties and better mechanical strength. So applications targeted by Idemitsu cover cutting not only metals and non-ferrous alloys but also fibre-reinforced plastics. Markets that should respond to the technology therefore include the aerospace, automotive, electronics and precision machinery industries. (Source: Asia Technology, October 1989)

Supercomputing gets a foot in the door

Long the preferred tool for meteorology, geophysics, aerodynamics and mathematics research, supercomputers are now coming to roost in the chemical process industries (CPIs). Pharmaceutical companies, the CPIs' supercomputing pioneers, are employing the high-speed machines to model complex biomolecules and thus narrow the search for drugs with the right attributes. Supercomputers at such firms as Du Pont Co. (Wilmington, Del.) and Monsanto Co. (St. Louis, Mo.) are being used in much the same fashion for studying synthetic polymers.

Surprisingly, however, many computationally-intensive applications, such as process design and optimization, have yet to tap supercomputing's power. The reasons, say participants in the field, are: the abundance of conventional computers, which, although less powerful than the supercomputers, are more easily available to users; a lack of software written specifically for supercomputers; and a dearth of trained people to develop appropriate CPI applications.

Meanwhile, surveys forecast a burgeoning US market for supercomputers: sales will shoot up to about $9 billion in the early 1990s. That is good for supercomputer users, since rising shipments will cut hardware costs and make it easier for programmers and others to develop software specifically for supercomputers. Most new supercomputers now sport many of the off-the-shelf components, including the microprocessors used in desktop computers.

In the US, federal funding of supercomputing technology has boosted its presence on many college campuses. There is a Supercomputing Center at Carnegie-Mellon University and at the University of Pittsburgh, and machines have been acquired with the assistance of the US National Science Foundation at the John von Neumann Supercomputer Center (Princeton, NJ), the University of California (San Diego), the University of Illinois (Urbana-Champaign) and Cornell University (Ithaca, NY). State governments have also established facilities, usually near college campuses, in Minnesota, Ohio, Texas and Alabama.

The latest federal initiative is to hook up these machines and some of the supercomputers at national laboratories via a 3-gigabit/s wide-area network; transmission at this speed would enable a computer program to run on multiple supercomputers simultaneously.

Meanwhile, activity in at least one supercomputer application, process design and optimization, has been relatively slow in gearing up. Neither at CPI companies themselves, nor at engineering-construction or process-technology firms, has any comprehensive program involving supercomputing and process design been announced.

Another potential application is to "reverse engineer" a chemical product, by analysing its structure, then working backward to the most energy-efficient, economical method of producing it from basic building blocks. Such a process would require extensive molecular modelling as well as the solving of complex process flowsheets to describe all the manufacturing steps. (Extracted from Chemical Engineering, December 1989)

Stacking up the memory power

British technology start-up Anamartic has shipped the world's first working product based on waferscale integration technology.

First samples of Wafer Stack, the 160 Mbyte fast-access solid-state mass storage memory product, have already been shipped to US business computer maker Tandem, which is one of Anamartic's backers. Other companies have also been signed up as customers and full-scale production will begin early in 1990.

Solid-state mass storage is ideal for large computers doing jobs such as transaction processing in a bank where information needs to be shunted back

and forth between the computer and its memory at high speed. Typical disk drives take around 20 ms to get hold of a piece of data whereas solid-state devices can do it in 220 ns or 0.2 ms.

This technology has a broad application in multi-user computer systems and in any application that suffers from a performance bottleneck caused by the memory disk.

Wafer Stack consists of eight 6 in. wafers of silicon each carrying 202 Fujitsu 1 Mbit DRAM memory chips together with control logic and interconnections. The wafers are made by Fujitsu and use a 1.3-micron CMOS chip technology.

The wafers are mounted on a board and stacked vertically as up to four pairs packaged back-to-back in a module. However, there is enough room to pack eight pairs of wafers in the package which would allow Anamartic to produce a 320 Mbyte memory. And by upgrading to 4 Mbit and maybe 16 Mbit DRAM technology the company could produce mass storage memories with capacities of up to a staggering 5 Gbytes in a package only slightly bigger than a shoe box.

The Wafer Stack package measures 8 1/2 in. by 5 in. by 15 in. Even faster access times could be achieved using SRAM memory chips getting average mass storage access times down to less than 75 ns, although this would mean storing only one quarter the amount of data.

Non-volatile systems needing no battery back-up and consuming less power could be made by using the new generation of flash memory chips, although these take longer to store data and are therefore better suited to recall-only applications.

Now 202 1 Mbit DRAMs give a maximum of 25.25 Mbytes of memory on each wafer; so to get 160 Mbytes from eight wafers means that Anamartic has to squeeze some 20 Mbytes of memory out of each wafer and that works out at a yield of working memory of around 80 per cent.

However, Anamartic makes use of the working parts of faulty chip die by dividing each one into four separate areas (called tiles) so that up to three quarters of a damaged dies can be used for storage.

Each wafer is individually interrogated by software running on test equipment to determine which portions of the device are usable. Working memory chip die, even those with only one usable tile, are interconnected to form a single spiral path of usable storage running from the rim to the centre.

This interconnection is done in software by programming the logic elements added to each 1 Mbit DRAM die to make connections with two of it's neighbours. Hardware connections exist which allow each die to talk to all four of its neighbours; all these connections are used when testing the wafer while two on each die are used in the working wafer.

It is this software interconnection technology that has given Anamartic the edge and allowed it to succeed where a number of others have failed.

But these technical difficulties could be nothing compared to what may happen in the market-place; now everyone knows waferscale integration works it will not be long before competition emerges. (Source: Electronics Weekly, 1 November 1989)

Aid for the deaf

International Business Machines has introduced a system to convert typed words into voice for transmission on the telephone. The system will increase the range of tasks that deaf people might accomplish in the workplace and at home. The Phonecommunicator system uses an IBM PC. Each conversation begins with a statement that a deaf person is on the line. A hearing person could type in messages on a Touch-Tone phone keypad. The deaf persons's computer would then display the message on its screen, and would present various possible words typed in, since each button on a Touch-Tone phone represents three letters. A. Sonnstrahl of Telecommunications Devices for the Deaf says the system is slow, but is better than nothing. What is really needed, says Sonnstrahl, is a portable system that translates voice to typed words.

A similar system was introduced by Ultratec in 1980, but it was withdrawn due to complaints about the system's slowness. IBM will compete with other makers of telecommunications devices for the deaf (TDDs), which generally require devices at both ends of the phone line. AT&T has said it will soon offer a service to translate TDD-typed words into voice. Some phone companies now have operators with TDDs to act as interpreters for call recipients who do not have TDDs. Some 21 million people in the US are classified as deaf or hearing-impaired, and there are some 200,000 telephone devices for the deaf now in use. (Extracted from New York Times, 13 December 1989)

Minicomputers configured on file servers

Sun Microsystems is introducing two minicomputers configured as file servers. Both the high-end Sparcserver 490 and the entry-level Sparcserver 1 are based on the Scalable Processor Architecture (Sparc) reduced instruction set computing-based chip. The Sparcserver 490, which comes with 32 Mbytes of main memory and 2 Gbytes of storage, has a performance of up to 22 Mips. The Sparcserver 1, which comes with 8 Mbytes of main memory and 654 Mbytes of disk storage, will be available in early 1990. The file servers allow Sun to compete against Digital Equipment and IBM in the minicomputer market. (Extracted from Computerworld, 11 December 1989)

New fuzzy-logic-based Expert Machine

Apt Instruments has developed a fuzzy-logic-based Expert Machine using digital electronics switching from the company's traditional analog electronics, because digital fit better into the standard digital engineer's picture of a control system. The machine, however, is slower and more expensive than analog-based machines. The Expert Machine operates by using the many shades of grey between true and false, as is the case with all fuzzy-logic controllers. Each set of rules handles a different aspect of the control problem, and is periodically monitored by a separate set of rules to ensure the system is operating properly; if it is not, the monitor directs operation to the proper set of rules. The Expert Machine is being developed for non-control applications. (Extracted from Electronic Engineering Times, 11 December 1989)

GaAs chip technology improving

Gallium arsenide (GaAs) digital chip technology is improving, and is becoming more practical to use. Its high-speed capabilities make it well-suited for supercomputers, military equipment and data communication (i.e., televisions,

telephone, real-time imaging systems, graphics data bases). Although sales of digital GaAs were only $51 million for 1988, many companies such as Cray Research (Chippewa Falls, WI), Prisma (Colorado Springs, CO), KOR Electronics (Huntington Beach, CA), Sciteq Electronics (San Diego) and Martin Marietta Space Systems (Denver) are using GaAs chips provided by vendors such as Gazelle Microcircuits (Santa Clara, CA) and Vitesse Semiconductor (Camarillo, CA). Several reasons for the low sales of digital GaAs ICs are relatively high (0.8 micron) gate length, lack of TAB packaging, awkward design tools, and lack of a decrease in wafer costs. (Extracted from Electronic Engineering Times, 27 November 1989)

Fastest neural microchip tools

California Scientific Software (Sierra Madre, CA) is developing tools for the N64, the fastest neural microchip world-wide, with Intel. Previously, the fastest board-level neural simulator ran at 11 million connections per second, and 70,000 connections per second for a 1-neuron chip from Fujitsu, but the N64 is capable of producing 2.5 billion connections per second. The N64 uses more than 200,000 transistors to simulate a network with over 8,000 connections. CSS has designed an integer arithmetic model instead of conventional floating-point arithmetic, resulting in the superior speed. Intel is designing a development system to broaden the neural chip market. CSS claims its BrainMaker software is the fastest simulator available. Already several Intel customers are using the chip in its raw form, even before Intel has developed the developmental tools. The article further discusses operations and expectations of the N64 and BrainMaker. (Extracted from Electronic Engineering Times, 20 November 1989)

"XT-on-a-card"

Chips & Technologies is working on an "XT-on-a-card" that could shrink hand-held personal computers (PCs) even further. The board is slightly larger than a credit card and about 1/4 in. thick. It is said to unite chip-on-board and surface-mount know-how. The C&T product includes three layers: the processor layer, including an 8086 chip, 512K of memory, and a CGA-compatible graphics adapter; a second layer with floppy disk controller, hard disk controller and serial and parallel interfaces; and the third layer with the I/O connectors within. V. Mahendroo, director of corporate marketing, says an actual product is not being announced now, but the board is being built with C&T silicon and other components that are currently obtainable, so the period from development to market should be relatively brief. (Extracted from Information World, 27 November 1989)

Interesting new portable

NEC Computer (Rockville, MD) will introduce a portable computer containing a fax board, scanner, printer and cellular phone which will be available from mid-1990. The 20 lb, 386SX-based machine will be the size of a lunch pail and have detachable peripherals opening from the back of the screen. A low-end model will have 1 Mbyte of memory and a 40 Mbyte hard disk; a high-end model will have 4 Mbytes of memory and a 100 Mbyte hard disk. (Extracted from PC Week, 2 October 1989)

New cleaning system

Mitsubishi Electric and Taiyo Sanso (both Japan) have jointly introduced a cleaning system that can clean such things as printed circuits, glass substrates, precision machine parts and nuclear power pipes via blowing submicron ice particles. Spokesmen for the firms said the system is seen moving to practical uses in spring 1990, at first cleaning semiconductors. Mitsubishi Electric will finish a trial model at its research laboratory in late 1989. The system eliminates the utilization of such chemicals as freon gas and trichlornethylene that previously were used in the cleaning work. There are two techniques for making ice particles, hinging on the necessary diameter and use. One is a spraying method that can generate particles 30-300 microns in diameter, and the other deals with vaporizing that can generate ice particles as fine as 0.1-30 microns. (Extracted from Metalworking News, 18 September 1989)

New personal memory device

Canon has come up with a personal memory device that supports a 2-Mbyte memory, sufficient to read and write as much as 800 pages of data. Field trials of the credit-card sized Optical Card System are in progress. The device is comprised of a Canon OC-10 Optical Card and an RW-10 Reader/Writer. It could be used for noting a person's health care data (medical images possible), personal information (e.g., identification purposes) and automobile histories. The card will be ready for shipment in 1991. (Extracted from Telephone, 15 September 1989)

Two new laptops announced

Compaq Computers will soon introduce two laptop computers with performance comparable to that of some desktop computers. The new portable computers will be the first notebook-sized machines with hard disks. Analysts believe that the new computers will give Compaq an advantage in the market for lightweight portable computers and might even help the whole market to grow. The faster of the two new computers is based on an 80C286 microprocessor, a more powerful chip than those used in competing laptop computers already on the market. Besides the use of hard disks, other important features include disk drives that use the same 3.5 in. diskettes found in standard desktop computers and removable battery packs that can enable the computers to operate for 3.5 hours. The display screen is easy to read. The new Compaq computers are priced at $2,499-4,999, depending on the options. Users can choose between 20 or 40-Mbyte hard disks.

A. Seybold, publisher of a computer newsletter, believes that NEC, Zenith Electronics, Toshiba and other companies will offer similar features in their new models for 1990. These firms also market notebook computers that weigh 4-7 lb, but use disk drives requiring 2 in. diskettes incompatible with standard desktop computers, or do not use any disk drives at all. (Extracted from New York Times, 16 October 1989)

Laptop that recognizes handwriting

Grid Systems has developed the GridPad, a notebook-sized laptop computer that recognizes printed handwriting as well as standard keyboard input. It is designed for users who record large amounts of data on paper, such as nurses, delivery drivers, consumer product representatives, police officers, census takers and claims adjusters. To record information, the user touches an electronic pen to the screen, where handwritten characters are recognized and converted to ASCII text. Signatures and graphics can also be stored in a memory bank. The software runs on MS-DOS, and further applications are being developed, but none are

available yet. (Extracted from Communication Systems News, 2 October 1989)

Portable with plenty of colour

NEC Information Systems (Boxborough, MA) and NEC Home Electronics (Wood Dale, IL) will debut a 386SX portable computer called the Prospeed CSX. Features include a 600-x-400-line compensated twisted nematic (CTN) colour LCD display that can show 16 colours at the same time from a palette of 64 colours. Two versions will be offered: one with a 100 Mbyte ESDI hard drive and one with a 42-Mbyte ST506 hard disk drive. Standard are a 3.5-in., 1.44-Mbyte floppy drive; one Centronics parallel port; an external VGA-compatible CRT port; one 9-pin serial port; and one external 5.25-in. floppy disk drive port. (Extracted from Information World, 25 September 1989)

Europe's supercomputer tackles real problems

Software specialists working on the powerful supercomputer developed under Esprit, Europe's research programme in information technology, have completed the first two programs to exploit its parallel architecture. The software is now well on its way to being marketed as a commercial product.

The Supernode machine costs tens of thousands of pounds instead of millions, yet is as powerful as existing supercomputers. The computer was developed by British and French groups as Europe's answer to Japan's national project to develop a "fifth-generation" computer, one capable of dealing with concepts and ideas instead of numbers. Supernode is now viewed as one of Esprit's most important successes, which has given Europe a lead over both Japan and the US in parallel computing.

The partners in Supernode II, the current phase of the project, include Thorn-EMI, the Royal Signals and Radar Establishment (RSRE), the University of Liverpool, Ove Arup, the consulting engineers, and Telmat from France. The first application comes from a team from Thorn-EMI. It is graphics software which allows people to depict a room as a three-dimensional image on a computer screen and view it from any angle while they vary the lighting inside. Potential users include architects and lighting specialists.

To show a more realistic picture that includes diffuse light, the software must set up and solve very large numbers of linear equations. Conventional serial computers, which process one piece of information at a time, would take several days to produce each image of a room. Even today's parallel computers, capable of performing several processes at once on a piece of information, would take a few hours. The software written to exploit Supernode takes between 15 minutes and half an hour to produce each new image of lighting in the room.

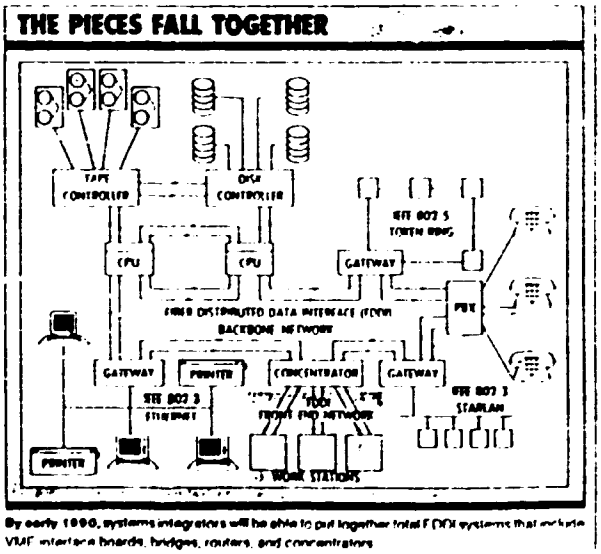
The Supernode computer consists of sets, or nodes, of transputers - the computer built onto a single chip and developed by Inmos, the British company bought recently by SGS-Thomson, the Franco-Italian electronics group. Supernode computers come in a range of sizes, bringing together up to 64 nodes, each consisting of 18 transputers. These nodes communicate with each other to produce the equivalent of today's scientific supercomputers.

The software from Thorn-EMI, written in a language called C, makes use of 16 transputers within a Supernode computer. The software works by splitting the scene into thousands of areas, each of which can act as a transmitter and receiver of light. The program then calculates the coefficients needed in the linear equations that describe the interactions between the separate areas.

The second of the two working applications comes from RSRE, and aims to find the best way of simulating complex systems such as biological processes, or economic scenarios. Such systems are composed of many discrete elements interacting with each other by sending messages. They are difficult to describe with the limited processing power of serial computers; even on parallel machines the task is not trivial.

The group's first program simulates the flow of traffic through a network of roads - 300 cars in an area of the Federal Republic of Germany measuring 22 kilometres square. Each transputer is given responsibility for one area of the map and Supernode views each car as a process. The cars have to obey certain rules; they must not exceed a speed limit and must overtake where possible.

RSRE's current system can simulate eight hours of traffic flow in five minutes. A serial computer would take several hours to perform the same simulation. The idea is to balance the load across all of the transputers, so that each is working at its most efficient, and none harder than any other. (This first appeared in New Scientist, London, 16 December 1989, the weekly review of science and technology.)



By early 1990, systems integrators will be able to put together total FDDI systems that include VME interface boards, bridges, routers, and concentrators

V. COMPUTER EDUCATION

Global network of institutions for training and research in informatics

Trinity College in Dublin, Ireland, in concert with the United Nations University, is working on the establishment of a global network of institutions for training and research in informatics. The project is directed at developing countries. Fellowships are available for third world nationals who can multiply the benefits of Trinity's training in their home countries and who would also form part of the proposed network. For further information, write to:

Professor F. G. Foster, Chairman, Systems Development Programme, Room 3044, Arts Building, Trinity College, Dublin 2, Ireland. (Source: Update, United Nations Centre for Science and Technology, No. 36, Winter, 1988)

Making child's play of classroom automation

There are two strings to the argument that pre-school children benefit from computing. The first is that children who will be working in the real world in 20 years will almost certainly need to use computers in one form or another. The earlier they get to grips with IT, the less technophobic they will be.

The second, more important part of the argument is that children should be given the best resources possible at this age if they are to develop a healthy attitude towards learning itself.

Children's attitudes towards society, education and the outside world are indeed fairly well shaped by the time they start at secondary school. If they can be shown how to use the power and versatility of computers at an early age, they may be more excited by the learning process.

It is important that the distinction is made between using computers for an application, as in business studies or computer science, and as a resource to help children learn. Left to themselves with a suitable program, very young children can enjoy computing and come up with imaginative ways of using the system. Conversely, if they are told that computers are just machines for running spread sheets or data bases on, they could be put off for life. For example, a group of seven-year-olds at Sheffield who are working on a project called 'Ourselves', have entered details about themselves onto a simple data base and can search it on different characteristics such as height or name. They have not been told they are learning how to use a data base, they just see it as a tool.

But learning a program in BBC Basic was one experience that many children in the mid-1980s were forced to endure, and was probably enough to put some of them off computing for life. Computer clubs, populated largely by maths teachers and boys, tended to concentrate on the programming and electrical side of computing, alienating the less techie children.

One solution is not to force children to type in endless lines of code (which invariably have unidentified and infuriating errors in them) but to appeal to children's more natural skills.

A large majority of software for pre-school children is written around the Concept keyboard. This is a touch sensitive keyboard area made up of either 128 or 256 cells, which can be used individually or as groups of cells that form larger control buttons. For example, it could be configured either as a qwerty keyboard or to show two options: yes or no. Its flexibility appeals to schools which can design their own programs around the Concept keyboard and use it for many different age ranges and levels. IT is also particularly suited to disabled children, who may not have the control necessary to use a standard keyboard.

Another solution is the touchscreen, which lets children select program and commands just by touching an area on a sensitive screen. Children use it to learn hand-to-eye co-ordination, being rewarded for picking out the right object on-screen with a tune and a kaleidoscope display of colours. The children can learn new skills without being put off by a standard keyboard, while the teachers, who are not particularly computer literate themselves, can see instant results without having to learn how to program.

The question of teacher computer literacy is an important one in all schools, not just those for disabled children and the training of teachers and the purchase of hardware have become even more critical.

Traditional suppliers to the education sector may find increased competition difficult to handle. Acorn has responded by making a reasonably priced IBM compatible machine available, as well as its BBC Micros and newer Archimedes computer. Microvitec has recently launched a clutch of PCs for the education sector priced from £800, while Apple has cut its prices for the Macintosh. Schools and colleges can now get a MacPlus for less than £700. (Source: Computing, 12 October, 1989)

VI. SOFTWARE

Software package for use across networks

Hewlett-Packard has unveiled a software package, NewWave Office, that allows its NewWave software to be used across computer networks. The new software allows a user to collect data from separate systems and reassemble them into one "object". The "object" is constructed manually at first; NewWave then records the process so that it can be automated afterwards. NewWave Office also includes such services as resource sharing, data access, electronic mail and network management for network linked clients; they run on MVF, HP-UX, and OS/2. Vendors are starting to develop applications for the NewWave system, including a version of the Excel spreadsheet from Microsoft, a LAN-based E-mail package from Da Vinci Systems (Raleigh, NC), and the DynaComm mainframe-to-LAN link from FutureSoft Engineering (Houston, TX). (Extracted from Networking World, 4 December 1989)

CAE software packages with BJT models for microwave designing

EEsof (Westlake Village, CA) has developed computer-aided engineering (CAE) software packages that include advanced large-signal bi-polar junction transistor (BJT) models used for microwave designing. Microwave circuit designers are increasingly turning to BJTs due to their widened frequency range (up to 6 GHz amplification and 20 GHz oscillation), as well as lower low-frequency noise and better transconductance than field-effect transistors (FETs). However, non-linear circuit simulations require precise BJT models. BJT model testing can be done by the integrated CAE software. The ANACAT program does silicon bi-polar device measurement, while Xtract does large-signal model characterization. The Libra non-linear simulator and the Touchstone linear simulator jointly perform large-signal circuit simulation, while Touchstone alone does small-signal simulation. Time-domain simulation can be done on Microwave SPICE. The OmniSys software analyses circuit simulation data and can supply initial specifications. (Extracted from MicroWaves, November 1989)

Excel spreadsheet for OS/2 available

Microsoft's (Redmond, WA) Excel spreadsheet for OS/2 is now available. The product can exploit the operating system's multi-tasking environment and

directly access memory higher than 640 K. Unlike Excel for Windows, Excel for OS/2 can consolidate worksheets. It can also support file names as long as 256 characters, compared to 8 characters with DOS. It has an interface that is identical to that of Excel for Windows and Excel for the Macintosh, and adheres to IBM's SAA (Systems Application Architecture) and CUA (Common User Access) standards. Customers must have an 80286 or 80386 processor, 2.5-Mbytes of memory, and OS/2, Version 1.1 or above. (Extracted from Information World, 16 October 1989)

Climate computer

The World Meteorological Organization (WMO) has developed a computer program, known as Climate Computer to bring computerized weather information management to climatologists around the world.

The program provides software for XT and AT-compatible micro-computers to manage and analyse climate data and maintain local weather histories. Twenty systems have been installed since 1984 and 80 more are to be installed over the next 18 months. The program is available to member States of WMO through their national meteorological services. Data which is generated by WMO's World Weather Watch will eventually be included in the computer program on a non-real-time basis.

For further information, write to R.A. de Guzman, Special Assistant to the Secretary-General, World Meteorological Organization, 41 Giuseppe-Motta, Case postale No. 5, CH-1211 Geneva 20, Switzerland. (Telex 23260 OMM CH; FAX + 41 22 34 23 26). (Source: Update, United Nations Centre for Science and Technology, No. 36, Winter, 1988)

Chinese in one simple program

Researchers at Dartmouth College in the United States have developed an interactive computer program to help students pick up nuances in the Chinese language by using electronic flash cards.

The program which works with Apple's Hypercard program and operates on Apple's Macintosh is called Hanzi Assistant. Students hear a pronunciation recorded in Beijing by Chinese radio announcers and see the Chinese characters written out, brush stroke by brush stroke. The program also offers a translation and phonetic breakdown. Dartmouth hopes to release the data base commercially on compact disc later in 1989. (Source: Business Week, 19 June 1989)

MRP II software systems expanded

Manufacturing resource planning (MRP II) software systems are being expanded to accommodate new demands, and will thus do more than their present duties in planning and scheduling all resources of a production firm. More firms have been taking up just-in-time output, which necessitates that MRP II systems be more interactive and timely and more precisely reflect the actual events happening on the plant floor. MRP firms have been examining ways to address the requirements of the combination shop by developing their own job-shop software or by seeking to team up with firms developing software tailor-made for the shop. Northeast Data Systems (Burlington, MA) and MSS International (Columbus, OH) have developed products that address the combination maker. (Extracted from Metalworking News, 4 September 1989)

International network of data bases to support human genome mapping project

With funds from the Howard Hughes Institute (HHI) researchers at Johns Hopkins University (JHU) in Baltimore, Maryland, are planning an international network of data bases to support the mapping and sequencing of the human genome.

The new data base at JHU, formally named the Genome Data Base (GDB), will provide access to primary data and literature citations and daily updates of information generated by scientific workshops, the data base's scientific editors and individual laboratories.

Users will also have access to OMIM, the on-line version of Mendelian Inheritance in Man, Victor McKusick's classic encyclopaedia of human genetic diseases. Other data bases with which it is hoped to forge links include the mouse genome data base at Jackson Laboratory in Bar Harbor, Maine, and that at the Centre d'Etude du Polymorphisme Humain in Paris.

The second centre in the network will be created in London, with the collaboration of the Imperial Cancer Research Fund. Data from the GDB will be transferred at the international human gene mapping workshop in the United Kingdom, and at every subsequent workshop the data will be updated and transferred to a new centre. Eventually there will be an international network of human genome data bases. (Source: Nature, Vol. 342, 23 November 1989)

India's sharp software edge

As the costs of software development and maintenance continue to spiral, more and more IS companies are turning their sights towards foreign shores to keep those costs down and alleviate shortages of experienced professionals. One country that has proven particularly adept at easing those shortages is India, where software skills and a favourable tax policy are encouraging the world's major computer vendors to set up software subsidiaries.

The India impetus in software development derives from the nation's highly trained workforce. Significant numbers of workers have specific knowledge of programming languages and familiarity with hardware, data base concepts and applications. Even more important, Indians possess the vital ingredient in most software development efforts - fluency in the English language. In fact, India's labour pool of English-speaking engineers and computer scientists is second only to that of North America.

Indians have another advantage that makes them attractive to foreign computer companies with pressing software development chores - a relatively low pay scale and a favourable exchange rate for many currencies.

One company that is capitalizing on these cost incentives is Blue Bell, Pa.-based Unisy. Corp., which has teamed up with Bombay conglomerate Tata Industries to form the joint venture Tata Unisys Ltd. (TUL). The operation, which has a strong turn-key business going in the States and Europe, has emerged as one of India's leading software exporters.

Siemens AG of Munich, Federal Republic of Germany, is likewise planning to take advantage of

India's software development muscle by joining forces with its subsidiary, also in Bombay. Starting in 1990, a new Siemens centre in New Delhi will develop software for the Federal Republic of Germany market.

The software export mode that is currently in vogue involves contracting with an export vendor or with system professionals to develop or maintain applications on-site for the duration of a particular project.

If a customer has well-defined specifications, however, applications could actually be developed at the exporter's location in India. After development, the software would then be tested and installed at the customer's site. As satellite communications technology continues to evolve and telecommunication costs continue to drop, such off-site, out-of-country development schemes are expected to dramatically increase. (Reprinted with permission of DATAMATION[r] magazine, 1 December 1989,[c] copyright by Technical Publishing Company. A Dunn and Bradstreet Company - all rights reserved)

European software firms face world-wide "eclipse"

Europe's software and services market will grow by $70 billion in the next four years but European companies will be eclipsed by global US and Japanese firms unless they become truly world class, warns market research firm Input.

Europe now accounts for $51 billion of the world software and services market - and this is due to rise to $120 billion by 1994.

The current figure is 29 per cent of a world total of $178 billion, with Europe second to the US (53 per cent) and before Japan (12 per cent).

Working from population figures and GDP, Input says Western Europe stands to become a very significant force after 1992.

Western Europe's population is 350 million compared with the US's 235 million and Japan's 120 million, while GDP for Western Europe stands at $4,500 billion, ahead of the US ($4,100 billion) and Japan ($2,100 billion). (Source: Computer Weekly, 23 November 1989)

Standards arrival signals lower data base prices

Data base software costs are set to fall thanks to emerging standards. These will allow user companies to switch emphasis from central data base products to end-users' applications.

So say the authors of a new fourth generation language evaluation report.* They also believe some suppliers are going to find it hard to survive.

Martin Butler and Robin Bloor says SQL, the emerging standard language for accessing data bases, will revolutionize the data base market as Unix has the hardware market.

They say Oracle will encounter market resistance if it does not uncouple its software tools from its data base, and that the number of competitors building gateways into its data base will eventually force its hand.

* 4GLs: An Evaluation and Comparison, Martin Butler and Robin Bloor, November 1989.

While praising Oracle's computer-aided software engineering (Case) product set, the report says performance deficiencies in its fourth generation language and data base management system are becoming more visible.

The report praises Software AG's offering as market leader in terms of quality and adds that fourth generation products which are designed with end-users in mind, like Focus and SAS, should continue to do well.

Uniface is the fourth generation language most likely to thrive as the ability to connect applications and relational data base management systems becomes increasingly important in the marketplace, according to the report.

Uniface, also known as Fastbuild, from Sybase, is tipped ahead of Accell/SQL from Unify, which is described as a "very competitive offering". Both will prosper as the Unix market builds up steam, and Uniface will do well in the DEC VAX market. (Source: Computer Weekly, 9 November 1989)

Translator changes 16 pc packages

System Compatibility's version 4 of the Software Bridge translator package converts documents between 16 different PC word processing packages.

The package is designed to provide converted documents which look and function as if they were created on the target word processor with soft carriage returns, tabs, bold face, underlining, superscripts and subscripts.

Software Bridge reads and converts files directly from data discs, with as few as three keystrokes. Automatic document insertion allows up to 250 documents to be placed in the conversion queue with straightforward menus and prompts.

This latest version also includes SoftScan, an ASCII to word processing document encoder. It maintains the page layout and converts documents to and from ASCII and the word processing program. Text converted with SoftScan is ready for editing, printout or telecommunications immediately. (Source: Electronics Weekly, 15 November 1989)

Software enables design of complex 32-bit chip

Complex 32-bit microprocessors can now be designed by engineers on their desktop PCs.

Design software from Canadian company Design Workshop, which runs on the Apple Macintosh, has already been used by Motorola during the development of its 68030 microprocessor.

Loosely based on Calma's GDSII language, dw2000 was designed to be familiar to users of industry standard packages, reducing the need for manuals and training. The program uses 125 basic commands in place of the 500 in earlier software. The difference can be made up using routines based on the shorter instructions.

A layout with up to 64 levels can be handled, matching the programs running on mainframe computers, without running noticeably slower. (Source: Electronics Weekly, 29 November 1989)

Declaration to solve Soviet software protection and production problems

Last summer, an unofficial delegation of Soviet and Western officials, IS vendors and lawyers met to

come up with solutions to the Soviet Union's software production and production problems. The end result of the informal East-West get-together was a landmark declaration seen as a promising first step towards boosting both Soviet and foreign software business.

On the Soviet side, there can be little doubt that the software industry is in serious trouble. One senior researcher at the Soviet Academy of Sciences estimates that locally developed programs represent a scant 3 per cent of the country's installed base of software, most of which is derived from pirated Western products.

Unlicensed copying of programs has severely stunted the Soviet software industry. To nurture growth in that sector, the communist country must confront some political, cultural and legal issues embodied in the concept of intellectual property rights.

Until recently, the Soviet Union relegated intellectual property to the public domain. In 1984, the Soviets passed a copyright law that allows artists to retain the rights to their own work. But this law does not apply to the creators of computer software.

In the absence of such a law, copying of software, whether foreign or domestic, is perfectly legal in the USSR - and rampant. Russian language derivatives of MS-DOS, MVT or RSX-11, for instance, are freely reproduced and distributed by such Soviet agencies as the State Committee for Informatics and the Electronics Ministry. These operating systems run on machines that fall into the Soviets' three main computer categories: the IBM 370-compatible ES series, the PDP-11-compatible SM systems and various types of IBM-compatible PCs.

Below the government level, anyone with access to hardware can also copy programs at will. Some of that copying is going on in high-tech co-operatives.

But, by now, the majority of the Soviet IS community are aware of the magnitude of their country's software problem. Soviet programmers in particular have begun to realize that intellectual property rights are central to their success. Western software companies are equally anxious to sort out the software rights issue so that they may start receiving Soviet royalties. It was this convergence of East-West interests that made the Pereslavl-Zalesskiy Forum possible.

Held in late June of this year, the unofficial two-day conference attracted some 60 participants.

The real work

The work actually began three weeks before the conference, when a small group of Soviets and Westerners met in Moscow to prepare a draft declaration of Soviet software regulation guidelines.

The key tenets of the declaration state:

- "Software industry ... can only develop if there are effective legal and ethical protections against unauthorized copying;
- "The concept of intellectual property plays a key role in establishing the software market: this means that the owner's permission is required before a program may be copied and used;
- "Voluntary observance of the socially accepted moral code is the key factor in the development of the software industry, since illegal copying of software is difficult to detect;
- "The change in morality will prompt changes in national laws and will, at the same time, serve as a guarantee that the relevant laws will work in practice;
- "The task of the software industry ... is to cater to the needs of end users and to provide them not only with their own programs but also with a wide range of support services, training, maintenance and upgrading."

The declaration, which is already being used as a model by Eastern Bloc countries, has been signed by companies in Czechoslovakia, Hungary and Poland, all of which use Western software. However, while the Pereslavl-Zalesskiy Declaration is clearly a step in the right direction, it is no panacea for the problems that plague the Soviet IS industry. (Reprinted with permission of DATAMATION® magazine, 1 December 1989, © copyright by Technical Publishing Company. A Dunn and Bradstreet Company - all rights reserved)

Systems solution to pollution

A long chain of environmental crises has mobilized the West Germans into action. Today, much of that action revolves around automation, specifically supercomputers, which power simulations being used by researchers in government and industry to clean up the current environment and forecast future environmental conditions. Catastrophic conditions such as the greenhouse effect are decidedly global problems that environmentalists everywhere are worried about.

Spotting such conditions and bringing them to the public's attention is the job of such organizations as the European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, UK, which works with the Max Planck Institute in Hamburg. Thanks to computer simulation, ECMWF researchers are now able to offer more than vague warnings about the serious damage done to the environment by such practices as burning coal and oil. Armed with the data from these simulations, they can provide scientific evidence based on realistic models.

Using various telecommunications networks, the ECMWF routes its atmospheric data to the computer systems of its 17 member countries. The main customers for the centre's medium-range forecasts, which track weather conditions for roughly one month at a time, are organizations within the agricultural, marine, energy-planning, land transportation and, of course, environmental and pollution control sectors. In addition, the ECMWF's data assimilation set, which consists of more than 70,000 global fields, has been used extensively by scientists and governments all over the world.

Although the centre's main mission is weather prediction, it designed its "spectrum" modelling tool to examine long-term atmospheric changes, as well.

While the approach taken by model builders and computer manufacturers has been reasonably successful so far, a much more comprehensive

strategy will be needed to tackle the enormous task of monitoring and predicting the long-term effects of various substances on the ozone layer. The ECMWF itself is working on creating a model that will project the long-term consequences of ongoing environmental changes.

ECMWF's West German partners in this effort are the Max Planck Institute and the Deutsche Klimarechenzentrum, a national climate research centre also in Hamburg. The focus at the Klimarechenzentrum is on the long-term effects of carbon monoxide on the earth's atmosphere.

To determine those long-term effects with a better degree of certainty, researchers need better models and machines. That opinion is voiced by Ernst Maier-Reimer, a senior scientist at the Max Planck Institute, who says that "the ability to simulate what the earth's climate and atmosphere will be 20 years from now is still not far enough in the future. We should be able to simulate at least 50 years ahead".

To put more computational muscle into the machines, the Federal Republic of Germany, under the auspices of its Research Ministry, is working on a high-capacity supercomputer with parallel processing capabilities called the Suprenum. The computer, which is being designed primarily for experiments in fluid dynamics, will also assist scientists in climate research related to ozone layer damage and the greenhouse effect.

Outside the governmental research realm, private industry in Germany is also keenly interested in applying IS technology to help monitor, simulate and, in some cases, repair damage that has already been done to the environment. (Reprinted with permission of DATAMATION® magazine, 1 December 1989, © copyright by Technical Publishing Company. A Dunn and Bradstreet Company - all rights reserved)

Software systems have much to gain from artificial intelligence methods

Many software developers still mistrust the artificial intelligence approach to building computer systems. As a result, most knowledge-based systems in use today are isolated from mainstream computer systems which remain largely unaffected by AI developments. The time is now ripe to embed AI capabilities in general, and expert systems in particular, within traditional software systems.

Already, AI is starting to make its impact in the data base arena. In addition, the first expert system specifically optimized for software developers has become available. Further moves to exploit AI within cases are already afoot.

One of the most celebrated examples of the application of AI techniques to extend current data base technology is Postgres, described by Relational Technology as the successor to the Ingres relational data base. Postgres is still at the research stage, but RTI's Michael Stonebraker has outlined its design goals in a series of papers called, not unnaturally, "The Postgres Papers".

The first goal is to support complex data and objects. The relational data model copes with business data very well, but is not so good at coping with the sorts of complex objects and relationships that exist in many engineering applications, such as CAD/CAM, programming environments, geographic data and graphics. Postgres aims to extend the range of objects that can be manipulated.

The second goal for Postgres derives from the first one. It is to make it easier to use the relational environment in new application areas. Key to this is the ability to support additional data types, such as geometric data types for CAD/CAM and latitude/longitude position data types for mapping applications. Supporting these also requires new operators and data access methods.

The third aim is to support active data bases and rules, to make expert system applications easier to develop. Such applications are often more easily described in terms of rules and triggers, than in terms of simple data values.

It will probably be some time before AI capabilities become deeply embedded within mainstream data base technology. At present, attention is focused on interfacing existing data bases with AI applications.

The aim of embedded expert systems is to enable IS staff to extend current systems to encompass fuzzy processing.

In a nutshell, the new IS/AI expert systems enable IS staff to build an expert system to handle the credit checking operations and then to embed that system within an existing application or applications. The expert system is able transparently to co-operate with the existing application, and has access to traditional IS data bases - such as the customer data base - as well as to its own knowledge base of credit rules.

By combining AI with existing applications and data bases each product should expand the types and complexity of application IS staff can address.

In fact, there is now a growing number of tools that make it feasible for IS software developers to include expert system-like capabilities within traditional mainstream computer systems. (Extracted from Computing, 26 October 1989)

AI system with "forgetting" function

Researchers are studying an artificial intelligence system with a "forgetting" function at the Cognitive Science Section of the Agency of Industrial Science and Technology's Electrotechnical Laboratory. The forgetting function system attempts to model the cognitive processes of the human brain, including its ability to forget. The forgetting function is designed to enable the AI system to eliminate unnecessary link weights during the learning process to reduce processing time. The system will use only the modules related to the immediate problem rather than processing every knowledge module it possessed and would consequently be capable of more human-like learning. (Extracted from New Technology Japan, November 1989)

Housekeeping the hard way

Hard discs are becoming an obligatory rather than purely a recommended feature of personal computing. More powerful and thus more useful packages will not function from floppy disc drives.

The list of such software lengthens almost daily and includes, among many others, dBase IV, Lotus 1-2-3 v8 and Pagemaker. Program files for

such applications often occupy two to four Mbytes of hard disc space. Add to this the data files generated - in desktop publishing some of these are now commonly up to a megabyte each - and even 20 Mbytes becomes an inadequate capacity.

There are a few simple housekeeping rules, which if followed will release a megabyte or two and enable the installation of an essential piece of software.

Obviously seldom used programs can be backed up and erased. It is surprising how many organizations waste precious disc space in this way.

Many less intelligent installation routines copy across a whole range of drivers for printers and monitors, and most are not required. They too can be deleted, but keeping the original discs just in case a decision is made to swap printers at a later date is always sensible.

Fonts can be very greedy and it may be worth sacrificing possible text embellishments to gain valuable room. If you use Windows or Gem it is sensible to look at applications specifically written for those interfaces.

Once the user is familiar with the software then example files can be deleted. This can free a lot of capacity, for example in Pagemaker. Tutorials can be taken off too; in Excel the CBT file is not far short of one megabyte in size.

Apart from size, the speed of the hard disc is of vital importance. The quicker the disc then the less time the processor stands idle. Generally larger discs have superior access times, 28 milliseconds being fairly common. However, the access time is not a completely reliable guide to the speed of the disc. A better measure is the amount of data that can be transferred in a given time. This depends upon a number of factors; the interleave, hard disc controller and disc cache.

It is advisable to choose a hard disc from a reputable manufacturer and with proven controller.

Disc speed, or lack of it, is most noticeable with programs that utilize virtual memory. Virtual memory is used by RAM-hungry programs that have to swap themselves out to disc and back again because of a shortage of real memory. A slow disc makes these programs crawl rather than run.

On the other hand, given sufficient RAM, some applications are able to exploit virtual discs. Such logical discs reside in memory and are therefore extremely efficient. They can be set up with Ramdrive.Sys or Smartdrv.Sys in the Config.Sys file.

Repeated writing to hard disc results in file fragmentation. A significant degree of fragmentation prejudices performance and it is good practice to unfragment files from time to time. Again it is essential to buy the necessary utility from an established supplier. One or two of those from the public domain are reputed to occasionally scramble files. As a disc is being rearranged, and this can take quite a few minutes, some of the contents are held solely in RAM. A power cut or accidental interruption may destroy important data, therefore a backup of the disc should be made before proceeding.

A hard disc can accommodate literally tens of thousands of files. In such a situation it is all too easy to lose track of files and to forget what each one contains. Organization of files into directory structures is a must. The two most popular methods are one directory per user and one directory per application. Often each user is given his or her own subdirectory in an applications directory. Even with one user, data subdirectories for each application are advisable.

The root directory should be kept as trim as possible. Apart from the two hidden system files, the only files that need to be kept there are Autoexec.Bat and Config.Sys. If a Command.Com file is moved into a DOS subdirectory, it is best to create or change the Set Comspec entry in Config.Sys or alternatively to include C:/Dos in the path. Batch files can be housed in a subdirectory as long as the path in Autoexec.Bat is amended.

Windows-based packages create temporary files with a .TMP extension and these are written to the root by default. Sometimes Windows leaves them intact, messing up the root. A solution to this is to make a subdirectory, called Wintemp, and include the command Set emp C:/Wintemp in the Autoexec.Bat file.

The DOS function Chkdsk may rescue lost clusters and dump them in the root with the .CHK extension. They should be viewed in a word processor to see if they contain valuable data (in ASCII format); those that do not can be deleted. Those that do can be appended to their relevant files.

Once in a while a lost cluster may be a bit of code, and it is impossible to decipher it in the word processor. Just to be certain transfer it to a special subdirectory. It might be possible that a program malfunctions at a later date because some of the code is in the lost cluster. The missing cluster can then be claimed from its subdirectory and merged back. This is not an easy task and should only be attempted for programs written in-house, for which no back-up has yet been made. Commercial programs should be replaced from the back-up copy. Non-ASCII data can sometimes be reclaimed as well.

Most problems can be overcome with a screwdriver, a pile of floppy discs and Norton Utilities. The head crash is a little more serious; however it is still possiole to resuscitate a lot of data if you know what you are doing.

The golden rule of course, to ensure against any situation, is to have recent back-up of the hard disc. This can be a chore, though there are various options which expedite the process - a tape streamer, the Back-UP/M switch.

Another probability worth investigating is the alteration of CMOS parameters; just re-run your particular set-up routine.

With Norton you can retrieve deleted or over-written files and directories; here it is imperative not to write to the disc again until the rescue is completed. Accidental formats can be undone by setting a path to Norton and including the line FR/Save in Autoexec.Bat.

In some situations it might be a little dangerous to leave all the Norton Utilities on the hard disc. A lot of damage can be done if they are used by inexperienced or malicious hands.

In such cases keep your utilities on floppy discs, except the FR program which is necessary for any format recovery.

Note that FR/Save creates two files in the root, Frecover.Dat and Frecover.Bak and they should never be erased.

Norton also contains a safe format routine which performs a logical format on floppies, whereas MS-DOS Format carries out a physical format as well and sabotages any subsequent attempt at unformatting. Fortunately MS-DOS Format does not physically format a hard disc.

Recovery is possible even if the Norton safe format has not been used. However, this is not true for some machine-specific versions of MS-DOS - for example Compaq DOS.3.1.

Viruses often corrupt the boot sector of the hard disc. A good idea is to view the boot sector with Norton and note its contents. Should a virus strike then the boot sector can be edited back to its original position.

Hard discs are vital, but come with their own set of problems.

Users are strongly recommended to buy a comprehensive guide to hard disc organization and management. (Source: Computer Weekly, 2 November 1989)

Computing in local languages

Four years ago, a publishing revolution occurred in the United States: the first desktop publishing systems that could be operated on personal computers became available. In no time at all, budding entrepreneurs were using them to bring out new magazines and newsletters, companies used them to produce reports, brochures and other literature and hotels found them useful for designing new restaurant menus. The trend spread rapidly to other countries, but so far has largely passed Asia by.

The main reason is language. The desktop systems were designed to operate in English and other languages that use the Roman alphabet. But the vast majority of Asians neither speak nor read English and many of their languages are written in completely different and far more complex scripts. Until recently, for technical reasons, computers were unable to cope with these; as a result, the desktop publishing boom has only infiltrated such places as Hong Kong and Singapore, where sizeable populations read English. The few Asian language desktop publishing systems that do exist are often cumbersome and difficult to use.

All that, though, is about to change. Apple Computer has just introduced its first Chinese language desktop publishing systems in Singapore and Taiwan, and systems in other regional languages will almost certainly follow. These, in turn, should sound the death knell for more cumbersome traditional publishing processes and spawn a wealth of new publications, just as has happened elsewhere.

The Apple launch is the latest example of the way Asia is moving into the mainstream world of computing on its own terms and in its own languages. Local language computing is needed especially for large-scale data processing, such as sending out tax returns and census forms or delivering large quantities of mail in the languages of the countries involved. Individuals operating the computers used to process such information are unlikely to read English, and training them to do so would be time-consuming and expensive.

As a result the big computer companies such as IBM, Digital and Wang are working hard to gain secure footholds in the emerging local language markets.

Asia, from Japan to Pakistan, is a babel of hundreds of different languages. India, for instance, officially recognizes 16 languages, most of which are written in different scripts. But, as might be expected, most large companies gained their first experience of producing Asian language computer systems in Japan.

But these days, the "hottest" local languages for the computer companies are traditional and simplified Chinese and Korean; these are the languages used by the so-called "little dragons" - South Korea, Taiwan, Singapore and Hong Kong - whose economies are among the fastest growing in the world.

Providing computers that will operate in Asian languages stretches the creativity of hardware and software designers. While the Roman alphabet contains only 26 letters, traditional written Chinese, known as hanyu, comprises some 500,000 characters, of which more than 13,000 are utilized for computing purposes; simplified Chinese, or hanzi, requires 6,700; Korean or hangul, about the same and Japanese, or kanji, 7,000.

Eight bits, or a single byte of binary code, are all that is required to signify to a computer which letters of the Roman alphabet are to be used. They also specify whether the letters are upper or lower case, and the use of punctuation and common symbols.

But this is far from enough to cope with the complicated ideographs of Asian languages, with their thousands of characters; the computer has to process more information to describe each ideograph. To handle Asian language programs, the operating systems - which determine the basic functions of computers - have to be altered. Either the circuitry has to be remodelled with a two byte capacity, or the computer "tricked" into handling twice the amount of information it was designed for. In fact, some companies use two bytes, others three or even four.

This diversity is mirrored in the different approaches computer companies are taking towards the Asian language market. Some are concentrating on localizing their computer operating systems, others are putting the accent on producing Asian language programs, and in between companies are doing a little of both. The results can be confusing; for instance, some computers use menus and commands entirely in Asian languages, some are all in English, and others a combination of both.

To make matters worse, there are no standardized input methods for Asian languages. China alone uses 500 different methods for inputting data. Also, because of the complexity of Asian language characters, the process involved in presenting them clearly on monitor screens is more complex than that needed for English; the same also applies to printers.

Companies also have to wrestle with the complexities of Asian language input systems. Writing words in English is a simple process

compared with building the characters of Asian languages. This is reflected in the wide variety of entry methods.

Some approximate the writing process by being based on calligraphic strokes. Others analyse characters into their constituent parts, known in the case of Chinese as radicals.

There are also English phonetic systems for simplified Chinese and for Japanese, which allow operators to type words according to their English sounds; these are then displayed on the screen in character form according to the local language. But in all these cases, the computer may not unerringly generate the unique character required; instead it will display a series of alternatives, leaving the operator to choose the appropriate one.

Keyboards are normally adaptations of those used for English and other changes are required to give screens and printers the greater clarity required for the display of Asian languages. For their operation, computers require more memory, additional circuit boards and extra chips to handle graphics. All these modifications cost money and they make Asian language computing systems more expensive than their English-language equivalents. They also put brand-name personal computers beyond the financial reach of many people.

This gap, however, is being plugged by local entrepreneurs in most Asian countries, who often represent serious competition for the multinationals. Pirated versions of personal computers are widely available and the software to go with them is often locally developed, some of it for the major companies.

The big advantage of this is that it allows small companies to develop in Asian countries, where they can compete against the multinationals. Nearly all Thai language programs have been developed locally and the industry is thriving.

Peter Gordon, an independent entrepreneur, would like to emulate the Thai experience elsewhere; he is attempting to set up a network of companies to provide local language solutions for such countries as Sri Lanka, Burma, Viet Nam, India and Bangladesh. In these countries computerization represents the wave of the future. They are also areas in which so far the major companies have scarcely deigned to tread; so by getting in early, Gordon and other entrepreneurs could well reap rich rewards. (Source: Asia Technology, October 1989)

VII. COUNTRY REPORTS

Canada

Descriptions of integrated circuit designs received by the Canadian Microelectronics Corporation

Design descriptions were requested from universities for each integrated circuit design submitted to the Canadian Microelectronics Corporation (CMC). These descriptions (maximum length of approximately 10 lines) are intended to provide information regarding the IC design activities within the university community. The following pages contain descriptions of three-micron CMOS designs received by CMC in April, May, July and September 1989. Further information about specific designs or the integrated circuit technology interests of the universities sponsoring the design activities can be obtained by contacting the universities concerned. (See table on page 42.)

Université de Sherbrooke

External control unit of a cochlear prosthesis
Soheyl Pourmehdi

This chip is a part of a portable real-time speech processing system for an auditory prosthesis. It processes the input signal by means of a TMS320 microprocessor and generates an opcode for a programmable device of a Sherbrooke multi-channel neural stimulator. The resulting data are then transferred through the skin to a cochlear implant by an electro-magnetic field to stimulate the auditory nerve.

Remote temperature detector, Mario Genest

This circuit is a remote temperature detector. The temperature is captured by a sensor which modulates the frequency of an oscillator. After being processed the signal is transmitted with FSK modulation to a receiver unit. The transmission is externally activated. It will be repeated every n seconds where n is programmable. The transmitter identification is also programmable and is transmitted along with temperature information.

Queen's University

Full-duplex modem transmitter, Amy H. Setiadi

This chip is a transmitter part of a microprocessor-controlled full-duplex modem. Its functions are to convert data from microprocessor into a continuous bit stream, modify it, insert link control words, insert synchronous characters in cases where data is not available, and append an LRC code word at the end of the data burst.

The interface between the micro-processor and this part consists of two data transfer ports, three control lines, two interrupt inputs, and two flags. The other inputs are synchronous characters, burst length selections, CPU's clock, CPU's reset and one bit control from receiver digital. The output is a continuous bit stream. The other control outputs are one bit control to receiver digital and one bit control to transmitter analog.

The design, using Queens Standard Cells, consists of three sub-systems. Each sub-system is produced by QUISC (Queen's University Interactive Silicon Compiler). Routing among sub-systems is done manually.

Technical University of Nova Scotia

Neural net, Ralph Mason

This design implements a 16 node digital neural net. The chip includes 16 serial/parallel multipliers and adders, 1.2 K of on-chip RAM for weights, XBAR switches and memory for output control, a ping-pong shift register bank for storing and transmitting neural outputs, as well as numerous control and glue circuits.

University of Windsor

A photo-synaptic connection for neural networks
Ajay Chandna

This chip contains a set of cells to test a new type of connection element for neural networks.

This "photo-synapse" consists of a photo-receptor which drives a variable floating resistor. The weight provided by the synapse is controllable by the incoming light intensity to its photo-receptor. This design is the first step in achieving optically programmable electronic neural networks. Special features of the design include the use of npn bi-polar photo-transistors in the CMOS process, and the use of MOSFETs in the sub-threshold region.

European Community

Giant "nervous system" to link Europe's networks

The European Commission has launched an ambitious programme of research which aims to link all the electronic networks of Europe into a single supra-national structure - the European Nervous System (ENS). The Commission says that the establishment of such links is critical to the success of Europe's single market, and to its industrial competitiveness. The free movement of goods, services, people and capital will be impossible without unrestricted movement of information, the Commission says.

The 12 member States of the EC have already approved the R&D component of the plan. The aim is to develop software and pilot projects that hook together the networks which already exist between national governments, industry and individual citizens. The merged network will provide instant access to information in areas ranging from tax and social security to crime and the transport of freight.

The new proposals for the Framework Programme divide the information technology sector into three distinct areas. First, mainstream research in information technology will continue under the banner of ESPRIT. Telecommunications research will continue under the RACE research programme and the third strand will be the European Nervous System.

The final budgets for the three components have yet to be agreed, but ESPRIT is expected to take up some 60 per cent of the programme for IT, which has a budget of three billion European Currency Units (£2 billion). RACE and the ENS will share the remainder.

The driving force behind the ENS is expected to be the private data networks of governments, which remain the largest application for information technology in Europe. ENS will also build on a number of small-scale research projects which already exist under ESPRIT. These include: the TEDIS project to develop the interchange of electronic data between member States; the DRIVE project which looks at the use of information technology in directing transport services in Europe; and the DELTA project to develop the application of satellite communications in education.

The proposal originated in the French Government, which took over presidency of the European Commission in July. France already has an extensive network of millions of computer terminals, known as Minitel, which provides teletext-style information services to homes and small businesses across France. France is keen to establish the standards it uses on Minitel elsewhere in Europe.

The ENS will require stringent security measures, since it will require the transfer of personal data, such as medical information and criminal records, across national boundaries. (This first appeared in New Scientist, London, 9 December 1989, the weekly review of science and technology)

Europe versus the rest of the world

More than 200 projects began life under the first phase of ESPRIT, each containing at least two industrial partners from different member States. At the programme's peak, 3,000 engineers and scientists from 420 independent organizations were working full-time on its projects.

At the 1989 ESPRIT conference in Brussels, more than 100 projects were able to demonstrate significant results. In some cases, researchers exhibited products that are selling on world markets.

The Supernode project, set up by the UK and France, is one example. The first phase of this project developed a cheap parallel supercomputer for Europe. The second phase, Supernode II, aims to develop software to run on the computer.

The Supernode machine is based on the Transputer - a computer built on a single chip by Inmos. The company was recently bought by SGS-Thomson, the Franco-Italian electronics company. Supernode computers cost about £250,000, but are as powerful as supercomputers which can cost millions of pounds.

According to Brian Oakley, the former head of the UK's Alvey programme of research in information technology, the Supernode project would never have got off the ground without ESPRIT. He feels that the computer the project has produced can compete well with those developed under Japan's national effort to develop a so-called fifth-generation computer - a computer that would be capable of processing knowledge in a similar way to the human brain.

Another major project, which has yet to be formally launched, is the European Microprocessor Initiative. This five-year programme will be Europe's answer to a Japanese initiative known as Tron. Both projects aim to bring together several computer manufacturers to develop advanced microprocessors that use the same design of hardware.

The leading partners in the European project are the Italian computer company Olivetti, SGS-Thomson and the French company Bull. Those involved believe that the project would never have taken place without the sense of community generated by ESPRIT, and that this represents Europe's chance to confront competition from the US and Japan in microprocessor technology.

The European chips will be based on the transputer processor from Inmos, and will employ the sub-micrometre technology to be developed under Europe's Joint European Submicron Silicon Initiative (JESSI) to cram more than 10 times as many transistors onto a chip the same size. The processors will be designed to function in personal computers and work stations that can run several processors in parallel. (This first appeared in New Scientist, London, 16 December 1989, the weekly review of science and technology)

EUREKA approves shipbuilding automation project

During the recent Vienna EUREKA Conference, a project on flexible automation in ship prefabrication was approved costing 130 billion lire (about $96 million) with IRI-FINCANTIERI as prime contractor. Industry from the Federal Republic of Germany (FRG), Sweden, and Spain will also participate in the project with a 30 per cent share. The project is aimed at reducing the cost of shipbuilding by decreasing working hours by

25 per cent. Shipbuilding is probably the only industry where automation has not been attempted because of the difficulties of handling construction parts weighing as much as 200 tons, and for the non-recurrent and non-standardized manufacturing processes. (Source: European Science News, 1 January 1990)

Federal Republic of Germany

More investment into JESSI

With the Joint European Submicron Silicon Initiative (JESSI) ready to start, the Ministry for Research and Technology is creating more research capacity. The idea is to ensure that the $4 billion, five-nation JESSI project achieves its goal of developing the tools and technologies needed to produce 64-Mbit DRAMs and similarly dense logic circuits by the mid-1990s. Planned is a $200 million research institute in Itzehoe, Schleswig-Holstein, to be called the Institute for Silicon Technology. About two thirds of the institute's activities will be in basic research and one third in applications-oriented research. With these two efforts under one roof, government officials hope to avoid a gap between fundamental and applications-related research for the JESSI project. Also, with 90 per cent of Europe's semi-conductor production equipment coming from overseas, the Ministry wants to boost activities in that sector. The five member nations of the JESSI consortium are France, the UK, Italy, the Netherlands, and the Federal Republic of Germany. (Source: Electronics, November 1989)

India

Build-up of microelectronics industry

India will invest a total of Rs 20 billion over the next five years in building up its microelectronics industry, with the Indian Government supplying a quarter of the capital and the rest required from foreign investors, according to a commission of experts. Exports of integrated circuits will reach about Rs 5 billion in the next five years. By the year 2000, microchip demand is estimated to reach Rs 28 billion. (Extracted from Aussenhandel, 23 November 1989)

The "people's" computer

By the time 1990 arrives, the term "PC" could well mean people's computer in India. Bookings opened on 15 November 1989 for PCs that will cost as little as Rs 10,900 (about $US 660), slightly less than the price of most colour TV sets here.

If the Government-organized programme works, its implications are enormous. The project should automatically improve Indian capabilities in software and hardware. Related areas like on-line services and data banks will also spring up everywhere.

Managing this ambitious project is the Government-owned Electronics Trade and Technology Development Corporation. ET & T has no factory; it is purely a bulk buying and distributing company, widely respected for the low-cost TV sets it markets.

Currently, stiff duties, imported components and high profit margins combine to keep the costs of PCs artificially high in India. Prices start at Rs 22,000 ($US 1,330) for standard PCs. A more complicated PC/XT could cost a whopping Rs 48,000 ($US 2,900).

ET & T hopes to sell at low prices and still do business by buying cheaply in bulk from selected companies. ET & T receives no special tax concessions. To minimize customs duties of about 109 per cent of the basic price, its computers will use as many Indian components as possible.

While the MS-DOS operating system is of overseas origin, the three software packages supplied with the PC (English word processing, the spreadsheet, and a data base) will all come from Softek, a firm based in New Delhi. In addition, central processing units for the first batch of PCs have been made by ESPL, a public sector company in Punjab, and the keyboards and monitors by Essen, based in Gujarat.

ET & T's advertisements for more franchisees have evoked a positive response.

Today, all Indian computer firms together do not sell more than 40,000 PCs a year - another reason for the high price-tags, but with its numbers game, ET & T has an ambitious sales target: 200,000 PCs in 1990. Financing arrangements will make that goal more feasible. Buyers will be required to put down only 25 per cent of the cost, and to pay the balance in instalments.

The Rs 10,900 PC includes, in addition to a keyboard and monochrome monitor, a 256 KB RAM dynamic memory and a single floppy disc drive. A hard disc version would cost Rs 22,900, around half the cost of most Indian-made XTs. The RAM chips are South Korean, while the hard discs are made by Seagate Technology of California. The floppy disc drives are Indian.

ET & T also plans service and cheap user-training facilities throughout India. Many industry insiders view that ambition with suspicion, for after-sales service has been generally poor in the country's computer market. In fact some experts are sceptical about the whole project because of the Indian public sector's reputation for inefficiency and corruption. Yet a report from Bangalore, often described as India's computer capital, predicts that low-cost PCs will spark off a price war among the nation's top private PC vendors, such as Wipro and HCL, while smaller firms would rather help ET & T as franchisees. (Source: Asia Technology, December 1989)

Italy

Centre for Informatics Engineering

The city of Milan, the Lombardy regional administration, and the Milan Polytechnic and universities are forming a consortium with industry support (Pirelli, Telettra, Italtel, IBM Italia, Honeywell Bull Italia) to create a centre for research and training in informatics engineering (CEFRIEL). Located in the old premises of Pirelli, the centre will sponsor specialized post-graduate courses in informatics to train engineering graduates for industry's advanced requirements. (Source: European Science News, Spring 1989)

Institute for Artificial Intelligence

Located in Trento, the Institute for Science and Technological Research (IRST), is one of the most advanced organizations in Italy for research on artificial intelligence and materials science. IRST was created in 1985; since 1986, Professor Luigi Stringa has been manager and is responsible for its

remarkable development. IRST presently employs 139 researchers - 69 for artificial intelligence, 34 for materials sciences, and 36 for structure of matter. By the end of 1989, IRST will employ 170 researchers, 28 per cent of whom are foreigners. Operating costs of IRST for 1989 will be 21 billion lire (about $15.5 million) and for 1990 and 1991 are expected to reach 24 billion lire per year. In 1990, IRST will exchange scientists with the MIT Vision Laboratory. IRST conducts advanced research on robots that interact with human intelligence and behaviour, and conducts research on hyperthermic therapies in oncology and medical bio-physics. In materials science, IRST is especially advanced on surface micro-analysis of metallic and non-metallic materials and integrated optical sensors for vision. (Source: European Science News, 1 January 1990)

Japan

New type of manufacturing

Future competitiveness is riding on the development of a new type of manufacturing. "Manufacturing 21", a five-year study sponsored by eight major Japanese companies and several universities, outlines various aspects of the post-industrial manufacturing era. Details of the study were revealed by J. Nakane, professor at Tokyo's Waseda University, at an annual conference given by the Association for Manufacturing Excellence in Louisville, KY. Plans include: shifting away from large manufacturing plants; cancellation of mass-production methods in advanced industrial nations opting instead for low-volume production; larger emphasis on flexibility and the ability to respond quickly to changing markets; products featuring higher value content; increased intellectual input from all employees; and higher concentration on amenities for employees in an effort to make manufacturing jobs more appealing. According to Nakane, the goal of the study team is to find new manufacturing systems to maintain Japan's manufacturing competitiveness and carry them into the next century. (Extracted from Industry Week, 20 November 1989)

Malaysia

An attractive investment

Malaysia's electronics industry is set to maintain its current growth of 12.4 per cent next year, and is increasingly attracting outside investment.

Future growth is predicted to come from the development of consumer and industrial electronics products, which currently account for 20 per cent of Malaysia's output. Components make up 80 per cent of the electronics output (total £3 billion).

The electronics industry is undergoing major structural changes with foreign firms investing more and more of their hard-earned cash in the 13 states. The Government has now allowed foreign investors to hold up to 100 per cent of export oriented companies.

More interestingly, by 1995, the electronics industry is expected to possess the ability to undertake a significant amount of local product design, without having to go to Europe for many of its ideas.

National Semiconductor is following the movement to set up manufacturing closer to regions of vital importance, by undertaking more manufacturing in Malaysia. Some work is to be transferred to National Semiconductor Penang from Singapore. This will expand output at the Malaysian plant by 50 per cent, making it the company's largest plant in the world.

Output at the National Semiconductor facility for the current fiscal year 1990 is expected to grow by over 100 per cent to reach $445 million.

At the same time, M-SMM Electronics, which is a subsidiary of Sumitomo Metal Mining Company, has established a plant in Selangor to produce leads frames for ICs. The plant was started to cater for increased demand, and it is situated in Malaysia because of the closeness of semiconductor factories in the Asian region.

However, Malaysia could run into problems as a newly-industrialized country (NIC). There are fears of loss of certain economic advantages, and the 13 states could be forced to open their own markets and revalue Malaysia's own currency, the Ringgit.

But the way the region's economy is moving, it seems inevitable that Malaysia will become an NIC by the year 2000. By the same token, increasing prosperity will mean that foreign companies will be less likely to set up their own manufacturing plants there. (Source: Electronics Weekly, 25 October 1989)

Singapore

Slow-down in growth

The electronics industry in Singapore is bracing itself for slower growth for the year ahead. But this slow-down will not be uniform across all sectors.

Already, growth in the Singapore electronics industry has slowed to 3.9 per cent in the second quarter from 28 per cent in 1988. Companies in the chip business paint an even gloomier picture of the future. Meanwhile, the Japanese are continuing to invest in Singapore.

The British too have been increasing their investment in the Republic. UK computer manufacturer, ICL, became the second multinational company to set up an international purchasing office in Singapore recently. This brings to 61 the number of such purchasing offices registered.

The generally high level of prosperity within Singapore has meant a shortage of skilled labour, which in turn has meant that managements are being forced to consider help with relocation allowances and training. (Source: Electronics Weekly, 25 October 1989)

Taiwan

Chip consortium set up

Taiwan is to have a chip industry consortium technology development project along the lines of Europe's JESSI programme and America's Sematech.

It is being organized by the island's top technology body, the government-sponsored ERSO (Electronic Research Services Organization).

The "Sub-Micron Project's" target is to develop 0.5-micron technology for commercial use by 1995 and 0.035-micron technology at the research level.

The project will cost $1.25 billion. Half will be paid by the Government and half by the industrial participants. The equipment and the research facilities will be provided by the Government.

Four participants have signed up for the project: United Microelectronics Corp. (UMC), Taiwan Semiconductor Manufacturing Company (in which Philips has a big stake and so gets to join in the project that way), Vitelic and the two-year-old start-up Winbond Electronics. (Source: Electronics Weekly, 25 October 1989)

Taiwan makes indirect headway in Soviet market

A growing number of orders for Taiwanese computers has been coming from the Soviet Union.

In the absence of direct trade between Taipei and Moscow, the Soviet Union has been forced to place orders through third parties, including various European nations, Hong Kong, Singapore and India.

Industry sources said Taiwan has achieved an excellent reputation for quality and price competitiveness, perfect for a Soviet Union bent on promoting computerization of its society even as it seeks to cut costs.

The sources said Soviet orders in 1988 were placed on a trial basis, but orders in 1989 have been getting bigger and bigger.

One supplier reported that it is currently negotiating an order from the USSR involving 10,000 personal computers.

The source revealed that most Soviet orders are for XT IBM compatible PCs using 8088/8086 chips.

Total demand for PCs in the Soviet Union is expected to increase to several hundred thousand sets in 1989. (Source: AEU, March 1989)

Electronic firms prepare for post-1992 EC market

Taiwan's electrical appliance and electronic manufacturers are setting up factories and sales networks in Europe in anticipation of unification of European markets.

Tatung Co., Sampo Corp. and Great Electronics Corp. are readying themselves for 1992, when the European Community becomes the world's largest market.

Tatung has established plants in Austria, the United Kingdom and the Federal Republic of Germany and personal computers and televisions have carved a niche for themselves in the British market.

Sampo has invested some DM 500,000 (about NT$7.4 million) in Europe Sampo Corp. in the Federal Republic of Germany. (Source: AEU, 3 March 1989)

United Kingdom

Funding electronics research

Government research and development spending is failing to stimulate basic electronics research according to figures in this year's review of government-funded R&D, published last October.

A steady reduction in real terms of Government funded R&D, which totalled £4.6 billion in 1987/1988, is being offset by increased R&D spending in all sectors of UK industry except electronics.

The report said that in 1987/1988 industry spent £6.3 billion on R&D, but while electronics research accounted for over 28 per cent (£1.8 billion) this figure had actually fallen by 9 per cent - allowing for inflation - over the previous year, and the amount spent was worth less than in either of the previous two years.

Electronics researchers can receive Government money through Science and Engineering Research Council (SERC) projects, such as LINK, Department of Trade and Industry collaborative programs and, of course, Ministry of Defence contracts.

Despite an increase in the funding of research council projects over the next four years of about £40 million in real terms, the money allocated to SERC will fall by almost £25 million in real terms over the same period.

Over the next four years the DTI will see its R&D budget cut by £124 million or 38 per cent, allowing for inflation. So there will be less money to be spent on new LINK projects and the advanced technical programme which targets basic electronics research such as gallium arsenide and high-temperature superconductors. (Source: Electronics Weekly, 1 November 1989)

Support for compound semi-conductor technology

The Government's Department of Trade and Industry (DTI) and the Science and Engineering Research Council (SERC) have combined their interests in compound semi-conductor technology research by establishing a single body which will be responsible for the basic, strategic and more applied research. This Compound Semiconductor Technology Sub-committee will be responsible for three programmes:

- The gallium arsenide programme is a $23 million Advanced Technology Programme funded under DTI's Research and Technology initiative concerned with research on all aspects of gallium arsenide technology.
- The LINK Advanced Semiconductor Materials Programme is a $21 million programme jointly funded by the DTI and by SERC that is concerned with device-orientated research on generally non-silicon semi-conductor materials.
- The Low Dimensional Structures and Devices (LDSD) programme is funded by SERC to more than $8.75 million annually to investigate the physics of exploitation of ultrathin multi-layer structures in novel devices.

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Neural networking

A dozen large industrial companies have pledged support for a technology club which aims to find useful applications for neural networks. The Department of Trade and Industry has also offered financial support to University College, London, and the two software houses, Logica and SD, which founded the group.

Companies such as British Coal, Rolls-Royce, and British Nuclear Fuels are showing an interest in applying neural computing to real problems - for

example, detecting defects in products, forecasting for portfolios of shares and in the kind of system that can recognize faces at security checks. British Rail is also about to test whether it could use neural networks for "visual" monitoring of level crossings. (This first appeared in New Scientist, London, 28 October 1989, the weekly review of science and technology.)

Computer science

The University of Newcastle Department of Computer Sciences has been involved for many years in the problem area of inter-computer communications. A system for UNIX-based communications called the "Newcastle Link" was developed here and is now available as a commercial package. Work is now going on for heterogeneous computer systems to communicate. Additionally, extensive work is being done on fault tolerant systems, distributed processor systems, and shared memory parallel computers using the Encore Computer for in-house development. The Department of Electrical Engineering works closely with the Computer Science Department and develops VLSI hardware systems. These hardware platforms are designed with fault tolerance and self-correcting algorithms right in the chip. Another area of interest lies in the development of the electro-magnetic theory associated with mm wave scattering through particulate contaminated atmosphere using single particles in an open microwave resonator. Digital adaptive communication techniques are being investigated to develop an underwater acoustical communication link. This secure link is intended to provide high data rates, low error rate, and resistance to multi-path - all without using umbilical cables. (Source: European Science News, August 1989)

United States of America

Electronics industry moves into consortia

US electronics industry has blossomed into consortia since anti-trust reform made it easier in the 1984 National Co-operative Research Act. Some 140 co-operative ventures, mostly in the electronics field, have since registered with the US Commerce Department. Some, like Sematech and Microelectronics and Computer Technology, are well known while others are discreet; some involve universities, others do not; some depend on Government funds while others rely on members' support; some focus on production rather than R&D. Consortia supporters say the R&D arrangements favour small companies with early information on where the niches will be, while retaining competitiveness at the production end. Consortia critics regard them as a blind alley. (Extracted from Electronics, December 1989)

Administration withdraws help from semiconductor industries

The US domestic semiconductor and consumer electronics industries will not get any help from the federal Government in reversing recent market declines. The Bush Administration vetoed many of the recommendations put forth by a report by the National Advisory Committee on Semiconductors. Actions opposed by the Government included creating Consumer Electronics Capital, a publicly supported source of low-cost capital for the consumer electronics industry; more funding for Sematech; establishing standards for local technology content; and restricting domestic electronics market access to countries that restrict US access in their electronics market. The semiconductor equipment and materials industries are particularly in need of Government support, according to C.S. Kulicke, chairman of Kulicke and Soffa Industries. The Texas consortium Sematech plans to use much of its $200 million a year capital to aid the equipment industry; however, possible reductions in Government funding may force a change in plans. The Department of Defense funds 50 per cent of Sematech (industry funds the other 50 per cent). (Extracted from Electronic Engineering Times, 4 December 1989)

Member Organization	Representative	Telephone Number
University of Alberta	Dr. R. Stromsmoe	(403) 432-5148
The University of British Columbia	Dr. D. Camporese	(604) 228-4623
University of Calgary	Dr. J. Haslett	(403) 220-5908
Carleton University	Prof. C. H. Chan	(613) 564-7415
Concordia University	Dr. A. Al-Khalili	(514) 848-3119
Lakehead University	Prof. J. Coolen	(807) 343-8597
Université Laval	Dr. U. Ganguly	(418) 656-7943
University of Manitoba	Dr. R. D. McLeod	(204) 474-8886
McGill University	Dr. N. Rumin	(514) 398-7120
McMaster University	Dr. J. P. Reilly	(416) 525-9140 ex. 2895
Memorial University of Newfoundland	Mr. M. Bruce-Lockhart	(709) 737-8937
Ecole Polytechnique de Montréal	Dr. J.-L. Houle	(514) 340-4753
Université de Montréal	Dr. R. Corny	(514) 343-7472
The University of New Brunswick	Prof. D. Luke	(506) 453-4561
Technical University of Nova Scotia	Dr. D. Pincock	(902) 421-1250
University of Ottawa	Dr. D. Gibbons	(613) 564-3446
Queen's University	Dr. A. R. Eastham	(613) 545-6081
University of Regina	Dr. W. J. Hisskey	(306) 584-4161
Royal Military College	Dr. D. Al-Khalili	(613) 541-6401
University of Saskatchewan	Dr. R. Muir	(306) 966-8576
Université de Sherbrooke	Dr. S. Richard	(819) 821-7141
Simon Fraser University	Dr. R. Hobson	(604) 291-3128
University of Toronto	Dr. A. Salama	(416) 978-8658
University of Victoria	Dr. E. G. Manning	(604) 721-8612
University of Waterloo	Dr. J. A. Barby	(519) 885-1211 ex. 3995
University of Western Ontario	Dr. Z. Kucerovsky	(519) 679-2111 ex. 8309
University of Windsor	Dr. G. Jullien	(519) 253-4232 ex. 2574

VIII. FACTORY AUTOMATION

Programming beats robot imprecision

Even as automation replaces old skills, it brings new skills into being, such as those of the robot-trainer.

Pat Fothergill of Aberdeen University's own interest is in off-line programming of assembly robots - programming their operations from a keyboard - but she is intrigued by the skill of those who teach robots by physically guiding them through movements, for she believes their know-how might also be applicable to off-line programming.

One of the big challenges is to write off-line programs which will overcome the inherent inaccuracies of robots. More accurate robots can be bought, or built, but they are expensive. The issue is whether it is better to go to the expense of an accurate robot, or to find ways of working with a less accurate one. Sometimes, there is no choice.

Though a robot may lack accuracy, Fothergill explains, at least it has repeatability which is a robot virtue that must be exploited by the off-line programmer. Off-line robot programs have to cope with uncertainty. Not only is there uncertainty about the absolute position of the robot arm, there is also uncertainty about the positions and even the dimensions of the parts to be assembled. An important programming strategy is to take actions which will reduce that uncertainty. Nudging an object before picking it up is one example. Simply closing the gripper on the object will align the object's edges to the gripper, thereby eliminating any uncertainty about the object's orientation.

Of course, such actions must be done with a purpose, they must be part of a plan. Fothergill argues that it is possible to reason formally about such plans and actions. The necessary notation already exists as part of Rapt, a high-level robot programming language which she and Robin Popplestone developed at Edinburgh University.

Rapt deals with spatial relationships or constraints. One plane is against another. A point is against a plane. Actions establish relationships. Putting one block on top of another establishes a plane-against-plane relationship. Such relationships still leave room for uncertainty. There are still three degrees of freedom in the relative positions of the two blocks. The upper block, for example, can slide north-south or east-west, and rotate, while maintaining contact with the lower block.

But as the constraints accumulate, uncertainties or degrees of freedom disappear. The delightful thing about reasoning with these spatial constraints is that a large set of constraints often simplifies down to a few simple ones. If a side of the upper block is known to be coplanar with a side of the lower block, only one degree of freedom remains.

A second pair of coplanar sides reduces the degrees of freedom to zero. Certain constraints have to be satisfied if parts are to be mated at all. Once the parts are mated, new constraints will remain permanently in force - to assist the remainder of the assembly process or perhaps, if the job was poorly planned, to hinder it.

Almost all actions taken during an assembly task have just been delivered by a conveyor belt. We know what shape it is. We know which way up it is. We just do not know quite where it has come to rest or which way it is pointing.

All this knowledge greatly simplifies the task of the vision system. There is no need to do a complete three-dimensional interpretation of the scene. All that is needed, says Fothergill, is to look for the image of a suitable edge. Finding edges is a quick and simple task for a vision system. The information gained from the vision system is not a description of absolute positions in space. It is a statement of a spatial relationship. Therefore it fits neatly into the reasoning framework established by Rapt.

It might seem impossible to reason about the result of a sensing operation before the operation has taken place. But the trick is to perform symbolic reasoning when the program is prepared.

Clearly such reasoning must involve a description of the parts to be assembled. Rapt's way of modelling solid objects is different from those of most computer aided design systems. Interfaces have been built to Robmod, a solid modelling system developed at Edinburgh University, and to Pafec's Boxer, which was developed at the University of Leeds.

There are other ways of establishing spatial relationships. Many parts designed for automated assembly have self-locating devices such as tapered holes and pegs. These devices perform the now familiar task of establishing an accurate spatial relationship from a situation of uncertainty.

Perhaps surprisingly, assembly work can proceed without a detailed model of every part.

Coping with inaccuracy or uncertainty is nothing new in the history of technology. Technologists have always valued processes which produce an accurate result despite initial imprecision. Indeed without such processes, precision engineering could not have come into being. (Source: Computing, 14 December 1989)

Robot for dentistry and medical students

Researchers at the Institute for Medical & Dental Engineering (Tokyo) are developing a training robot to simulate dental patients. The robot's teeth are connected to a load sensor, which enables a computer screen display of the vertical force, moment for tilting tooth axis, tilt moment force to direction of tooth-axis and the rotational speed of the dental instrument. New dental instruments are capable of up to 500,000 rpm rotational speeds and high braking torques so that improper use can result in excessive pain and even hairline cracks in a patient's teeth. The skull of the robot is made of durable glass fibre-reinforced plastic and is covered with a human-feel PVC/rubber "skin" and a tongue. The research is in the latter stages and the researchers expect to have a final protype ready soon. Meanwhile researchers at Tokyo Denki University have developed a physician training robot that simulates cardiac patients. The robot simulates the symptomatic sounds of various heart conditions in such a way as to allow realistic auscultation with a stethoscope. The device is an improvement on audiotape training since it accounts for differences in sound when the stethoscope is

placed on different parts of the patient's anatomy. The robot, which is connected to a microcomputer, has miniature loudspeakers located at the aorta and the pulmonary, tricuspid and mitral heart valves; all generating different heart sounds the way a human heart would. The technology has been transferred to the commercial sector, where mass production studies geared towards reducing system cost are ongoing. (Extracted from New Technology Japan, October 1989)

Robots to simulate human touch

Researchers at the University of Michigan have developed a tactile imager that may enable the creation of robots capable of simulating human 'touch'. The microelectronic device is a pressure sensor that converts its readings into electronic signals, which produce a pattern that can be analysed by a computer. The sensor may enable robotic gripper arms that can differentiate between assorted items and correctly select the desired part out of several in a bin. When coupled with feedback systems, the sensors could also enable robotic arms to handle delicate items without damaging them. (Extracted from Robot World, September 1989)

IX. STANDARDIZATION AND LEGISLATION

Standardization

Manufactures approaching product standardization

Computer makers are moving towards standardization of their products. Due to a new method of arranging the inner components of the machines, known as "object-oriented programming", computer procedures are boosting methods for operating computers that they anticipate as becoming the standard. The possible benefits of standardization for users include the fact that it will be easier to change from one computer to another as new technology evolves. Also, it will be easier to see that various pieces of software will work in unison. (Extracted from The Economist, 29 September 1989)

Data base interoperability standards group formed

The SQL Access Group has been formed by hardware and software vendors to develop standards for data base interoperability based on the open Structured Query Language. The group is already working on an interoperability model for the standard SQL and a standard network protocol. It is also working on a call-level application interface to SQL, letting developers write programs accessing data from different data bases. Presently, MIS managers are hindered by a lack of standards. According to A. Werman, President, Data Definition (New York, NY), users are bound to benefit from the work of the many existing standards groups. Sybase, one of the SQL Server pioneers, is not part of the SQL Access Group, and has an interoperability solution available now. (Extracted from Information Week, 16 October 1989)

BSI quests towards systems interaction

Interaction of computer systems from different suppliers may soon be standard according to the British Standards Institute which is conducting a survey to determine UK user requirements for standardization on this topic. It has produced a questionnaire and users are encouraged to fill it in to get as wide a coverage of UK requirements as possible.

A number of actual standards are now specified and there are already products being offered by suppliers which are claimed to conform to those standards. This makes it possible for computer systems from different suppliers to inter-work much more easily than was the case in the past.

However, human users still find that applications they are familiar with, and like, do not run on the various sorts of hardware that they can access.

Alternatively, if the required software is up and running on another system, then, very often, either the user interface is different or the functions do not work in quite the same way.

Although OSI standards are necessary before effective interworking can take place they are not sufficient. Portable applications (with consistent user interfaces and capable of using the same data) are actually required as well.

If a suitable set of interfaces to the computer system could be defined then it could be possible for a software supplier to produce one version of an application that would work on any machine that supported the standard set of interfaces.

If the interface also made the software independent of the data storage method on a particular system, then users could use their old software on new systems, in which case there should be real cost savings to users. (Source: Computing, 31 August 1989)

Standard language for inspection machines

Computer Aided Design International is developing a standard language to more closely link inspection machines to design and quality inspection systems. The Dimensional Measuring Interface Specification (DMIS) would put inspection equipment, including co-ordinate measurement machines and vision systems, in direct communication with CAD systems. Inspection programs could be sent to the dimensional measuring equipment and in turn the inspection findings could be sent back to CAD or quality assurance programs. The American National Standards Institute is seen adopting the latest version of DMIS (2.0) in a number of months. Several manufacturers, including almost all major aerospace and auto producers, are working on DMIS projects and a number are employing DMIS output operations. (Extracted from Metalworking News, 10 September 1989)

New micrographics standards

Two international standards on micrographics have been recently issued in draft form by the International Organization for Standardization (ISO).

The first standard, ISO/DIS 10196, proposes recommendations for the creation of original documents to aid their reproduction as microforms. The second is ISO/DIS 3272-2, Microfilming of technical drawings and other drawing office documents - Part 2: Quality criteria and control of 35 mm silver gelatin microfilms, which deals with legibility requirements of microfilm and is, therefore, more technical than ISO/DIS 10196. This standard is a revision of ISO 3272-2 from 1978. The

other parts are Part 1: Operating procedures and Part 3: Unitized microfilm carriers. The standard will be extended further to include Part 4 dealing with drawings of elongated sizes.

For more information on these and other micrographic standards, contact International Organization for Standardization (ISO), 1-3 rue de Varembé, 1211 Geneva 20, Switzerland. (TP + 41 734 12 40; Telex: 23887). (Source: IS Bulletin, Vol. 20, No. 8, 1989)

Supercomputer hardware standard

The first supercomputer hardware standard will be the High Performance Parallel Interface (HPPI), to be adopted in 1990. The interface is an 800 Mbit/s point-to-point communications link that will facilitate data transfer, improve visualization (using real-time graphics to monitor the supercomputer's operations), and improve disk input/output. Cray and IBM will produce HPPI-compatible hardware in 1990; Ultra Network and Network Systems intend to connect their networks to HPPI interfaces. Proprietary networks in the future may be succeeded by standards-based networks such as HPPI. (Extracted from Electronic Engineering Times, 4 December 1989)

AT&T and Du Pont team up to push a metric connector standard

One of the last bastions of English measurement in electronics - connector technology - is under attack by a powerful duo. Following the lead of the recently adopted IEEE Futurebus Plus standard, which calls for a metric interconnection, AT&T Microelectronics and Du Pont Electronics are pushing a new, high-density interconnection system called Metral as a world standard for telecommunications, data-processing, instrumentation, and industrial markets. The Metral system is based on a 2-mm grid; it provides up to 432 signal positions on a double-high Euroboard - more than twice the 192 positions available with present-generation DIN connectors. AT&T Microelectronics of Berkeley Heights, N.J., and Du Pont Electronics of Wilmington, Del., will jointly develop Metral products, but they will manufacture and market the products separately. (Source: Electronics, November 1989)

Cabling standard gets nearer

A standard allowing local area networks to run over non-proprietary twisted pair telephone cabling is expected to be ratified shortly.

Known as 10Base-T and originating from the US standards body IEEE, the specification will drastically reduce maintenance costs, moving costs and the amount of effort needed to manage networks.

According to a report prepared jointly by research firm Dataquest and builders association BSRIA, there will be more new connections based on 10Base-T than on both Ethernet and thick Ethernet cabling by 1992.

10Base-T (10 Mbits a second bandwidth based on twisted pair cabling) has a star topology, at the centre of which is a wiring hub.

Personal computers connect directly to the hub, thereby negating the need to rip up existing cabling when the computers move within a building.

The star topology provides a central point from which networks can be managed and monitored and to which all maintenance activities are directed.

In addition, using industry-standard twisted pair cabling for data and voice throughout an organization drastically reduces the space required below its floors or above its ceilings. (Extracted from Computer Weekly, 23 November 1989)

Standards

It is a commonly held truth that life in computing would be a great deal easier if there were proper standards governing the way networks, processors and software programs talk to each other, but users often feel as though the whole process is completely out of their hands, despite the fact that it is in their interests that the process moves along rather more quickly than it is apt to do.

There is a rigid mechanism for setting standards, but there is no rule that says users cannot work on independent research that may one day end up as a computing or telecoms standard number.

The official route for research is through the British Standards Institute (BSI), which talks directly to the International Standards Organization (ISO). The BSI is made up of formal members such as the NCC and the Computing Services Association (CSA).

All roads lead to ISO, but the various standards in networking have been established by a number of different bodies. The following list looks at those standards, how well established they have become, and who was originally responsible for them.

X.25

X.25 is a generic family of standards that govern networking, particularly packet switching networks. It is usually associated with wide area networks and with communication between local area networks, and concerns how data is transmitted around a network. It is a well-defined standard that has been taken up extensively by manufacturers who want to make networks talk to each other, and was originally specified by the CCITT (Comité Consultatif Internationale de Télégraphie et Téléphonie).

X.400

This is another standard that was originally specified by the CCITT and has become well defined and widely used by organizations and manufacturers, including British Telecom. It was first ratified in 1984, then revised in 1988. X.400 is concerned with electronic messaging, including processes such as message handling, encryption, security, header formats and transmission protocols. Messages created for facsimile and telex services can be handled by systems written around X.400.

X.500

This is a standard that is eagerly awaited by users who have systems based on X.400 messaging. It is another CCITT set of recommendations and it governs international standards for directories and addresses.

Having a straightforward standard addressing system will make inter-system/inter-computer

communications easier, in the same way that standards for international dialling have made placing telephone calls abroad far simpler than it used to be. The standard and technology behind X.500 are stable, and it should begin to be included in electronic messaging products soon.

LU6.2

LU6.2 is a proprietary standard for transaction processing designed by IBM. The company announced LU6.2 and its place in its overall networking system SNA in 1984. It is part of APPC, another IBM standard for program-to-program communications.

The theory is that when all components on a network have APPC-based programs running on them, transparent peer-to-peer communication will be possible. Work is progressing at ISO to come up with a similar capability for all systems.

There is no formal route for affecting IBM's standards-making process, although the company is made aware of the needs of user organizations through the IBM Computer Users Association (CUA) and the PC User Group.

TCP/IP

Transmission Control Protocol/Internet Protocol (TCP/IP) was originally a US military communications protocol, which suppliers had to adhere to if they tendered for US military business. But it has also become a de facto standard for suppliers who make Ethernet and Unix based systems.

Like all de facto standards, TCP/IP is criticized for being far too open to interpretation, and is generally held to be an interim solution to a problem that will be formally solved by proper standards ratified by ISO.

802.3

Ethernet was a forerunner of 802.3, and has become a generic name for the standard. But it is only one trademarked versionof 802.3. 802.3 includes the CSMA/CD (Carrier Sense, Multiple Access with Collision Detection) access protocol, digital signalling and (mainly) coaxial cabling.

802.3 is a broadband bus networking system, which means all the devices on the LAN listen at once for messages. The CSMA/C protocol means that when a device sends a message it listens to check if there has been a collision between its message and any other. If there has been, it sends the message again. Carrier Sense means that it listens first to see if there is a clear path for its message. 802.3 is one of the most widely used networking standards, especially by users of Novell, 3Com and DEC equipment.

X Windows

X Windows is a standard that governs user interfaces on workstations and the way in which data is represented and organized on networks. It was developed by a consortium of suppliers including Digital Equipment, Hewlett-Packard, Sun and IBM, but was originally based on university research.

Steve Price of the NCC believes that the standard may be submitted to ISO, but adds that ISO has a competitive standard of its own called Terminal Management (TM) that could supersede X Windows.

The IEEE 802 committee on LAN standards specified different types of LAN. The three most relevant are 802.3, 802.4 and 802.5. These specify access protocols and interface circuitry between workstations and networks.

802.4

This is a standard that covers two protocols, broadband bus and broadband token bus. Broadband networking systems can split a bandwidth into multiple transmission paths, so that multiple concurrent communications can be transmitted.

Token bus describes the way in which messages are moved from one user to another. Whenever the token is not being used, a device may claim it and mark it busy. 802.4 is usually used in industrial applications.

802.5

Most industry watchers predict that this LAN standard, otherwise known as Token Ring, will prevail in the 1990s and beyond. Although the first Token Ring network was invented in 1969, the technology was given a formal boost by IBM, which has adapted it as its main PC LAN standard. The advantage of Token Ring is that it is capable of being faster than Ethernet. Current predictions say that speeds of 100 Mbits per second will soon be commonplace.

FTAM

This is a key ISO standard that governs the transfer of files from and to different systems. It is a mechanism for managing and storing files.

ODA

Office Document Architecture is a new ISO standard that is concerned with the representation of mixed-content structured office documents, from memos to desktop publishing. The documents can include character text, graphics and fax quality images. It will mean that application software written to include the standard will be able to swap documents much more easily. It is a recently ratified standard, but manufacturers are showing some interest in using it.

OSI

The OSI Model is the recommended set of standards generated by ISO. It covers seven layers of computer and computer-related communication. Layer One, Physical, outlines how to design wiring and connectors interfaced to the network. Layer Two, Data Link, covers hardware specifications and device access to the network. Layer Three, Network, covers transmission routing, including error control for X.25 networks.

Layer Four, Transport, handles data flow-control and transmission integrity. Layer Five, Session, controls when and how data transmission starts and ends. Layer Six, Presentation, covers translation of software to and from a universal code set and Layer Seven, Application, governs the user/network interface. All the standards in computing fall into one or more of these layers.

SNA

SNA (System Network Architecture) is IBM's parallel model to ISO's OSI outline. It corresponds

almost layer for layer, although there are differences. IBM supports both SNA and OSI in its hardware and software, but it is the only company that uses SNA as its internal architecture. Some suppliers offer SNA facilities within their products. There is no way of knowing how closely SNA and OSI will move together in the future.

EDI

EDI (Electronic Data Interchange) is an emerging standard that will be used for exchanging standard forms between companies. It will make invoicing and ordering more straightforward. Different market sectors that have set up their own EDI networks, such as the European motor trade and retailing organizations, are working together on making a standard EDI format. That format will include support for X.400, which will mean that EDI will be more widely used than it is now.

GOSIP

This stands for Government OSI Profile. It was developed in close co-operation with suppliers by the Central Computer and Telecommunications Association (CCTA), which is the body that advises government offices on what systems to buy. It is a selection of options and standards that guides users who are thinking about the issues associated with OSI. There are versions of GOSIP for the French, German and US Governments.

There are serious moves afoot to encourage associations which produce such "profiles" of the OSI model to agree international standards and boundaries to stick to. Otherwise, there is a real danger that users in different countries or industries become islands of incompatibility.

TOP

TOP (Technical and Office Protocol) was originally developed by Boeing Computer Services for the office environment of manufacturing companies. It is deliberately closely compatible with MAP, so that manufacturers have a system that can talk to the factory network. There is a European arm of the MAP/TOP user group that has some input in the way the two standards develop.

MAP

MAP (Manufacturing Automation Protocol) was originally defined by General Motors. GM took a profile of the OSI model from top to bottom, then re-engineered it to do particular jobs. For example, the TOP messaging layers were developed to handle manufacturing by robots, rathern than office messaging. MAP is based on 802.4 networking.

Who is who in standard making

ISO

International Standards Organization is a United Nations body based in Geneva, Switzeriand. It is made up of national standards bodies such as Britain's BSI and the American National Standards Institute.

CCITT

Comité Consultatif Internationale de Télégraphie et Téléphonie is another United Nations standards body based in Geneva. It is made up of telecoms administrators and manufacturers and is one arm of ITU (International Telecoms Union). Users cannot get directly involved in CCITT. The DTI is the United Kingdom's official representative on its committees, but British Telecom and Mercury are also involved. The CCITT works on some joint activities with ISO.

IEEE

IEEE (Institute for Electrical and Electronics Engineers) is an international professional organization that develops electrical and electronic standards along with ISO. It is based in the US, and anyone who has the right qualifications and the spare time can contribute.

ECMA

ECMA (European Computer Manufacturers Association) publishes some standards and provides a valuable service for its members by producing interim guides. It is made up of European computer manufacturers.

Various other organizations in the UK may influence international standards. One is ITUSA (IT User Standards Association), another is the NCUF (National Computer Users Forum). Both have direct access to BSI, which can in turn pass on their work to ISO.

Contacts

User groups

Telecoms Managers' Association	0689 75555
Telecoms Users Association	01-883 7229

Industry Associations

The OSI Network Management Forum is an international consortium of IT vendors, service providers and users concerned with open standards. Its world-wide headquarters is in the US, on 0101 201 766 1544; fax number 0101 201 766 5741. UK contacts: Derek Willson of BT, on 01 356 5366; Terry Ward of STC, on 01 368 1234.

Eurosinet is a group of systems and services suppliers concerned with promoting the use of OSI standards over international networks. UK contact: Helen Pringle of Logica, on 01 631 0837.

The Open Token Foundation lobbies to keep Token Ring standards open. UK contact: Nora Cunningham of Madge Networks, on 02 404 5651.

Watchdogs

Oftel	01-353 4020
	01-822 1600
	01-822 1690
British Approvals Board for Telecommunications	0932 222289

Consultants

There are a number of consultancies which specialise in data communications. They include:

Butler Cox	01-831 0101
CMG	01-222 7245
Eosys	02814 5123
Logica	01-637 9111
The National Computing Centre	061-228 6333
The Networking Centre	0442-217611
Octagon	01-636 1991

Reports

You can get reports on the market from sources including:

Frost & Sullivan	01-730 3343
IDC	01-995 8082
Ovum	01-255 2670
The Yankee Group	0923 246512

(Source: Computing Special Report, 21 September 1989)

Legislation

Algorithms patentable

The US Patent & Trademark Office may decide to make algorithms patentable, stopping electronic design automation tool collaboration, and possibly affecting local and wide area network designs, neural network research and other electronics endeavours. Many problem-solving methods derived at universities are being used in commercial package elements. The US Court of Appeals has ruled that a novel algorithm is enough to gain a patent, but only for a particular physical implementation. It is unclear whether universities gaining algorithm patents would use those patents to avoid commercial use of the algorithm or gain money from their use. Logic synthesis algorithms will not be patentable. (Extracted from Electronic Engineering Times, 20 November 1989)

Texas Instruments ends 30 year wait for patent from Japan

Japanese chip manufacturers have awarded Texas Instruments a patent for the integrated circuit the company invented 30 years ago.

The patent, granted to run until 2001, is for the invention of the integrated circuit, a single piece of silicon which has transistors, diodes and resistors connected together. Formerly these components were on individual pieces of silicon wired together. The chip is the basic component of all computers today.

Texas Instruments originally applied for a Japanese patent for the integrated circuit in 1960 but was unsuccessful. (Extracted from Computer Weekly, 30 November 1989)

Unisys steps up copyright pressure

Unisys is writing to all UK members of the European Parliament as part of a campaign to amend a proposed directive on software copyright as pressure grows on the Government to help stall the legislation.

The letter says that unless two sections of the EC Directive on Legal Protection of Software are changed, "fair competition will be restricted and distorted" in the European software and services market and open systems would be crippled.

Unisys has joined forces with the ECIS (European Committee for Interoperable Systems) pressure group, which includes Ashton-Tate, the Federation Against Software Theft (FAST), Lotus, WordPerfect and the British Computer Society.

ECIS opposes the draft directive, because software interfaces would become classed as "ideas" and be copyrightable, and a clause on reverse engineering would make it legal to decode and copy a program's design.

The letter says that interface protection will only benefit large companies and stifle open systems. (Source: Computer Weekly, 30 November 1989)

Firms fall out as copyright goes off menu

The US Copyright Office is cracking down on software companies claiming copyright protection on computer displays in a move that could significantly affect software development.

Previously, the Copyright Office had said a complete software program could be copyrighted. This prompted a massive move by companies to protect their products, especially their user interfaces. But the Office now says some screen displays cannot be copyrighted.

The new copyright status of screen displays could have a major impact on several "look and feel" lawsuits. Some software companies, including Apple, have filed for patent protection for their software. But patents will not protect a product unless courts back up the claim. The US software industry is bracing itself for long and expensive legal actions. (Extracted from Computer, 21 September 1989)

EC piracy plans sail into trouble

The European Community is expected to release a directive on software piracy - despite serious concern within the industry over some of its proposals.

The Federation Against Software Theft, which represents UK software houses, has joined 17 other national software associations to request a number of changes to the draft EC proposals, released earlier this year.

Although most of the associations are backing the EC directive, top of their hit-list is the clause covering who owns a software program.

The EC wants copyright retained by the person who commissions a program, but the trade bodies say copyright belongs to the company which writes the software. (Extracted from Computing, 19 October 1989)

X. RECENT PUBLICATIONS

Risk of software failure highlighted

Urgent action to improve the quality and development of software for safety critical systems has been called for in a recent report published.

Compiled by the Institution of Electrical Engineers and the British Computer Society, Software in Safety-Related Systems stresses the need to reduce the growing risk of a major disaster through software failure. Fully computerized control systems are becoming more prevalent throughout the industrial and commercial world and are the subject of increasing concern.

Among the 15 recommendations made in the report, three major initiatives are called for: establishment of a UK scheme to monitor programmes

in safety systems; setting life-cycle limits for software; a major research programme to be run through the Science and Engineering Research Council.

Risk of software failure in safety systems, such as those which control nuclear plants and modern aircraft, has become a daily reality, according to John Souter, head of sciences at BSI's quality assurance software engineering department. BSI set up a consortium in May to work towards safety software validation. (Source: Electronics Weekly, 25 October 1989)

Connector growth moderate

The European connector market will grow a moderate 4.1 per cent from $2.48 billion to $2.92 billion from 1988 to 1992.

Italy is the fastest growing market and its share of the European market will rise to 7.8 per cent from 6.9 per cent, says a report published by Elsevier Advanced Technology.* A price war is holding back the UK market.

While volume growth will be in double figures, price erosion will limit growth to 4 per cent a year to 1992, says the report. (Source: Electronics Weekly, 25 October, 1989)

Free ASTM publications catalogue available

The 1990 ASTM publications catalogue describes 68 volumes of the Annual Book of ASTM Standards and several hundred ASTM Special Technical Publications, Compilations, Data Series, Manuals, and Standard Adjuncts. ASTM standards and its related technical publications are used worldwide to specify materials, assure quality, integrate production processes, promote trade, and enhance safety.

The catalogue is available free from ASTM Customer Service, 1916 Race Street, Philadelphia, PA 19103, 215/299-5585. (Source: News Release, 7 December 1989)

Planning and programming the introduction of CAD/CAM systems - A reference guide for developing countries

This new UNIDO publication in a systematic way presents the factors that developing countries should consider when deciding to introduce industrial automation technologies in the production processes, mainly in the capital goods industries.

With the advent of the new technology associated with CAD/CAM, the performances of small and medium-sized engineering industries in many developing countries has been remarkably enhanced since the early 1980s. In developing countries, small and medium-scale enterprises have become aware of their technological deficiencies in turning out competitive products with respect to product design, cost and delivery dates.

The publication presents three main topics:

(a) The technological aspects of CAD/CAM with a description of the most advanced computer-aided design and computer-aided manufacturing technologies explaining hardware,software and systems including work-stations, displays, plotters, computers, data bases and networks.

(b) Evaluation of available CAD/CAM systems through a detailed and clear explanation of how to compare systems and suppliers, the ramifications of purchasing turnkey systems, how to determine CAD/CAM needs and how to prepare a financial justification.

(c) Management approach for implementation of CAD/CAM systems, with indications of the changes at the organizational level and applications in solid modelling, group technology, computer-aided process planning, artificial intelligence and personal computers applications of CAD/CAM for the small metal-working industry. The study finally presents a future outlook of CAD/CAM.

This publication will be of interest to production engineers, managers and policy makers and government officials involved in capital goods production.

ARSO-DISNET guide

The ARSO Network of documentation and information system has produced a guide which deals with establishing an information and documentation centre. The guide was developed with the financial support of the International Development Research Centre (IDRC) of Canada and the French Government. It examines how to design and manage an information and documentation centre and looks at the technical aspects of work on standards and related subjects in the Centre. For more information, contact African Regional Organization for Standardization (ARSO), P. O. Box 57363, Nairobi, Kenya.

Newsletters on software for disaster management

The Computers in Relief and Development Newsletter provides information about software for disaster management, response and preparedness. Emergency management-related software is available specifically for emergency planning, event management, resource management and administration of relief personnel. For further information, contact Computers in Relief and Development, 106 Park Road, Loughborough, Leics. LE11 2, United Kingdom.

Implementation guide for electronic data interchange (EDI)

Electronic data interchange (EDI) implementation guide is a concise 100-page guide to EDI and paperless trade. It starts with a chapter for beginners and goes on to explain costs and benefits of EDI, use of standards, applications and recent developments. Additional information is given on the legal aspects of EDI and such concepts as packet switching, OSI, X.400, and EDIFACT are explained in layman's terms. Contact: Euromatics, 68 ave d'Auderghem, B-1040 Brussels, Belgium. (TP + 32 2 736 9715 or 236 0029).

Conference proceedings on new information technology for library and information professionals and educational media specialists

This 480-page conference proceedings contains 64 original contributions covering such topics as library automation, online information retrieval, networks, data base development, CD-ROMs and multimedia systems, hypermedia and information technology. These papers give an historical and current overview of activities and applications in information in South-East Asia and the Pacific region. A subject and author index are included. The Proceedings of the 2nd Pacific Conference on New Information Technology, 29-31 May 1989, Singapore,

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* Profile of the European Connector Industry by Elsevier Advanced Technology at $275 a copy.

were edited by Ching-chih Chen and David Raitt. In the United States and Canada, contact MicroUse Information, 1400 Commonwealth Avenue, West Newton, MA 01265, USA. Elsewhere, contact FID, P.O. Box 90402, 2509 LK The Hague, Netherlands (International Federation for Information and Documentation (FID) Publication no. 676, ISBN 0-93155-06-X). The cost is US$57.50 plus postage.

New Arabic manual

An expanded version of an earlier single-volume edition of an Arabic manual for translators has been made widely available by UNIDO. This three-volume manual is a comprehensive guide to new terminology, covering almost every aspect of international activity from industrial development to international law on drug control - all with special reference to the United Nations.

This expanded version contains basic information that is often difficult to locate in United Nations documentation; provides nomenclature relating to committees, organs and meetings; and includes abbreviations and acronyms that are widely used in English.

The manual is also intended for government officials, scholars and journalists, as well as translators. The cost of the manual which should accompany the order is US$150 and the symbol ID/352(SPEC.), ED/352/Add.1(SPEC.) and ID/352/Add.2(SPEC.) should also be quoted. The manual can be ordered directly from: Documents Unit, UNIDO, P.O. Box 300, A-1400 Vienna, Austria or from United Nations Sales and Publications in Geneva or New York.

National information policies

This survey which reviews the information policies and practices in 17 industrialized countries, with particular reference to scientific and technical information was carried out by the International Federation for Information and Documentation (FID) on behalf of the UNESCO General Information Programme. The policies and practices are presented in a way which makes comparison possible. The 17 countries are Australia, Austria, Canada, Czechoslovakia, Denmark, Federal Republic of Germany, Finland, France, Hungary, Japan, Netherlands, Norway, Poland, Spain, United Kingdom, United States and the USSR. International regional institutions are also included. National information policies: A review of the situation in 17 industrialized countries, with particular reference to scientific and technical information by Michael W. Hill can be ordered from the FID Sales Department, P.O. Box 90402, 2509 LK The Hague, Netherlands (TP +31/70 140671; Fax 1 31 70 834827; Telex 34402 KB GV NL Attn. FID).

Choix et développement d'un système micro-informatique

This is a 247-page guide in French for teachers and managers at small and medium-size firms on how to select microcomputer hardware and software for business applications and how to conduct training in their use.

The International Trade Centre (ITC) has issued this guide free of charge for foreign trade training institutions in developing countries. It is also available to foreign trade training institutions in developed countries at the cost of US$30. Funding for this publication was provided by the Government of Sweden. For more information, contact the International Trade Centre, 54-56 rue de Montbrillant, 1202 Geneva, Switzerland (TP +41 22/730 01 11; TX 289052).

XI. SPECIAL ARTICLE

Computer software policy and development in the People's Republic of China*

by Erik Baark**

One of the important effects of the opening of the People's Republic of China (hereinafter referred to as China) to the international community and market in the 1980s has been the rapid introduction of new information technology. In addition to imports of a number of major computer systems as the COCOM regulations were gradually relaxed during the decade, the country experienced a virtual boom in the diffusion of micro-computers in the early 1980s. A substantial amount of these micro-computers are now produced indigenously, and there has been a growing export of personal computers manufactured in China.

In the process of diffusion of computers, it has become ever more apparent that the lack of adequate software is posing a serious barrier to the effective use of computing power in China. Therefore the Government has placed increasing emphasis on the promotion of software development, both for the domestic and the international market. This paper examines the software sector in China and the software policies adopted during the last decade. In addition, it looks at Chinese software exports. Finally, the specific problems posed by a lack of legal protection for software in China, the difficulties of processing the Chinese script, and the weak professional and technical infrastructure is discussed.

China's software sector

In the mid-1980s there were 216 enterprises engaged in computer information processing services. Approximately one third of these enterprises only provided information processing services, while the majority were in other lines of business as well, such as marketing computers and software or delivering training. In fact, the income from technical services constituted only 12 per cent of total turnover in the sector. The companies employed more than 4,000 software technicians.

The sector is dominated by four large corporations, all based in Beijing but with a wide network of subsidiary companies in other regions of China. They are:

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* This paper is a revised version of an article entitled "China's Software Industry" which is forthcoming in Information Technology for Development. I am grateful to Robert Sware, Richard Conroy, and Liu Suying for providing me with important background material.

** Professor Baark is with the Institute of Social Sciences, Technical University of Denmark, Lyngby, Denmark.

- China Computer Technology Service Corporation (Zhongguo jisuan jishu fuwu gongsi). This corporation was established in 1980 for the purpose of providing maintenance service, systems design, installation and training for domestic and foreign computers. By 1986 the Corporation had established 42 subsidiaries and 14 training centres, earning ¥ 135 million ($US 36 million) annually.

- Stone Corporation (Sitong jituan gongsi), an entrepreneurial firm set up in 1984 by scientists from the Chinese Academy of Sciences. Through the marketing of micro-computers, peripheral equipment and specialized software, this corporation quickly managed to become one of the largest and most profitable firms in the emerging high-technology business of China, earning ¥ 106 million ($US 28 million) in 1986.

- China Software Technology Corporation (Zhongguo ruanjian jishu gongsi). Established in 1982, this corporation includes 32 subsidiaries and achieved a turnover of almost ¥ 20 million ($US 5.33 million) in 1986. The Corporation is targeting both the domestic and the international market for new software and services, and apparently was the largest State-run software company in China in 1989.

- China Computer Systems Engineering Corporation (Zhongguo jisuanji xitong gongcheng gongsi). This Corporation, created by the Ministry of Electronics in 1984 on the basis of a large number of research institutes and factories in China, primarily undertakes systems engineering projects for large enterprises and public organizations. Approximately a third of the units participating in this corporation are research institutes, less than a quarter are enterprises, while the rest are regional branch units. Altogether these units are said to represent a staff of 60,000 people, a third of which are scientists and technicians.

With the exception of the Stone Corporation, these firms are still heavily influenced by the State authorities, in spite of their formal status as semi-private ventures. For this reason, they tend to lack entrepreneurial and commercial incentives, often becoming what the Chinese term "portfolio" companies. This has left the rapidly expanding market for hardware, software and training services open to more business-oriented firms such as the Stone Corporation and other start-up companies in high-technology areas such as the "Electronics Street" in the Zhongguancun area in Beijing.

A major problem is that although these new entrepreneurs have targeted the large information technology market with considerable success in recent years, they tend to lack the technological resources available to the somewhat lethargic State-supported corporations. A similar weakness characterizes data processing services. At the end of the 1970s, it was decided to establish a range of computer services centres at the provincial and municipal level. It is generally recognized, however, that these computer centres have failed to provide services to users beyond a limited community of scientists.

The Chinese software sector thus tends to be dominated by State-run research institutes and their technology development companies. 1/ In contrast to the West, where large private firms supply both computer systems and applications software, Chinese users usually look in vain for such packages from domestic computer manufacturers. Some manufacturers even regard the diversification into computer services, maintenance, training, etc. as a burden on their "normal" business (Chen Liwei, 1985, p. 59).

It has been estimated that for the rest of this century, the Chinese computer information service industry could grow by 20 per cent annually. With this growth rate, it is projected that the ratio between the production value of the information service industry and the computer industry will be 1:5-8 in 1990 and reach 1:2-3 by the year 2000 (Gong Bingzhen, 1988). 2/ At the same time, the sector is expected to undergo a structural transformation from the current emphasis on marketing, training and installation service to an increasing share of software and information services, as indicated in table 1 (see page 56).

This growth and structural transformation would, in Gong Bingzhen's view, require the Chinese government to increase investment in the sector, for instance by linking the allocation of funds for development of the sector to investment in computer manufacturing. Gong Bingzhen suggests that one fifth or more of the investment in the national computer industry should be reserved for the development of software and services. Moreover, he suggests that such measures as tax relief and special funds for the development of the sector should be introduced. Finally, the Government should set new prices for the products delivered by the information service firms.

More concrete projections referring specifically to the software sector are made by Jia Yaoling (1989). He suggests that China could have as many as 100 firms specializing in software development and production by 1995. Their combined annual turnover would amount to ¥ 1 billion ($US 266 million), earning $US 50 million on exports - a tenfold increase in export value over a five-year period. This scenario would also require continued official support, in particular the promulgation of regulations providing legal protection.

The software market: diffusion of computers and applications

An accurate picture of the diffusion of computers in various sectors in China is difficult to establish since available statistics are often contradictory. Table 2 (see page 56), based on national surveys conducted by the Chinese Association of Computer Users, indicates an important change that has taken place since the early 1980s. In 1982 almost 60 per cent of China's computer stock was installed at research institutes, universities and colleges. In 1986, these institutions accounted for 43.9 per cent, while public administration had raised its share to more than 30 per cent.

It is noteworthy that industrial enterprises apparently still accounted for less than a third of computer installations in 1986. Most likely these installations were also rather small systems (mini- or micro-computer systems), since most enterprises in China cannot afford to purchase large systems. There are regional disparities, however, and

statistics from major industrial centres such as Shanghai city and Liaoning province indicate that the industrial sector raised its share from 15 to 36 per cent of the total installed base during the same period.

A report from 1988 indicates that the trend has been somewhat reversed, so that "of the total number of computers in China, 30 per cent are used for industrial operation control" ("Computer Industry ...", 1988). Nevertheless, major computer resources continue to be concentrated within sectors of research, higher education and State administration. The relatively low rate of diffusion of computers in the industrial sector may pose a long-term structural problem.

One aspect which must be considered in connection with these figures concerning diffusion of computers in China is the low rate of utilization that is a distinctive feature of Chinese computer installations. The rate has been estimated at 20 to 30 per cent, and it appears extremely difficult to raise this figure. 3/ This under-utilization of equipment implies that an investment worth ¥ 25 billion ($US 6.6 billion) has been wasted ("Computer Industry ...", 1988).

In the mid-1980s the emphasis on software production generated a rapid growth in production of new items. The results of the process can be gleaned from table 3 (see page 56) which shows that - at least in quantatitive terms - a larger selection of software became available during 1985-1986.

By 1986 the authorities made a survey which apparently resulted in the registration of more than 20,000 items of software applications. A few thousand were selected for the first National Exhibition of Computer Application Results, held in Beijing in June 1986.

The diagram in figure 1 (see page 56), prepared on the basis of the exhibition catalogue, indicates the importance of applications developed for industrial sectors. 4/ Generally such software is developed by organizations subordinate to an industrial ministry. A relatively limited amount of general applications packages are developed for service and administration, although items listed under industry occasionally cover management information systems (accounting, etc.) developed for a specific line of business. Thus, in spite of the substantial share of computer installations in administrative departments, as indicated in table 2, there appears to be a lack of applications software for this sector.

The domestic market for computer software is thus composed of two major parts. On the one hand, there is a core demand for major systems designed around large computers, the development of which is usually commissioned on non-commercial terms. Whatever "market" there exists for such systems is highly monopolistic. On the other hand, the rapid diffusion of micro-computers in China has led to a large potential demand for general-purpose software and standard applications. 5/ This market is highly competitive and constrained by poor quality of products, lack of commercial marketing outlets, and the weak protection offered by the legal system. In spite of the apparent concern of policy-makers for increased commercialization of software in China, little progress seems to have been made so far.

For example, the Chinese market for computer networks is seen by some commentators as a particularly promising area. There is a substantial market for micro-computer networks (of the LAN-type) at the large and medium-sized enterprises which have already installed many micro-computers. Only during the last five years have some software companies offered services in this important market. The domestic computer manufacturing companies have largely ignored the potential market for networking packages ("An analysis of ...", 1989).

For several years the formulation of large plans for the establishment of specialized information systems have been fashionable in China. Major cities, such as Shanghai, have already drawn up programmes for the development of specialized systems, while Beijing and Tianjin cities are planning to introduce similar systems within the municipal area. It is envisaged that such systems will develop towards inter-city links. The weak telecommunications infrastructure in China has been, and continues to be, a major constraint for the development of such integration at the inter-city level or at the national level. Shanghai has taken steps to introduce advanced digital communications in the city, but the high costs of such systems have held back large investments in this area. The development of software for networks and large information systems is usually undertaken on a contract basis by the major State-operated corporations or directly by research institutions. Although the Government has increasingly invited tenders for such projects, this use of market forces has hardly managed to bring about the commercial exchange of software that has been a priority lately.

Computer software policy in the 1980s

During the period from the 1950s, when China initiated indigenous development and production of electronic computers, to the end of the 1970s, when equipment ranging from mini-computers to super-computers was manufactured in China, very little effort was spent on the development of new software. The emphasis was placed instead on production of computer hardware. Chinese computer manufacturers developed the most essential operating systems software and adopted a few language compilers for languages such as FORTRAN, PL/I, and APL. Applications programs were predominantly developed by scientists and stressed numerical and scientific problems.

The early 1980s witnessed a significant shift in policy as the leadership turned its attention from the production of mainframes and mini-computers to the diffusion of micro-computers. Available statistics suggest that in 1980 there were only 600 micro-computers and some 2,900 larger computers installed in China. In 1985 the relative shares had changed considerably, so that official figures listed 130,000 micro-computers and 7,000 larger installations. More recent figures from 1987 indicate that the installed computer base comprises 8,824 mainframe and mini-computers plus 275,000 micro-computers.

The vast majority of these micro-computers were imported from the United States, Japan and Europe, or assembled in China on the basis of imported kits. Nevertheless, official figures suggest that an increasing number of micro-computers are designed by Chinese manufacturers and include a significant number of components produced in China. There are 150 computer manufacturers in China at present, producing 396 mainframe and mini-computers and 59,000 micro-computers annually. The output value of this industry exceeded ¥ 2 billion ($US 533 million) 6/ in 1987 ("Computer Industry ...", 1989, p. 5).

A number of other important changes in policy took place simultaneously with the shift in emphasis from large computers to micro-computers. First, peripherals and complete computer systems - rather than exclusively the central processor - were identified as a crucial link in production of new systems. Secondly, the emphasis on hardware was supplanted with a stronger support to software and applications. Thirdly, the policy guidelines stressed that the expansion of computer services might play a leading role in the diffusion of computers (Chen Liwei, 1985, p. 60).

A turning-point came when a new emphasis on software development was included in the Sixth Five-Year Plan (1980-1985). 7/ In this plan a key national project with the topic "Research and Development of Computer Software" was allocated a budget of ¥ 8 million ($US 2.13 billion) (China Electronic Yearbook 1986, pp. iii-67). In 1982 the establishment of a national computer software sector was endorsed by Premier Zhao Ziyang in an official policy statement, thus providing instrumental support to the sector. Subsequently 47 research and development projects were completed under the plan. In addition, thousands of applications were allegedly created during this period. These results fostered a wider recognition of the importance of software by national policy-makers (Zhong Xichang, 1986).

The policy change was further reinforced by the establishment of the "State Council Leading Group for the Invigoration of the Electronics Industry" headed by Li Peng (Simon and Rehn, 1986). 8/ Established officially in 1984, this organization has been concerned with setting the priorities for the development of the electronics industry across departments. One of the sub-groups created has been exclusively concerned with applications and software. After providing an initial impetus to the development of the sector, however, the group experienced serious difficulties in co-ordinating the activities of different departments. Nevertheless, the group appears to have been able to influence the priorities of the State Planning Commission so that several software development projects were included under the Seventh Five-Year Plan (1986-1990).

The most important policy-making institution in this sector continues to be the Ministry of Machine-Building and Electronics Industry. 9/ The priorities in the software sector formulated by this organization in the mid-1980s have been to improve the diffusion and application of fourth generation languages and to introduce standard software packages for several fields of activities. In addition, training of software engineers has been given high priority. 10/

During the last five years there has been a broadening of the conceptual framework of China's policy, as the information sector and information technology have become the centre of attention. The introduction of these new concepts is significant inasmuch as it signals an effort to integrate policies regarding the development of computers, software and telecommunications. There is a mutual interrelationship between these sub-sectors which has been largely ignored until now. It is significant, however, that Chinese observers now express concern that the lack of adequate software is inhibiting the diffusion of computers ("Computer Industry ...", 1988), or that the weakness of the telecommunications infrastructure tends to hold back the introduction of office automation systems (Xie Xiren et al. 1989, p. 39).

The current policy for the development of the software sector includes the following components (see Guidelines on ... 1989, Appendix III, pp. 75-79):

- Establish a fully-fledged software industry in two stages:
  - . The first stage should emphasize the commercialization of software products and the introduction of "industrialized" methods of software production;
  - . The second stage should concentrate on the creation of a comprehensive, integrated software industry with modern business management, offering services to the whole society.
- Develop both the domestic and foreign markets for Chinese software, stressing applications in major sectors of the Chinese economy and international competitiveness abroad.
- Make a rational selection of products and technologies for a concentrated effort on key breakthrough projects, e.g.:
  - . Applications software for micro-computers and for large national information systems;
  - . Chinese language processing, networks, graphics and data base management systems;
  - . Systems software for micro- and mini-computers (operating systems, high-level languages);
  - . Software engineering: development tools, standards, software management and quality assurance technology.
- Promote research and technological innovation.
- Strengthen the management of the industry and introduce an appropriate legal framework.
- Adopt special measures for the promotion of the software industry, such as tax reliefs, full retention of export earnings, special funds for development and easier conditions for travel abroad.
- Speed up manpower training.

The overview presented above indicates that the Chinese software sector has achieved a substantial expansion under a period of increasing official support in the 1980s. The structure of the industry is rather weak however, and its resources are inhibited by barriers of both a technical and human nature. In my view, one of the main issues to be faced in the immediate future is how to develop the international marketing for Chinese software so that the industry's products will be commercialized, and so that the industry does not have to continue to rely on large projects allocated in the various five-year plans. Other issues include solving the problem of Chinese language input and processing and the introduction of more advanced software engineering and systems analysis techniques.

Exports of Chinese software

Chinese software producers have in the past adopted a strategy of technical and economic

co-operation to facilitate exports of software and services. One example of this was the announcement in 1988 of a joint venture with a total investment of ¥ 4 million, the Shanghai Venus Software Company Limited. The venture involves three Chinese organizations and eight Japanese companies, and appears to be aimed at developing products for the Japanese market ("Software Company", 1988). It was announced recently that the China Computer Technical Service Company has entered into a contract with the Japan Electric Company to export Chinese software to Japan, where the market is expanding rapidly ("Japan Imports ...", 1989).

Other computer software exports announced include more specific systems, for example a package with a five-stroke Chinese character input technology which was apparently purchased by Digital Electronic Corporation (US). A micro-computer-based typesetting system for simplified Chinese characters has been offered on the East Asian markets by the China Printing Science and Technology Research Institute. By mid-1987, this system had reportedly been sold in the domestic market for an amount of ¥ 1 million, while sales agreements totalling $US 100,000 had been concluded ("Chinese Software ...", 1987).

During the period 1982-86, income from software exports allegedly amounted to more than $US 5 million. Qinghua University, one of the leading centres of software research, developed software for both firms in the US and in Japan. The export of such services provided badly needed foreign currency earnings to a total of $US 1.8 million (Cheng Jun, 1987). In addition, Qinghua was able to get an additional income of $US 1 million on the exports of software services during the first five months of 1986. Shanghai city, another centre of computer development in China, was apparently also able to earn more than $US 1 million through software exports before 1986.

A study of software exports from the Beijing region revealed that as much as 80 per cent of the software products were sold on a commission basis (Yin and Yu, 1988). This implied a loss of potential revenue by at least half of what could have been earned through direct sales. Nevertheless, supplying software to international customers was an extremely lucrative business. The study indicated that an income of $US 2.5 million had been generated from software which amounted to 11 per cent of items sold domestically, for which an income of a mere ¥ 250,000 had been generated. In other words, for each man-year involved $US 7,630 was generated in foreign currency, while the necessary investments had been a neglible ¥ 550 per man year.

An important component of the Chinese policy to create an internationally competitive software industry has been to send personnel to work in foreign firms. The Chinese have also considered this an aspect of exports, since the hiring out of Chinese personnel, more than 1,000 programmers in recent years, has generated other sources of foreign currency revenue. In spite of the apparent shortage of software engineers in China, many organizations have been eager to offer qualified staff at a low cost to foreign software houses.

Although these exports indicate the new capabilities of the Chinese software industry, most software packages sold abroad relate to the processing of Chinese script, which is a rather specialized market. The survey mentioned above also indicated that 70 per cent of the software programs exported had a size of fewer than 20,000 code lines, while at least 80 per cent took less than four man-years to develop (Yin and Yu, 1988). In other words, most of the work which the Chinese undertake for foreign firms on a commissioned basis remain small adaptations or modules. The capability to develop and sell larger software packages abroad have not been promoted significantly through this effort. Sub-contracting services and the "export" of manpower is also a somewhat limited market, although it is clearly an important entry point for the internationalization of Chinese software. A major drawback is the requirements of marketing, documentation and after-sales service at the international market, which may prevent Chinese software producers from capturing a significant share of important markets in data base management packages, graphics, or network design.

It has been argued however that China may have a comparative advantage in exports of systems software, since rather large groups of programmers were collected in past efforts to equip the indigenous Chinese computer systems with basic software (Jiang et al., 1988). The Joint Design Group for the development of systems software for two major Chinese computer series (the 16-bit mini-computers known as DJS 100 and the 32-bit medium-sized computers of series DJS 200) collectively represent important qualifications, which could be utilized in exports under the right conditions.

Legal protection for software: an inadquate framework

A frequent complaint from Chinese and foreign observers is the lack of legal protection for software in China. A recent analysis (Fakes, 1989) has shown that Chinese laws and regulations concerning foreign trade and licences currently provide inadequate protection of foreign software in China. The Chinese strategy has been to provide contractual protection on licences of software for a limited period of time, and to simultaneously pursue a policy of software technology assimilation, i.e., the copying and widespread diffusion of software without permission. 11/ Arthur Fakes concludes his analysis with the following words:

> "China has yet to learn that seizing the property of foreigners does not encourage them to offer help. China is only now beginning to learn that its political actions can decrease trade and the variety and number of technology acquisitions. In respect to software, China could encourage foreign help in reaching its goal by enacting legal protections against: (1) the unauthorized reproduction and distribution of software and (2) the misappropriation of software trade secrets by any party." (Fakes, p. 292)

In order to expedite the enactment of the Chinese Copyright Law, it was decided to exclude protection of software author's rights (Gao Hang, 1988). It is envisaged that separate legislation will be drawn up concerning the protection of software. There has also been a long debate whether Chinese computer software should be provided with protection under the Patent Law, but most people agree that this law is not a suitable framework. 12/

Meanwhile the copying of computer software inside China is at least as serious a problem as the approach to international software markets that draws the severe criticism of Arthur Fakes and most foreign firms. A lack of legal protection for domestic producers of software have virtually removed the incentives to engage in the development and commercial marketing of software. This state of affairs has characterized both micro-computer software and packages developed on larger systems.

Many research units have experienced that only a few dozen copies of new software packages will be sold, even if several hundred copies are known to be used. 13/

Consequently, the income from software and systems development in China is generally low by domestic and international standards. Standard micro-computer software packages are sold within a price range of ¥ 50 to 250. Dedicated applications software developed for large mainframe computer systems, such as a management information sysiem for enterprises, are produced under contract for a sum in the range of ¥ 50 to 100,000. This price is barely sufficient to recover the cost of a team of qualified technicians and use of computer facilities. These conditions reinforce the reluctance of computer manufacturers to engage in software development. For example, the Keli High Technology Corporation, a profitable computer production and marketing firm in Beijing, has consciously avoided undertaking software development and sales, allegedly because they cannot afford to make losses. 14/

The Chinese language

The difficulties of processing the Chinese script on computers have continued to be a major stumbling-block for the diffusion of computers and software, particularly in the administrative sector. After a few years of experimentation in the late 1970s, a series of national standards was promulgated for the coding of Chinese characters (Dai Zhaokang, 1989, p. 7). Research and development projects in the early 1980s produced a Chinese version of the MD-DOS operating system (CC-DOS) and of the UNIX operating systems kernel, which are now able to process Chinese characters. In addition, new versions of a few general application packages for word processing, data base management and spreadsheets have been developed to cope with Chinese characters. Other research and development projects are in the process of providing reasonably functional protocols for data communication, involving Chinese characters, and the technical problems of producing output have also been largely solved.

The key outstanding problem is to find a convenient and fast method of input. Hundreds of different input methods emphasizing various modes of entry (keyboard, pen, etc.), various components of the Chinese characters or their pronunciation have been developed over the years. Some have been filed for patents and others have become accepted as "standard" input methods for popular operating systems such as the CC-DOS. Nevertheless, so far no method has achieved the versatility and relative convenience of the ASCII keyboard.

Zhou Zhinong of the China Software Technology Corporation has distinguished between four generations of Chinese character processing software. The first generation is based on entering a single character. The second generation of software will be able to quickly enter Chinese words, which are mostly composed of multiple characters. The third generation is based on intelligent voice recognition and will be able to enter text on the basis of sentences. The fourth generation would use artificial intelligence and enter text based on its meaning (Zhou Zhinong, 1989, p. 13).

The vast majority of character input software available in China today belong to the first generation. A few systems, including the "Natural Number Chinese Character Input System (Ziran ma hanzi shuru xitong)" developed by Zhou Zhinong himself, belong to the second generation, while there is now a considerable amount of research in the area of voice recognition and artificial intelligence in order to develop third and fourth generation systems. It may take a decade before third and fourth generation systems become generally available in China. But even the transition to second generation systems will mean a major advance since the number of entry mistakes will be reduced significantly.

Professional and technical infrastructure

According to an official from the Computer Bureau, Ministry of Electronic Industry, by 1984 only 10,000 of the 80,000 employees of the computer industry were engaged in services (Chen Liwei, 1985, p. 59). These people were working in about 60 computer service units in China. In many Chinese articles, these figures were used to argue that China had a ratio of 1:7 among software and hardware personnel in the computer sector, while the US was seen to have a ratio of 4:1 among these groups.

More recent reports have estimated that between 30,000 and 40,000 people are engaged in software development in China. 15/ Approximately one third of this corps of software personnel were based in Beijing. These new figures provide a ratio of 1:2 among software and hardware personnel in the Chinese computer industry proportions which are still far from the US pattern.

Moreover, statistics compiled by the China Computer Society have indicated an annual capacity for training 18,000 people at educational and research institutions. A delegation of international computer professionals which visited China in May 1987 offered the following conclusion:

> "Computer science education has progressed rapidly in the past several years in China's top universities and research institutes. This progress must be attributed in part to the official recognition of computer science as a scientific discipline with the formation of the Chinese Computer Federation in the mid-1980s, and the subsequent expansion of government support for new educational programmes, facilities and research."
> (Wilson et al., 1988, p. 963)

The delegation noted, however, that the growth in computer education and research continues to be hindered by the absence of adequate hardware and reliable software. In addition, the need to master English in order to use textbooks and practice programming skills was seen as a major problem for the students, while the isolation from the international research community constituted a significant impediment to faculty.

Several methods have been applied to ensure widespread training of software professionals. Apart from the university sector, it has been estimated that an additional annual contigent of 80,000 people could be trained in computer applications by the industrial ministries (Cheng Jun, 1987). China is also sending many software engineers abroad for employment or training in Western computer or software companies, hoping that they may learn more advanced methods. However, the general feeling in China is that there is a fundamental gap between the number of people trained in information technology and services and the actual requirements. It has been estimated that from a base of 15,000 professional staff in the information service industry in 1985, the contingent needs to be raised to 100,000 in 1990, to 250,000 in 1995 and finally reach 500,000 people in the year 2000 (Gong Bingzhen, 1988, p. 211).

These software professionals would also need access to an infrastructure of modern hardware and productivity tools. The access to hardware has been gradually upgraded during the 1980s, in particular due to the equipment installed in key universities as part of a World Bank project. In addition, substantial efforts have been spent on the indigenous development of advanced software engineering tools. In 1987 China announced its first experimental automatic software production system. This system was a key national project under the Seventh Five-Year Plan and was developed by a group of Ph.D. students at the Computer Department of Nanjing University under the supervision of Prof. Xu Jiafu, a well-known computer expert. After two years of theoretical research and practical development work this group had completed a system which was able to automatically write programs from conceptual diagrams, provide automatic validation and testing procedures, etc. ("China's first ...", 1987). A recent announcement of the development of a system for automatic design of algorithms (NDADAS) for a Sun workstation by this group indicates that technical capabilities have also been created.

International collaboration constitutes another important component of the strategy to improve computer software engineering methods. For example, a national project entitled "Integrated Software Engineering Environment (ISEE)", led by the China Software Technology Development Centre jointly with 10 universities and academic research institutes, included a major effort by US researchers to introduce software engineering techniques in China. This project was initiated in 1984, and results were presented at a conference in Beijing in 1986 (see Zhong Xichang et al., 1986).

Another important initiative undertaken to introduce and develop software engineering methods is the proposed International Institute for Software Technology, which is envisaged to be set up as a United Nations University Research and Training Centre in Macao. This centre is expected to become engaged in the development of application software development tools, project management methods, distributed system software, and applications in selected fields.

Table 1

Projected annual turnover and structure of China's computer information sector, 1990-2000
(million US dollars)

	1990	1995	2000
Computer industry	1,200	3,000	8,000
Information services industry	200	750	2,600
of which:			
- Information service	10%	15%	20%
- Software service	10-15%	20%	25%
- Specialized service	45-50%	35-40%	30%
- Systems service	25-30%	30%	25%

Source: Adapted from Gong Bingzhen (1988), p. 211. Estimated turnover in US dollars represent mean values of Gong Bingzhen's projections, using the exchange rate 100 dollars = ¥ 375.

Table 2

Sectoral shares of computer installations in China, 1982 and 1986
(in per cent)

Sector	1982	1986
Research institutes	39.7	31.5
Industrial enterprises	28.5	25.7
Administration	13.2	30.4
Universities and colleges	18.6	12.4

Source: China Electronics Yearbook (in Chinese) 1986, p. iii-72.

Table 3

Production of applications and integrated systems, 1984-1986
(No. of items)

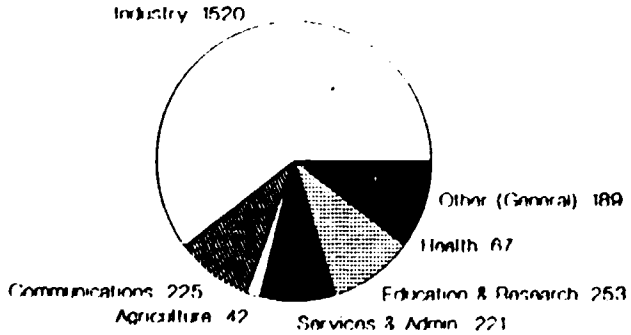
	1984	1985	1986
Applications software	290	2,878	11,066
Integrated systems	26	221	38

Note: Network systems increased and CAD systems declined in the category of integrated systems.

Source: China Electronics Yearbook (in Chinese) 1986, p. iii-61 and 72.

Figure 1

Computer software: Main application areas



Source: National Exhibition Catalogue, 1986.

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Zhou Zhinong "The Development of Entry Techniques of Chinese Character Codes (Hanzi bianma shuru jishu de fazhan)" China Computerworld (Jisuanji shijie), 19 September 1989, p. 13.

Notes

1/ The Joint Institute of Information High Technology established in Spring 1989 by the computer departments at seven universities and three civilian and military institutes from nearly all regions of China is a typical manifestation of this point. This new institute is collectively owned and features 350 technical personnel, which are involved in a broad range of applications systems engineering. See "Information High-technology ..." (1989).

2/ Gong Bingzhen is employed at the Computer Systems Engineering Institute of the Ministry of Machine-Building and Electronics Industry. When interviewed in Beijing in 1986, he was also Vice-Director of the China Systems Engineering Corporation, so one can assume that his projections are optimistic.

3/ The most recent figure, 20-30 per cent, is provided in "Computer Industry ...", 1988. The Chinese sources have never explained how they arrived at this figure, nor tried to define what it stands for: Are 75 per cent of computer installations in China out of order at any given time, or is the installed base only utilized 25 per cent of the time?

4/ The diagram does not include items which were developed for defence-related applications (including space and aerospace), for which a separate catalogue was published. It is, of course, very difficult to get a clear picture of the production of, and demand for, software in these important sectors.

5/ The high rate of diffusion of microcomputers in the mid-1980s led to an installed base of almost 300,000 microcomputers in China. However, this market has stagnated during the last couple of years. A study of 26 major computer producers showed that the income of the industry had gone up 25.64 per cent from 1987 to 1988, but profits dropped by 7 per cent. The reasons appear to be competition from imported equipment and higher costs of production and marketing ("The Computer Information ...", 1989).

6/ Dollar equivalent calculated according to a 1989 exchange rate of approximately $US 100 = Y 375, which will be applied throughout this paper.

7/ The crucial significance of this event was stressed by Hao Chunmin, Deputy Director of the China Software Technology Development Centre, in an interview in Beijing in Autumn 1986.

8/ Li Peng has apparently become even more influential since the recent political conflicts in China, occupying the important administrative post of Premier. Together with the newly elected General Secretary of the Chinese Communist Party, Jiang Zemin, who has been a key figure in Shanghai's high-tech modernization during the 1980s, he appears to ensure the continued priority of computer and software development.

9/ This Ministry was formed by merging the Ministry of Electronics Industry and the State Machine-Building Industry Commission in March 1988. The purpose was to promote the integration of electronic and mechanical engineering. Bureaucratic inertia may, however, impede this process; see Simon 1988.

10/ Interview with an official of the Computer Industry Bureau at the Ministry of Electronics Industry, Autumn 1986.

11/ Arthur Fawkes (1989) discusses the potential protection offered under four relevant legal documents that have become effective since 1985: the United Nations Convention on Contracts for the International Sale of Goods, the Foreign Economic Contract Law, the Regulations on Administration of Technology Import Contracts, and the General Principles of Civil Law.

12/ To my knowledge, there have been few concrete initiatives to protect software, in spite of the urgency of the matter. Foreign firms have also been concerned with the problem, and a conference was recently convened in the United States to propose new measures.

13/ Interview with a researcher at the Computing Centre of the Chinese Academy of Sciences in Beijing, Spring 1987.

14/ Interview in Beijing, Spring 1987.

15/ Within a span of two years, various sources have provided widely different estimates. The figure 30,000 is cited in "Computer applications ..." (1988), while "Software firms ..." (1989) indicates that "China has around 35,000 people involved in software development." Yin Zhihe et al (1988) claims that 40,000 people are working on software. To add to the confusion, no source provides a more detailed breakdown of this aggregate figure.

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03		International non governmental organization	14		Bank or financial institution	25		Information centre
04		UNIDO National Committee	15		Industrial enterprise	26		Publisher
05		Embassy or Mission to UNIDO	16		Public utility	27		Bookseller
06		Government body for development aid	17		Trading concern	28		News agency/press
07		Ministry for industry	18		Engineering organization	29		Radio and television
08		Other governmental department	19		Consultant			
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11		Manufacturers' association	22		Industrial training or productivity centre			

F FIELD OF INTEREST. Check the appropriate box(es) which reflect your *main* field(s) of interest

		MANUFACTURING INDUSTRIES - PLANTS, PROCESSES AND PRODUCTS
001		Food processing
002		Beverages
003		Tobacco
004		Textile and garment
005		Leather
006		Wood processing
007		Pulp and paper
008		Petrochemical and plastics
009		Industrial chemicals and fertilizers
010		Pharmaceuticals and other chemical products
011		Rubber
012		Non-metallic mineral products and building materials
013		Iron and steel
014		Non ferrous metal
015		Fabricated metal products
016		Machinery
017		Electrical machinery
018		Transport equipment
019		Precision instruments
020		Agricultural machinery
		NON MANUFACTURING INDUSTRIES AND PROJECTS
021		Mining and quarrying
022		Utilities (including power plants)
023		Public services (transport, communications, tourism)
024		Construction (civil engineering) projects
		SUPPORTING INDUSTRIAL ACTIVITIES
025		Industrial planning and programming
026		Industrial policies
027		Industrial financing and investment promotion
028		Promotion of export oriented industries
029		Industrial development surveys
030		Industrial legislation
031		Industrial property
032		Transfer of technology (licensing)
033		Industrial research and development
034		Standardization
03b		Industrial organization and administration
036		Industrial co-operatives
037		Industrial information and documentation
038		Industrial promotion
039		Industrial training
040		Industrial management
041		Industrial consulting services
042		Development of small scale industries
043		Industrial estates
044		Appropriate technology

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