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EMERGING TECHNOLOGY SERIES

2/1996

Information Technology

UNITED NATIONS
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EMERGING TECHNOLOGY SERIES

INFORMATION TECHNOLOGY 2/1996

CONTENTS

UNIDO's *Emerging Technology Series* is established as a mechanism of current awareness to monitor developments in the microelectronics sector and inform governments, industry and academia, primarily in developing countries.

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TO OUR READERS

This issue of **Information Technology** brings a special article on a comparison of national information policies. It advocates, in conclusion, those policies that "reflect an adequate understanding of current international trends". I can only agree with such a statement. At the same time, however, I would like to stress that those "trends" mean much more than technological and economic ones. In a similar manner to the tax policy of a country, which controls the way the country's economy develops, at the same time providing financial input to the country's budget, information technology policy, apart from influencing domestic and export components of production and application of IT, leads the country to a new age of the Information Society – an age that despite the IT achievements we witness today – hardly even began.

In the last few years, the Internet was launched and went public. Already now, far from its final shape, it has created a new social dimension comparable only to the explosion of television some forty years ago. TV brought a vision of the world into our homes, changing our leisure, the selection of what we buy and how we elect our presidents and public representatives. The Internet will change our lives even more. Forthcoming "electronic money" is just an example. It is difficult to foresee what the IT dominated world will look like, but it will certainly be very different from the contemporary world. The Internet is the first, but not the last component of the change. One should realize that perhaps 99.9999 per cent of information processing machines currently in use all around the world are Von Neuman machines with essentially the same basic design philisophy (the use of the instruction counter) developed for the EDVAC machine in 1948. Those machines, with the instruction counter, are called computers. Recent advances in technology now facilitate different design philisophies, and an emergence of self-organizing machines with capabilities far beyond those of a computer is only a matter of time. The social and economic impact that these machines will perhaps exceed the impact that we experience nowadays through the use of computers.

The above considerations were introduced to justify my opinion that the IT policy of a country should, apart from production/application cues, provide a strong, long-lasting social component aimed at adjusting society to the changes IT is introducing with the increasing acceleration of our lives. Education as a sole remedy for the social impact of IT is not enough. I have a feeling that social adjustment guided by national IT policy should, to the same extent, develop knowledge of IT through education, as render social acceptance of the change IT brings.

Knowledge may be the driving force of the information, but what counts most in competitive manufacturing is accurate information and having it available in the right place at the right time. As competitivity and the complexity of modern industry increase, even small firms need more information processing capacity than their senior management can usually muster. So, whether you are a factory manager, an engineer or company information specialist, or a government planner needing quick, reliable and focused information, today's response almost has to be a database. Some firms design computerized institutional memories from scratch, integrating them with expert systems that also diagnose problems and advise solutions. Depending on the type of information required, others rely on commercial application packages. UNIDO's new **Information Resource Management System (IRMS)** falls into a third group of specialized systems focusing on a wide variety of data and how industry managers use them. The IRMS is generally available to government departments, industrial companies and institutions as an integrated information processing package. It can be tailored to individual needs of the user organization, and is specially designed to operate in decentralized networks. Configured particularly to support the activities of information centres and the information needs of small- and medium-sized firms, the package handles two information types – metadata for general references, and technical data. The software basis is UNESCO's Micro-ISIS, topped up with Pascal programmes for user friendliness. A special formatting language allows data to be prepared in a form usable by other software packages such as expert systems and geographic information systems. Further information can be supplied by Ms. Shadia Bakhait of the Industrial Information Section, Investment and Technology Promotion Division (e-mail: sbakhait@unido.org via the Internet).

Konrad Fialkowski
Scientific Editor

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A. SPECIAL ARTICLE

National Information Technology Policies: An International Comparison

by

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Abstract

Governments all over the world are increasingly seen to be formulating and implementing national information technology policies in order to develop this crucial high technology segment of their economies. Even as the world is moving towards more and more market oriented economic strategies, Governments continue to play the role of a nurturer of industry in many countries. This paper brings together the experiences of countries at varying levels of economic development and investigates the nature of national strategies for IT production as well as application and diffusion. While the paper argues for a nurturing role for the State in terms of formulating and executing IT policies at the national level, it makes explicit the consequences of policies that are oriented primarily towards IT use and those that are production oriented and often detrimental to domestic IT diffusion. Using examples from countries as varied as India, Brazil and Singapore, as well as countries of sub-Saharan Africa and the European Community, the paper cautions against the setting up of highly restrictive, regulatory policy regimes that invariably constrain IT use in the domestic economy. Further, the inward (domestic market) or outward (export) orientation of production policies tend to have a determining effect on the competitiveness of local IT industries, and are seen to have important implications for IT diffusion within the respective economies.

Introduction

Information technology is seen to be occupying an increasingly important place on the policy agenda of most advanced and industrializing countries of the world today (OECD, 1989). Many countries are also explicitly perceiving IT as a driving force in economic development and State policy as the means to explicitly facilitate its use and production (Harindranath, 1993). However, there are studies which show that most such policy initiatives are production oriented (Dahlman, 1992). Through detailed evidence from India and drawing on examples from countries as varied as Brazil and Singapore, as well as countries of sub-Saharan Africa and the European Community, this paper shows that restrictive and regulatory policy interventions that merely affect the production of IT may not only constrain the healthy growth of a domestic market for IT but also serve as a disincentive for rapid adoption of IT. The experiences of India and Brazil particularly exemplify this point. On the other hand, policies that are primarily IT application and diffusion oriented or those that focus equally on both supply and demand sides, as seen in the case of Singapore, tend to be more advantageous in the long term by promoting IT applications that benefit the economy.

Production at the expense of diffusion: the case of India

India's IT policies have traditionally focused on the supply side. The Indian approach to the development of the IT industry has moved from import substitution during the late 1970s and early 1980s, towards more market oriented policies during the 1990s. India's import substituting policy regime forced firms to manufacture computers within the country. However, indigenization proved difficult, and even impossible to achieve due to the rapidity of technological change and the non-availability of locally made components. An industrial licensing system regulated not merely to the entry of firms, but also their expansion, diversification and even their exit from the industry. This in turn encouraged firms to set up sub-optimal scales of production. Further, the domestic production was protected from foreign competition through a system of import licensing and abnormally high customs tariffs. This guaranteed good profit margins despite the low production volumes. High tariffs on the import of complete systems provided sufficient incentive for local manufacturing even though the actual import content of such systems were very high. While all this was aimed at building domestic technological capabilities, it also provided across-the-board protection to even inefficient firms that operated with no concern for relative costs of domestic and foreign production, or even quality.

These policies resulted in a high-cost industrial structure in general, and a large number of inefficient assemblers in the computer industry who added no value to the products they claimed to manufacture within the country. Though the policy framework did lead to some level of technological capability in IT, the regime was not geared to facilitate efficient, quality conscious production based on economies of scale or scope, constant technological upgrading, competition and hence returns on investments. This was particularly the result of a lack of an export orientation in production, and consequently these firms needed continued sheltering from foreign competition for their very survival. Indian efforts in building capabilities in IT would perhaps

have had more success if policies had not continued to remain protectionist and if attempts had been made to make the industry internationally competitive. As we will see later in this section, this also had important implications for IT diffusion in the domestic economy.

By 1991, however, macroeconomic imperatives led the Indian Government to rapidly liberalize economic policies. The nature of the computer industry in the country began changing around this time, and firms began to move from being mere vendors of hardware to those providing hardware and software solutions (Harindranath & Liebenau, 1995). Thus the Indian experience exemplifies the negative outcome of highly restrictive policy regimes that are more concerned with regulation rather than development. However, there are also other lessons to be learnt from India. Although liberalization may lead to price reductions and improvements in quality as a result of competition, there is a possibility that it may have a negative impact on the technological capability of some domestic hardware manufacturing firms. Import substitution had forced some of these firms to build up the capability to manufacture systems based on indigenous designs, often at great economic cost. Liberalization and the ready availability of foreign technology may lead to a gradual waning of such skills. Further, it also makes locally relevant R&D investments economically unsustainable. In order to avoid such a situation, perhaps the most appropriate option, and one that may also have a direct bearing on IT use and the growth of the industry, would be to implement a policy with renewed focus on computerization and IT applications for the domestic market. A large and healthy domestic market for IT applications will help firms to experiment and learn, thereby building locally relevant capabilities and design skills. Not only will this improve the domestic IT industry's turnover, but will also serve as a platform for exports. However, strategic thinking from the Government, as will be evident from the case of Singapore, is essential to direct the attention of entrepreneurs to the special needs of the domestic economy, and to thus promote the widespread use of technology.

With liberalization, many Indian IT firms are becoming increasingly outward oriented. But this may have serious implications in the use of existing skills for domestic purposes. For instance, outward orientation may result in local skills being increasingly directed towards the more lucrative export market rather than for domestic purposes. Therefore, it becomes imperative for the Government, which is the largest IT user in the country, to specifically encourage applications development for the domestic market. With regard to India's policies in software, a preoccupation with encouraging exports has resulted in minimal attention being directed towards creating and sustaining a large domestic market for software and IT applications.

The most important drawback of Indian IT policies has been that it encouraged low volume, high-cost production under a restrictive and protective environment, to the detriment of speedy adoption of IT by domestic users. This was further aggravated by the absence of any consistent effort at either applications development for domestic use or the creation of a strong domestic market for software. For instance, there is an argument that the lack of a sufficiently developed local market for software and applications development is the result of the Government's hardware production oriented policies (Dharmadhikari, 1988). The fact that IT diffusion in India is still in its infancy suggests several possible explanations (Harindranath & Liebenau, 1995). On the one hand, the inward oriented, protectionist policy regime stressed production as against IT use, and made IT procurement an expensive and procedurally difficult proposition, and on the other, the Government's attitude that computers were meant for social elites limited computerization within Government and administration. Further, the labour displacement, at least in the short term, that occurs as a result of the introduction of IT presents the Government with a politically and socially sensitive problem. Inadequate IT awareness, and a lack of understanding of the importance of IT in improving administrative and business operations often worsen the situation. It is here that Governments can play very effective roles, and precisely where the Indian Government had failed to convince the masses early enough. As a result, almost four decades after the first computer entered the country in 1955, and after more than two decades of policy for IT, there are only around one million personal computers in use in the country, while the entire industry accounts for an annual turnover of just about US$ 1.6 billion, contributing less than 1 per cent to the total GDP.

As India liberalizes in the 1990s, IT awareness is gradually creeping in, not because of any policy emphasis on IT use, but simply because businesses are trying to cope with increasing competition from multinational corporations (MNCs). At this juncture, it is important for India, and indeed for any emerging economy on the path of economic restructuring and liberalization, to strengthen the country's IT infrastructure. In the absence of such an infrastructure and a culture of IT use in Government and business, there is a very real danger of the domestic industry succumbing to increasing international competition (Narasimhan, 1993; Sen, 1993).

Brazil, the Indian experience revisited

Brazil's experience has been akin to India's in that the former has also moved from protectionist production oriented policies towards more market friendly policies. Brazil followed a restrictive market reserve policy between 1978 and 1992 according to which the production of micro- and minicomputers was reserved for domestic firms while foreign firms were allowed to manufacture only mainframe systems in the country (Evans & Tigre, 1989). Though the protected Brazilian computer industry did develop into one of the largest in Latin America, it suffered on account of the high cost of locally manufactured equipment with low levels of IT diffusion for many years (La Rovere & Goodman, 1992). When the market reserve ended in 1992, Brazilian firms were looking for technological alliances with foreign firms primarily to remain competetive. Thus, the Brazilian case serves to reinforce the point that the setting up of inward oriented, regulatory policy regimes invariably lead to inefficient industrial structures with firms that have no economies of scale and are not competitive in the international markets. Further, such policies, by driving up the cost of IT equipment in the local markets, constrain IT diffusion and use in the domestic economy.

Constraints on IT diffusion: the policy experience in Africa

If the IT policies implemented by India and Brazil shows the general ineffectiveness and sub-optimality of inward oriented production policies that aim to build domestic IT industries in isolation from the rest of the world, the African experience primarily sheds light on application and diffusion oriented policies.

Most countries of sub-Saharan Africa are characterized by the absence of any overall IT strategy or policy framework (Harindranath, 1993a). However, highly restrictive policies

concerning the acquisition and use of IT in the public sector do exist in many countries, and these are generally implemented through government computer bureaus or committees, often dominated by people who lack the necessary IT skills and are hence unable to make the right choices and policy decisions in relation to the acquisition and use of IT. Some countries, such as Ghana, have a number of organizations intervening in the choice of technology during the formal processing of applications for IT procurement. Thus the entire procedure is subject not only to particular interests of every one of these organizations, but is also susceptible to interorganizational rivalry and its consequent problems. Moreover, the process invariably undergoes severe delays and the final outcome is often less than appropriate.

The lacklustre efforts of many African countries to develop appropriate IT capabilities and to promote IT diffusion provide a pointer to the fact that the building of such IT capabilities requires not only policy direction, but also infrastructure facilities, and the accumulation of relevant skills and experience in order to make policies work in the first place. Unfortunately, any improvements in telecommunications and IT training infrastructure are constrained by the lack of adequate financial resources and the annual drain of wealth, in the form of debt and interest payments, that characterize many African countries. For instance, the widespread lack of IT awareness and skills at all levels in both government and private sectors poses a major constraint on obtaining the maximum benefits out of existing applications. This is especially true of countries like Ghana, Malawi, Sierra Leone, Tanzania and Zambia. This lack of awareness has resulted in many countries undertaking computerization efforts in a haphazard manner, often focusing on merely labour-saving applications. Under such trying circumstances, it is indeed a challenge to optimize the utilization of existing IT. This calls for planning and coordination of IT use at both government and organizational levels.

It is noteworthy that the above-mentioned impediments notwithstanding, African countries have continued to commit sizeable amounts of economic resources to IT. Although IT has the potential to contribute towards national and sectoral development efforts, preconditions have to be satisfied prior to the large-scale diffusion and use of the technology, such as reliable communications infrastructure, human resources development and effective organizational mechanisms to coordinate IT activities in the country. Much of Africa is found to be lacking in these areas. Plans are not formulated with any consistency, the relevant infrastructure is not put in place, adequate IT skills are not created, acquisition is often not well thought out, and servicing suffers from severe neglect. Clearly, the necessity for an integrated IT strategy or policy framework that addresses these concerns relating to IT diffusion and use cannot be overstated.

Balancing diffusion and production: the case of the "intelligent island"

Singapore represents an ideal instance of an appropriate balance between demand and supply side policy interventions. The success of Singapore's integrated approach to IT is evident from the fact that the country has the highest apparent consumption of IT hardware relative to GDP of any economy in the world, and also has one of the highest intensities of IT use in the world (Dahlman, 1992). Moreover, Singapore is already implementing well thought out strategies to transform the island state into a completely computerized information society, often called the "intelligent island", by the year 2000 (National Computer Board, 1992).

The more significant aspects of policy intervention in this country include systematic computerization in the government sectors, framing of national IT plans that address clear goals such as the development of an adequate number of IT skilled personnel based on projections into the future, developing local production capabilities for domestic use as well as for exports, stressing global competitiveness, and finally the goal of transforming Singapore into an information society (Raman, 1990; Gurbaxani *et al*, 1990; National Computer Board, 1992). The export orientation of IT production policy in Singapore forced firms to manufacture to international standards in quality and cost. Further, addressing both the domestic and the global marketplace, these firms succeeded in bringing down the cost of equipment, thereby improving access to the technology. Thus, while the Government took on the major role of developing a sophisticated IT infrastructure, pragmatic policies guided both supply and demand for IT. By pushing through large-scale projects for the informatization of the society, the Government of Singapore has provided the engine of growth for the domestic industry, while at the same time ensuring that production capabilities are aimed at much larger global markets. Gurbaxani *et al* (1990) identify two problems that are common in IT development: (1) the stagnation of local IT demand and use resulting supply side focus on export of IT products that are more sophisticated than those demanded at home; and (2) the stagnation of local IT production resulting from high levels of IT imports that are too sophisticated to be manufactured by local firms but for which demand exists at home. Through appropriate policy interventions that dealt with both demand and supply aspects, Singapore has steered clear of both these problems. Therefore, the key responsibility for nurturing and developing both IT production and diffusion in Singapore was taken on by the Government itself.

IT diffusion and production: the need to nurture

Policies for the development of the IT industry and the diffusion of IT are not peculiar to the newly industrialized countries of Asia and Latin America or the less developed countries of sub-Saharan Africa. Closer to home in the European Community, industrial policies and national strategies to promote the IT industry have not been entirely uncommon. A detailed comparative analysis of national IT policies in the European Community, Japan, and the United States of America was undertaken in the wake of the Japanese fifth-generation initiative in the 1980s, by M. English and A. Watson Brown (1984). They identified a seven-point action agenda for European Governments to be implemented at the Community level. These were primarily intended to make the European IT industry globally competitive, and hence focused largely on the supply side. The agenda suggested that Europe must move from isolated efforts by individual IT companies towards concentrated efforts by Governments, universities, companies, and major users to develop the domestic industry. Further, it recommended that Europe ought to build a home market with the necessary business volumes that can depreciate new research and product development. Another significant action point called on European Governments, universities and companies to concentrate on a few selected areas in IT rather than spreading their efforts thin over the entire spectrum of information technologies.

Indeed, the emergence of globally competitive high technology industries, especially in the field of IT, in the countries of east Asia has further brought back into firm focus both the State and its role in nurturing industry through a variety of technology policy interventions. For instance, alarmed by the prospect of the US IT industry losing its competitiveness in critical information technologies, chief executive officers from 11 American IT companies formed the Computer Systems Policy Project in late 1989 (Crawford, 1991). Their aim was to provide relevant information and assistance to the US Government in order to help formulate and implement technology policy initiatives that would enable them to meet international competitive challenges. Recommendations for technology policy interventions to improve the competitiveness of the American IT industry have also been made by two US Government committees in the early 1990s (Crawford, 1991). These reports by the Council on Competitiveness, and the Office of Technology Assessment present a public policy agenda for the Government and suggest ways and means to realign American research funding priorities. Such supply side interventions are appropriate not only for the USA or the European Community but also for other countries that are sufficiently well versed in the use of IT, and possessing domestic industries supported by large user populations.

It is now well recognized that States can intervene in order to provide the right macroeconomic environment through the provision of quality infrastructure, and a professionally adapted workforce, as well as access to capital and credit (Jacquemin, 1984). Policy can also be used as an effective bargaining tool during negotiations between large MNCs and the Government. Public policy can also be usefully implemented to promote research and training as well as technology awareness programmes that would make their adoption and rapid diffusion possible. However, even as an overall policy framework may facilitate better utilization of IT, its mere existence cannot guarantee that these policies will be implemented, or that they will be instrumental in developing any meaningful domestic technology learning capabilities. Even explicitly defined policies may fail unless backed by effective organizational mechanisms to implement them. In sum, it is evident from the examples of India, Brazil and sub-Saharan Africa that regulatory regimes often tend to constrain IT diffusion in the local economies, while policies that balance off the diffusion and production imperatives and those that are primarily concerned with use rather than production tend to facilitate increased IT usage. As far as policies of the latter kind are concerned, Singapore comes across as a country with unambiguous goals and action strategies to achieve them. Such policies lead to the development and maturing of local IT markets, very often providing the opportunity for the establishment of fully fledged and competitive domestic IT industries in the future. Any pragmatic public policy intervention needs to primarily aim at encouraging IT use, and then, depending on the idiosyncrasies of the particular market, move up the ladder of technological capability into carefully chosen niches such as software services, hardware manufacturing and systems integration (Harindranath & Liebenau, 1995).

Comparative analysis of national experiences with IT policies is of crucial significance to both industrializing and advanced countries. The former can benefit from the experience of more advanced countries in the promotion and utilization of IT for economic development and competitiveness, as well as the strengthening of their technological capabilities in IT. The need to compare policy experiences in promoting high technology industry is a matter of the utmost urgency for the industrialized countries of Europe and North America, particularly because more and more technological innovations are likely to occur outside their national boundaries in the years to come (Crawford, 1991). Understanding foreign experiences in nurturing the IT industrial complex may help European countries to refocus attention more clearly on critical deficiencies that may occur in their public policy interventions, or even enable them to usefully intervene in areas that have remained outside the purview of State policy targeting. For instance, the US anti-trust legislations have been influenced by the experience of foreign countries that have traditionally had a partnership approach between the State and industry, and as a result, laws now permit certain kinds of joint efforts between American companies (Bartocha, 1986). In the ultimate analysis, all nations stand to benefit from formulating and implementing public policy that reflects an adequate understanding of current international trends.

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B. NEWS AND EVENTS

Forecast for 2006

What products will have the greatest impact on life at home and in the office in the next decade? The following were selected by Battelle Memorial Institute, Columbus, Ohio.

- **Genetaceuticals.** Genetics-based medical treatments will cure or mitigate the effects of various human diseases, including pharmaceutical treatment for osteoporosis, MS, cystic fibrosis, Lou Gehrig's disease and Alzheimer's.
- **Personalized computers.** Very powerful computers will include voice recognition and the ability to perform personalized services such as shopping, data collection and tracking your favourite sports. Millett says the computers will be as mobile and versatile as their users.
- **Multi-fuel automobiles.** To obtain maximum efficiency and meet environmental standards, vehicles will use combinations of various fuels, such as reformulated gasoline, electricity and natural gas.
- **Next-generation TV.** Not only will it be large, flat, and hang on the wall, it will be digital, high-definition and capable of being used as a networking computer and video-conferencing device.
- **Cyber cash.** Electronic money will eliminate the jingle in your pockets as credit-card-sized smart cards replace not only cash, but house and car keys.
- **Home health monitors.** Just as weight is routinely checked on bathroom scales, so too will many physical functions be monitored on simple-to-use, noninvasive and inexpensive home devices. Battelle cites liver functions, ovulation, and levels of cholesterol, triglycerides, sugar, hormones, water, salt and potassium.
- **Smart maps and tracking devices.** Expect global positioning devices to be so ubiquitous that they will also be used to track the exact location of children and pets.
- **Smart materials.** Intelligence built into materials will warn when limits are being exceeded. For instance, structural materials in bridges and buildings might change colour when overloaded.
- **Weight control and anti-aging products.** These developments may include weight-control drugs that use the body's natural weight-control mechanisms, wrinkle creams that actually work and an effective cure for baldness. Battelle predicts many of those developments will come from genetic research.
- **Never-owned products.** Leasing will be commonplace for major household appliances.

Home health monitors that let consumers monitor their own health conditions such as liver functions, ovulation, cholesterol levels, sugar, hormones and water.

Next-generation TVs that are large, flat, and hang on the wall. These digital, high-definition displays will have clarity comparable to movie screens.

Global positioning systems that can tell exactly where your children and pets are; prevent crime by tracking the location of cars and valuables; and show travellers, boaters and hikers their exact heading and location.

Personalized computers that recognize your voice and follow your commands will replace the PCs we now use.

Multi-fuel cars will use combinations of various fuels, such as reformulated gasoline, electricity and natural gas.

Smart cards will replace cash for purchasing everything from soft drinks to international investment options.

Smart materials will give off warnings when subjected to excessive stress. When used in bridge or office construction, for example, these materials could change colour before unsafe conditions arise. Automotive parts, on the other hand, could warn when they are ready to give out. (Source: *Industry Week*, 19 February 1996 and *Machine Design*, 21 March 1996)

Information technology: asynchronous transfer mode switches are the latest to thrill Silicon Valley

Examples include virtual reality, personal digital assistants, and practically everything dreamt up at the media laboratory of the Massachusetts Institute of Technology. An even faster networking technology than ISDN, called asynchronous transfer mode (ATM), is causing a stir.

ATM is already half a decade old. Its selling point is that it is tailor-made for multi-media. The Internet, plus the various "local" and "wide" area networks (LANS and WANS) used by companies chop data into "packets" of variable length. By dealing with packets, the network does not need to consider what sort of information is being transmitted; it just mixes all the packets together and pumps them through the network by the fastest route available at any time, allowing software on the receiving side to sort them out again.

None the less, packet-switching has its drawbacks. The sorting takes up valuable time; and the irregular nature of the packets creates bursts of frantic motion followed by frozen pauses. That wrecks "real-time" music or video, where the re-ordering process can make the best digital recording sound like short-wave radio.

ATM solves this problem by breaking the digital information into tiny "cells", or mini-packets, of exactly the same 53-bit size. These uniform cells travel faster and are easier to sort out when they arrive, raising transmission speeds to 155 mbits per second, more than 15 times the speed of normal LANS, and permitting a network to carry broadcast-quality video and sound.

But, unlike the Internet, which uses existing telephone lines, networks and computers, ATM often requires new cabling and new software, along with network managers who can make it work its magic. A firm that embarks on this course will often need to hire new people, invest in training and prepare for headaches of various sorts.

That may be worthwhile for big communications companies, whose business is pumping data through wires. Long-distance telephone carriers prize ATM's ability to handle voice, video-conferencing and computer data seamlessly. Some of those that carry Internet traffic have already installed ATM switches on their most congested links.

However, most of the world's data networks are on internal company LANS or WANS. (A LAN tends to be within a single building or campus; a WAN is made up of the leased lines linking up various LANS.) This is the domain of systems managers who think more about monthly budgets than multimedia. And since most corporate PCs do not have sound cards or CD-ROMs, they could not use ATM video and audio even if they could get it.

In the case of WANS, moreover, ATM can sometimes be too fast. The technology generally runs at speeds of at least 51 mbits per second, and leasing a telephone line capable of handling this can cost $100,000 a month. That is a lot to pay for a sharper picture in your video-conferences.

In the case of LANS, the problem is not so much the cost of transmission within a building or campus, but the cost of installation. An ATM card and switch for a PC costs around $800, and might not be compatible with the existing software.

ATM's backers hope that two changes will make systems managers readier to accept the new technology. One is its falling price.

In addition, unlike a conventional LAN, ATM is flexible enough for a network manager to connect teams at will, regardless of where they are. With such "virtual LANS", managers can reconfigure network connections between employees as often, and as easily, as they redraw their organizational charts. (Extracted from *The Economist*, 20 April 1996)

Arizona promises key for remote security

Greater security for remote keyless entry (RKE) systems is being promised by Arizona Microchip Technology with the release of the first members of its Keeloq code-hopping family.

The announced HCS300 and HCS301 devices are transmitter sections of an RKE system. Both are eight-pin devices, which need a power supply, transmitter and push-buttons to function. The devices differ only in their operating voltages.

The claimed benefits of the devices include 64-bit read protected keys, non-volatile memory, and security against scanning, physical attacks and exhaustive search attacks.

Receiver devices will be available soon, but can be made now using standard PIC microcontrollers. Applications are being sought in home security, cellular phones and smart cards along with the RKE systems for vehicles, garage door openers and secure building and area access.

The Keeloq technology was acquired from South African Nanoteq at the end of 1995. (Source: *Electronics Weekly*, 27 March 1996)

Wireless security schemes — an overview

Conventional RKE systems transmit a code that can be grabbed straightforwardly by the potential thief. Code-hopping systems, which change the code with each transmission, offer greater security with the use of a pseudo-random bit sequence.

However, problems occur if the transmitter is used out of range of the transmitter, resulting in the two losing synchronization. Complicated techniques are required to solve this and other problems.

The Microchip code-hopping technique uses 64-bit private key encryption. The transmitter and receiver both contain an externally unreadable EEPROM with a counter, initially set to the same value, and an encryption key.

On transmission, the counter is incremented and a non-linear encoder uses the private key to give a 32-bit code. The receiver decrypts the code to, hopefully, give the same value as its own incremented counter. If the transmitter is activated several times out of range, a small discrepancy between the two values results. A manufacturer-defined window can be set to allow for this difference. (Source: *Electronics Weekly*, 27 March 1996)

Faster Internet access

New technologies such as cable modems and digital phone lines based on ISDN or ADSL technologies may be able to provide faster Internet access that will open up a wide range of different services. With an ISDN (Integrated Services Digital Network) line users can communicate at about 128 kbit/s—the true data throughput for two ISDN channels is 116 kbit/s—this is some nine times faster than the typical 14.4 kbit/s modem user. But ISDN has taken a long time to come to market and it is mostly being promoted to business users.

Cable modems, however, might become the best technology for offering millions of Internet users faster access and eventually eclipse ISDN. Cable modems can in theory, offer data access rates as high as 10 Mbit/s and several large Silicon Valley firms are planning cable modem products.

Cable modems can provide a theoretical 10 Mbit/s access rate, however, that is often the total bandwidth which will have to be shared by hundreds and maybe thousands of users, like a party telephone line. Even so, it should still be faster than ISDN. But is the issue of faster access a red herring? Many of the World Wide Web sites on the Internet have maybe a T1 line communicating at 1.5 Mbit/s.

If they have hundreds of users connecting over cable modems, or even ISDN, each user will be connecting at a fraction of that total data rate, maybe not much faster than a 14.4 or 28.8 kbit/s modem.

Businesses, with their own internal high-speed networks, should do well in terms of Internet access speeds. These private, Internet-like networks are called Intranets, and for vendors such as Silicon Graphics and Sun Microsystems, the demand for Intranet-based computers and software is outpacing that for Internet systems.

Telephone companies could meet the cable modem challenge with a broad-band, but one-way only, version of ISDN called ADSL (asymmetric digital subscriber line) that offers a theoretical 8 Mbit/s data channel to the user, and a return control channel of just 640 kbit/s. This band-width is not shared with other users as in a cable modem. But with widespread availability of cable modems still at least two years away, with ISDN rates going up, and ADSL technology still in development, the brave new world of the Internet visionaries is likely to sound like the usual industry hype for most consumers for some time to come. (Extracted from *Electronics Weekly*, 10 April 1996)

Beyond the V.34 modem

Modem data rates typically double every 18 months or so. The V.34 28.8 kbit/s modem started to make its impact on the market in the summer of 1995, and so there is less than a year to discover where the next data rate jump is coming from.

With no new analog modulation scheme waiting in the wings, the Internet market must base its plans on the introduction of packet-switched data networking over the PSTN and more generally available ISDN digital telephone lines.

The most recent attempt to squeeze a bit more out of the existing V.34 (28.8 kbit/s) modem protocol has resulted in proposals for two new rates at 31,200 and 33,600 bit/s. The ITU's standards committees are in the middle of ratifying these new rates as extensions to V.34 and first products could be out by the end of the year.

First tests of the new modem rates over the American public telephone network have not been encouraging. All

modems rely on line integrity and transmission quality to support their full data rates. If error performance becomes too great, then the modem automatically switches down to a lower rate which can be supported. However, the hit rate falls significantly as data rates move above 28.8 kbit/s to the new standard rates. The first 31.2 kbit/s modems worked at full rate for between 30 and 40 per cent of connections and the 33.5 kbit/s tested could only guarantee full rate operation for 10 per cent of connections. This compares with a 75-90 per cent success rate with 28.8 kbit/s.

Modem makers believe that they have hit a fundamental limit for the traditional analog line modem. So the way ahead seems to be the use of digital transmission technology such as ISDN and eventually the introduction of broadband packet switched data services such as switched megabit data services (SMDS) and asynchronous transfer mode (ATM).

The digital telephone line or ISDN service can put two 64 kbit/s digital telephone lines direct to the home or office, but the market is dogged by availability problems and high terminal prices. Basic rate ISDN terminals can cost as much as £600 compared to 14.4 kbit/s modems costing £99. (Source: *Electronics Weekly,* 10 April 1996)

World plan for shift to 12-inch wafer

SEMI, the international chip-making equipment trade body, has smoothed the way towards global coordination of the semiconductor industry's upcoming shift to 12-inch (300 mm) wafers.

At the SEMI-organized Semicon Europa trade show at Palexpo in Geneva, the heads of both the US 12-inch project called I300I (International 300 mm Initiative) coordinated by Sematech, and the Japanese 12-inch initiative called SELETE (Semiconductor Leading Edge Technologies Inc.) were telling how they had exchanged data on wafer and carrier standards.

Instead of joining I300I, the ten leading Japanese semiconductor companies formed SELETE to pursue exactly the same aims as I300I.

However, at Semicon Europa, the heads of I300I and SELETE pledged to promote international co-operation in developing common specifications and standards for 12-inch wafer production and processing. The bill for the conversion could be as high as $10 billion. (Extracted from *Electronics Weekly*, 3 April 1996)

Chip-makers face rebuff

The USA and Japan are expected to further rebuff EU chip-makers as trade officials meet in Brussels to discuss potential cooperation.

Although the EU would like to gain over 20 per cent of the foreign market share, the US-Japanese bilateral agreement prevents it from doing so.

At present, the EU holds only 6 per cent of the market share in the USA and under 1 per cent in Japan. The current bilateral agreement between the USA and Japan is due to expire in July.

The US Government is apparently adamant it will prolong it, although some US chip developers believe this form of aid is not necessary. (Source: *Electronics Weekly*, 20 March 1996)

Security flaw in Sun's Java

In what seems to be an almost weekly discovery of security weaknesses with the Internet and its related technologies, a team of researchers at Princeton University have discovered a serious security flaw in Sun Microsystems' Java computer language.

Java is being promoted as a new lingua franca for Internet applications because of its cross-platform capabilities. Hundreds of companies are developing Java-based applications but if security problems continue, it may harm Java's widespread use.

Edward Felton, an assistant professor of computer science at Princeton, claimed that the flaw he and colleagues found could allow computer hackers to enter someone's computer system and destroy files. Felton said it would be possible to create a "booby trapped" web page. Anyone looking at that page with the popular web browser, Netscape Navigator, would make it possible for others to read or destroy data on the user's PC.

Sun admitted that the problem is serious and said it has already created a software fix which it is distributing over the Internet to concerned users. (Source: *Electronics Weekly*, 3 April 1996)

Selling computers is hard

Although sales of personal computers are expected to swell to 75 million world-wide this year, retailers are finding life difficult. In Japan, where PC sales shot up by 70 per cent in 1995, price wars drove several computer shops into bankruptcy. Expansion and unsold stock cost Escom, Germany's biggest retailer, a loss of DM 125 million ($87 million) for 1995. And in America, even the most successful shops face trouble.

In most countries, the bulk of PCs are still sold by dealers directly to businesses buying them in large numbers—or else by telephone and mail order. But in all the big markets, the fastest growth is in retail sales, as individuals and families buy an increasing proportion. In America last year, retail sales accounted for 11 million of 23 million sales. Of the 6.2 million computers sold in Japan in 1995, 1.3 million went through retailers, a larger share than in the previous year. In Britain, 2.8 million machines were sold in 1995; PC sales through retailers grew by 38 per cent to account for 14 per cent of the total, according to Romtec, a market-research company.

In spite of such growth, the experience of American retailers, which have expanded fast on the back of rocketing growth in 1992-1994, points to potential problems ahead. Everywhere, the market is becoming increasingly competitive, as customers are offered a wide choice of different models and ways to buy them, including unbranded "clones" sold with minimal service and support.

The main complaint of computer retailers is that profit margins are low. What keeps margins low is mainly the speed with which new models appear on the market. Constant innovation compels manufacturers to sell quickly. As an individual PC ages, its price can easily drop 30 per cent in six months. Occasionally, manufacturers trigger price wars in their desperation to grab market shares.

Falling prices put greater pressure on retailers, who cannot afford to be left with unwanted computers. Even with the best stock management, selling computers is hard work. Many computers, according to Dataquest, are sold over the telephone or by mail. That keeps overheads low. The advertising for such sales tends to be minimal, and the effect is to encourage customers to think of computers as commodities, selling mainly on price. Against such competition, retailers have to muster other traditional selling skills, such as choice and service.

Many retailers are trying to boost profits by persuading customers to buy cheaper (but higher-margin) goods as well as the computer itself. But what varies is the nature of the extras they sell.

What retailers fear most is that the computer will lose its novelty value. In the United States, many stores are starting to find PC sales easing off. Retailers face a squeeze as the rate at which they build new capacity starts to outpace the rate at which customers buy new computers.

In most countries, it is thought that a large number of buyers are still poised to buy their first computer. This should keep retailers happy for several years to come. Britain, for instance, saw a huge buying spree in December 1995. But research by Sanford Bernstein, a New York investment firm, suggests that the decision to buy a computer is tied closely to income. Half of America's households with an income of more than $50,000 own computers, and 65 per cent of households with incomes over $75,000. The intention to buy a computer—and the likelihood that someone intending to buy really does so—declines sharply with income.

Nobody can be surprised by the revelation that rich people are more likely than poor ones to invest in a home computer. But the unanswered question is how long the home computer will remain a plaything of the affluent before becoming, like the television and the video recorder, just another universal household gadget. (Extracted from *The Economist*, 23 March 1996)

Galapagos Islands hit the Web

The company that claims it can provide ISDN from almost anywhere on Earth set off in May 1995 on a voyage to the Galapagos Islands from where it intends to beam back pictures and information to a Web site. This will be California Microwave's second adventure of this type. In December 1995 it equipped the RV Livonia with an Inmarsat system for its 10-day trip to Antarctica. Photographs and Quicktime VR movies were transmitted to a Web site at http://www.terraquest.com. The Galapagos trip will be on two yachts and will send back colour photographs using Kodak digital technology. The transmission equipment used is the Mobilesat Lynxx RT Inmarsat B terminal available in the UK from Ascot distributor 7E Communications. Peter Beardow, 7E director, said: "You just point the antenna at the satellite and you have a 64 kbit/s ISDN link." (Source: *Electronics Weekly*, 14 February 1996)

Development of sustainable business information networks for the promotion of South-South trade, technology and investments: lessons of the G77 trade information network by William Tiga Tita

Chambers of Commerce have always been the public sector's overture to private sector economic development. Mr. Tita writes about the ongoing development of a system whereby Southern Chambers of Commerce act as brokers of necessary business information to investors from other parts of the South. He is the Project Manager and Principal Technical Adviser for the Global Management Centre, Private Sector Development Programme of UNDP.

The proliferation of information network projects in the South during the past decade underscores the significant role that information and its infrastructure (telecommunications and information technology) will have to play if the South hopes to compete economically in the coming century. Access to reliable, accurate and timely information has become a necessity for countries and their businesses that wish to survive in this increasingly globalized economy. This article will focus on the lessons of the Trade Information Network (TIN), a G77 Chambers Network project for promoting South-South trade, in order to examine some of the essential requirements for a sustainable network in the South.

One of the most vexing problems of the late twentieth century is the growing gap between the realities of South-South cooperation and the potential for promoting sustainable human development, as well as national and collective self-reliance. Despite the current focus on South-South cooperation at the international level and within the United Nations system, it remains the least-utilized among the primary global types of cooperation: North-North, North-South, South-North and South-South. It is also important to note that even within the South great disparities exist between regions and countries.

Despite current discussions regarding the significance of business information networks for South-South cooperation, the experience of the emerging "Asian Tigers" demonstrates that information networks are also as much a consequence of trade growth as a cause of it. The challenge in South-East Asia, as trade information experts will attest, is to provide the business community with information on how to expand market share. In Africa, Latin America, or even countries in South-West Asia the challenge is twofold: to provide information that generates new opportunities in markets that have not been accessible before, and to expand market shares in existing ones for indigenous businesses. This issue can be illustrated through the following incident, suggesting the focus of efforts in the development of the Trade Information Network (TIN), for South-South cooperation.

An elderly African trader who appeared virtually lost at a major European airport was seeking assistance to exit immigration. A cursory examination of her documents by an interested bystander revealed that she was instead bound for Brazil with a European connection. Moreover, she had already missed her flight an hour earlier, though she had arrived several hours before. A "to whom it may concern" note which she was carrying was written in English, requiring translation into Portuguese if it were to be useful at her final destination. This woman was a successful and respected trader in her country and she carried a significant sum of hard currency, but by the time her problems were resolved, she had to buy a new ticket, pay for an overnight stay and for the cost of several international calls.

These unexpected delays and other related problems increase the cost of doing business between Southern countries. Issues such as these could have been anticipated and addressed through an effective business information service. Such an information service could have provided a detailed travel itinerary, including stopovers, detailed instructions on passport entry to her destination of choice and the conduct of business upon arrival there, as well as a pamphlet outlining the relevant experiences of other traders' business trips to that country. A strong information network, backed by a personal commitment to service will strengthen the confidence with which these international business endeavours are undertaken.

Examining the economic performance of the South in the recent past provides a disturbing picture. For instance, in 1992, the least developed countries' share of world trade was 0.3 per cent, against 0.6 per cent in 1980, a 50 per cent decline. By 1994, Africa's share of world trade was still declining. Although total Foreign Direct Investment (FDI) flows into developing countries reached a record 80 billion dollars in 1994—boosting their share to some 39 per cent—80 per cent of these flows were to 10 countries; none were to Africa, with China attracting some 50 per cent alone. To survive, the developing countries have to become competitive in the global marketplace. To thrive, they must

adopt basic approaches which are considered today to be the basis of competitiveness.

These realities cannot be reduced to any single, casual factor. Yet a cursory look at the impact of communication technology must have us wondering whether the state of the third world's communication technology does not contribute heavily to the grossly uneven access to global resources on the part of the least developed countries. The potential of the information and communication revolution to transform how we live, our patterns of work, our institutions and our environment is well known and cannot be understated. There can be little doubt that the development of these technologies is among the most significant transformation in human communication since Guttenberg's printing press. This revolution has brought about openness, connectivity, accessibility, networking, decentralization and democratization. It is key to both decentralization of power and social transformation. The developed countries have registered quantum gains in productivity, business, trade, transport, manufacturing, banking, tourism and management, all of which can in large part be attributed to these technologies.

Chambers of Commerce and information services: the case of the Trade Information Network (TIN)

There is certainly no doubt that business information systems are critical to marketing trade, technology and investment opportunities. The potential role for Chambers of Commerce in providing this service is based on the expectation that an intermediary institution is needed to broker for the small and medium-sized businesses of the developing world.

Eight years ago the Group of 77, in association with the United Nations, decided to fill this gap by assigning to its Chambers of Commerce the responsibility of setting up a trade information network among its member States. This Chambers conference has held annual meetings to discuss developing the Network, and in November 1990 approved a master plan. This plan defined standardized procedures for data collection and various systems options commensurate with the different capacities of the participating Chambers. It is currently being implemented on a pilot basis. The Network is expected to be consolidated in another several years.

Its design and operational strategy have benefited from the efforts to date. Though we continue to learn from various experiences of member States, the network is very much in its experimental stages. In establishing the TIN, three broad and interrelated strategies have been utilized:

- Development of an institutional mechanism that ensures the full participation of all stakeholders in the Network and promotes human networking in particular. The Chamber Network has been developed on a regional basis with each regional centre acting as a national focal point. There is a global management centre to co-ordinate the interregional activities of the Network and to gather and disseminate the lessons of pilot centres to the other members. Several workshops bring together participants from selected Chambers during the year and there is an annual general assembly to discuss the progress of the Network as well.
- Outreach to international and regional networks. There are several thousand databases available world-wide through a variety of networks. All of these are useful to the business community. For the individual Chambers to become "gateways in cyberspace" to the world of business in their countries, there is a need to make information from the various networks accessible to them. TIN seeks to establish linkages to these various networks that will make such access feasible and practical.
- Technical and institutional support at the field level. Field visits are programmed to develop national capacities, resolve specific problems and provide support towards the sustainability of local networks. As much as is possible, the technical cooperation among developing countries (TCDC) modality is the approach utilized in meeting the needs of the national focal points of the Network.

Lessons learned

Through the case of TIN, and also in efforts to establish other business networks in the South, a number of important guidelines in designing and implementing such networks have emerged:

- The essence of sustainable business information networks is not about hardware and software or the establishment of yet another computer on-line service. It is rather about information sharing, empowering users and their institutions (in this case the Chambers of Commerce) to handle issues on a sustainable basis, that relate to trade development. It does utilize computer-mediated communications as a means to achieve its final goal, but its most fundamental agents of communication are people. For quite some time into the future, the human network will continue to dominate our information exchanges, followed by other widely-used communications media: catalogues, telex, telephone, fax, etc.
- The Network must utilize a broad-based participatory approach. This is true at the Chamber of Commerce level, and at the national, regional and inter-regional levels. All stake-holders must be involved and included in the process. It cannot be merely a turn-key operation.
- It must emphasize complementarity. TIN tries to complement and supplement national, regional and other group efforts and does not attempt to compete with them. In this regard, it builds strategic alliances with all known networks involved with South-South trade. A consortium of Network experts will meet in Romania in October 1996 to discuss further modalities of co-operation.
- It must be an instrument of dialogue, promoting discussion on how to achieve synergy.
- Its primary focus should be on capacity-building, relying heavily on national human resources and providing training at both the technical conceptual levels. The experience is that the Network is as good as the standing of the Chambers of Commerce with its members, and as its capacity to support and sustain services. The strategic issue for the Chambers is also to define its mission in this new era of information technology and to prepare for the next century.
- It should be situation-specific, and address problems, issues and opportunities on an individual basis at national levels. Outside intervention should be limited to the macro-level (national business information systems) and the meso-level (Chamber capacity-building). At the micro-level the Chambers can and should address the requests of its business community with outside assistance on an as-needed basis.

Both the design and the implementation of the Network must include revenue-generating strategies. Though the network must be financially supported during the pilot phase, it should sustain itself at the operational phase. In some

exceptional situations, the subsidy phase might need to be prolonged.

Conclusion

Given the multiplicity of networks in existence, as well as the numbers of countries interested in support in this field, it is obvious that the task is much greater than the stringent financial and human resources available at both national and international levels will presently allow. The need to design a strategy for the future which is realistic and well-targeted and can provide for a sustainable and cohesive assistance, particularly to the least developed countries, is imperative. The lessons of TIN may be a modest contribution to addressing the critical issues in preparing the South to become a major player in the expanding economy of the future.

Is this utopian fantasy or achievable aim? That will depend on one's view of the global collectivity's potential for change. Cartoonist-philosopher Charles Schultz sums up the human condition by putting these words into the mouth of his little "Peanuts" comic-strip character, Linus: "There's no heavier burden than a great potential!" (Reprinted from *Cooperation South*, 1996)

Getting heavy with computer chips

A trio of physicists and electronic engineers at the University of Illinois at Urbana-Champaign, and AT&T Bell Laboratories in Orlando, Florida, have found a way to prolong the active lives of chips, perhaps by as much as 50 times. It is cheap, adding about a tenth of one per cent to the price of a chip, and it is simple, requiring no change in the equipment used to make the chips. It just requires a change in the recipe that the chips are baked from.

What the team has done is a neat piece of lateral thinking. They replaced the ordinary hydrogen that the chips are baked in with deuterium. This is the form of hydrogen that makes heavy water heavy. The nucleus of a normal hydrogen atom is a single proton. A deuterium atom has a proton and an neutron at its core. Chemically, it is identical to hydrogen, so baking a wafer in deuterium works just as well at sealing up the dangling bonds. But because deuterium is heavier, it is a lot more difficult for passing electrons to dislodge.

In practice, chip-makers are unlikely to use the discovery to extend the life-times of their products. They well understand Henry Ford's principle that components should not outlive their usefulness. Instead, deuterium baking will allow more powerful chips to be made. The tiny components on modern chips can tolerate fewer dangling bonds than did their larger, more robust, predecessors. Designers, therefore, have to tone down the voltages (and thus the speeds) at which they operate, in order to preserve them. With deuterium baking, this problem should go away, enabling individual transistors to work faster without a significant redesign. The new recipe really could mean chips with everything. (Source: *The Economist*, 9 March 1996)

Collapse of DRAM prices

Going over a cliff or temporary blip? There have been loads of comments about the collapse in the DRAM price, the slowing of PC demand, the flat US mobile phone market and the prospects for a traditional chip recession.

Everyone remembers 1984 and 1985—a 40 per cent rise in the market one year followed by a 15 per cent decline the following year. Could it happen again?

There is the usual wishful thinking from some quarters to the effect that the chip industry is now "mature" or that chips are now so "pervasive" that the fall-off-a-cliff scenario cannot happen again.

What has happened? The facts are that 4 Mbit DRAMs now cost $6 when they were $13+ in the early 1990s and that 16 Mbit DRAMs now cost $33 when they were $50+ through 1994-1995.

Married to slowing sales growth of PCs and mobile phones, and the prospect of two new Taiwanese DRAM players coming on-stream in the second half of this year, the gloomy prognostication is for a chip glut, further collapse in prices and bombed-out profits.

But there is a hopeful scenario: that the collapsing prices relate only to fast page mode DRAM which has been caught in a technology shift towards EDO and synchronous DRAM.

Intel controls the situation. When it brought out its Triton chip-set last year, the PC industry stampeded towards EDO, dumping fast page mode in the process. New chip-sets from Intel this year could provoke the same stampede to synchronous DRAM and an unceremonious dumping of EDO and burst EDO.

Intel could be reacting to a slowdown in PC sales with the traditional Intel response to troubled times—to run faster with the technology.

By pushing its Pentiums and chip-sets to faster and faster frequencies—already up to 133 MHz and rising— Intel could be spurring on the PC industry to new capabilities such as 3-D graphics.

3-D graphics could be a sufficiently attractive new feature for which people might feel persuaded to buy a PC for the first time or to upgrade their existing ones.

However, in the last three years the price of DRAMs—the largest microelectronics value in a PC after the micro-processor—increased at 10 per cent every year for those three years, according to Jean-Philippe Dauvin, President of World Semiconductor Trade Statistics.

It is no coincidence that the price of PCs has remained static through those years—and this may have caused consumer resistance and slowing sales. Shoppers had become used to getting the same thing for a lower price, or a better thing for a lower price, or a better thing at the same price. But with PC prices staying high on the back of high chip prices, it could be that shoppers have been put off buying PCs.

With the cost of the chips representing over 50 per cent of the cost of a PC, and with the PC taking nearly 40 per cent of the output of the chip industry, high chip prices could have a beggar-my-neighbour effect on both the chip and PC markets.

So a halving of the DRAM price—in effect a postponed learning curve effect with three years traditional price erosion compressed into three months—could be a good thing.

Tied to an upgrade in PC performance as Intel pushes clock rates to 150 MHz and beyond, a fall in PC prices enabled by cheaper DRAM could be what is needed to get the PC market moving again—higher performance at lower prices. (Extracted from *Electronics Weekly*, 20 March 1996)

Internet security

Internet security has been a hot potato as commercial interests try to turn the global network into a secure medium for conducting business. But the issue of security is a hard one to implement precisely because of the very qualities that have made the Internet a global medium.

The Internet was not designed for conducting business but as a communications medium that could survive a nuclear war. Its TCP/IP communications protocol can route messages around any damaged parts of the network and use whatever

computer networks are available. However, for businesses trying to collect credit card information over the Internet, this means that credit card numbers can pass through many unsecured computer systems before they reach their final destination.

And it does not take much to set up a server connected to the Internet, to scan passing traffic for credit card numbers and potentially use that information for fraudulent purposes.

But it is not only credit card information that companies are trying to protect. There is the additional issue of electronic commerce that involves things like letters of credit, electronic legal documents and digital signatures. Security also means preventing outsiders from accessing corporate information on computers connected to the Internet, and of protection from the dreaded, if mostly mythical, world-wide hacker community.

The widespread belief that security on the Internet is poor, is partly a misunderstanding and is being used to explain the failure, so far, of Internet-based shopping services. Netscape Communications, the maker of the popular Netscape Web Browser, has built in encryption capabilities into its browser that encrypt credit card information with a reasonable level of security. In any case, credit card customers are not liable for unauthorized purchases.

But the fact remains that for a large number of commercial applications, Internet-based transactions are far from the secure environments that large organizations are used to dealing with. This has led to many different alliances and consortia to develop security standards for the Internet.

But with so many security options available, and the many different and usually incompatible security features found on Internet related applications, there is a danger of creating confusion and misapplication of what is available.

While there is work being done by international industry consortia on various security standards, progress is slow.

To prevent outsiders from breaking into a company's computer system connected to the Internet, firewalls from a wide number of vendors are available. These are hardware and software systems that monitor the TCP/IP traffic coming in and out of the organization and they are programmed to only allow certain kinds of messages, applications, or users, to have access to the inner network.

But firewalls are complex to set up and it is easy to overlook certain key factors and leave a glaring hole in the firewall that could be breached by a hacker. This is why the controversial Satan program was developed by Dan Farmer and released about a year ago. Satan is a program that automatically checks for holes in a company's firewall. At the time, Farmer received a lot of criticism for creating his program, since Satan could also be used to make it easier for hackers to find a way in. But all the controversy over Satan actually helped shore up a lot of weak firewalls.

Although the popular Web Browser Netscape, provides built in security, there have been several well publicized holes discovered in Netscape security. In fact, it has become a popular pastime among university graduates to try and find ways around Netscape's security technology.

For example, researchers at Princeton University recently discovered that it is possible to use a Java-based program to get around a firewall by exploiting a weakness in TCP/IP. This little trick would allow a hacker to enter a supposedly secure system, and download private information.

Netscape has fixed this security hole but it shows how the complexity of firewalls and the idea of downloading applications can provide a fertile field for malicious hackers and virus creators.

Java, for example, is an innovative computer language that allows users to transparently download small Java programs as they look at Web pages, and provides multimedia effects such as animation. But the problem with Java is that the user, or the firewall administrator does not know what the Java applet will do. Sun says that it has carefully designed safeguards into Java that would prevent it from being used in a harmful way but there is no way yet of policing Java-like applications and making sure that no security problems will arise.

Encryption technologies based on public key/private key encryption offer some of the best security based applications, but there are political problems. The US Government strictly controls the export of the best US-made security products which is a problem for multinational companies that want to standardize across their entire organization. "Security is only as good as the weakest link", says Jones at EDS.

As more companies develop internal Intranet networks based on the same public Internet technology, security issues will multiply, and unfortunately, there is no easy solution. (Source: *Electronics Weekly*, 20 March 1996)

Low-power radio

Within the crowded radio spectrum there are nearly 40 slots allocated to licence-free, low-power commun-ications. These are dedicated to applications as diverse as car alarm key fobs, medical telemetry and local area networks. The permitted maximum power varies between 10 μW and 5 W. This limits the range of low-power radio equipment to a few hundred yards, but at least one company claims that its equipment achieves 100 km, over the North Sea, reliably on 500 mW.

Some of the frequency bands are controlled by international agreement, but far more of them are specifically assigned in their parent country.

One of the concerns of the Low Power Radio Association (LPRA) is the fragmented nature of the European market. The EC intends to harmonize its allocations by the year 2008. Some allocations are already Europe-wide. A band at 2.4 GHz is mostly harmonized as is the 433 MHz slot used for car alarm key fobs. The other one that everyone agrees on is for inductive loop hearing aids, which is up to 135 kHz.

Outside these frequency bands, makers of low-power radio equipment have to make units that can be set to more than one frequency if they want to sell internationally.

Another complication that affects UK and European manufacturers are products from some Far Eastern sources, some of which flout the law with the radios they export to Europe. For instance, some work near 300 MHz, a frequency allocated in the USA. This disregard for standards allows them to unfairly undercut legitimate manufacturers.

Poorly-designed, unreliable, key fob controllers give low power radios a bad name which can affect the professional market.

For instance, users of low-power radio equipment in the UK do not need a licence of any kind. The rule is that the manufacturer must get a representative sample of the transmitter and aerial type approved by a test house validated for this kind of work.

An original equipment manufacturer (OEM) wishing to incorporate low-power radio into some equipment may choose to develop the radio themselves. This can save manufacturing cost, but may involve a surprising amount of development. The alternative approach is to buy in a ready-made, type-approved, radio module. This may be somewhat more expensive, but removes much of the risk.

Low-power radio modules can be classified in several ways. Some are transmit or receive only, others do both. Most are available as uncased modules for incorporation into OEM equipment, although many are available as cased, standalone, units.

Data is either transmitted as it is presented ("wire replacement") or formatted by the radio. Wire replacement radios normally have restrictions on the pattern of digital data handled because streams of bits that do not change state can confuse the receiver. Few radios accept voice as this is not permitted on most of the frequencies available.

The market for low power radios is growing rapidly. The Radiocommunications Agency library have a list of low power radio frequency allocations and the LPRA produces a year book listing manufacturers of low-power radios. (Low Power Radio Association. Tel.: 01422 886950 Radiocommunications Agency. Tel.: 0171 215 5961) (Extracted from *Electronics Weekly*, 24 April 1996)

Web site offers interactive MRI for experiments

Most sites on the World Wide Web purvey information. But one new site offers researchers the opportunity to conduct experiments from their desktop or laptop computers on an interactive, real-time magnetic resonance imaging (MRI) system using conventional browser software such as Netscape. Most uses would most likely involve biological or medical applications—such as studying the effects of drugs or contrast agents in animal models. But the system also could be employed in composite materials research.

The site is at the University of Illinois' Biomedical Magnetic Resonance Laboratory, Urbana-Champaign (http://bmrl.med.uiuc.edu:8080). The interactive MRI system, known as NmrScope, is available on the Web through a server called NWebScope. The system links standard commercial MRI system components with an IBM RS-6000 workstation and software produced at the University of Illinois. A researcher pays only the usual usage fee on the MRI system.

To use NWebScope, an authorized researcher must arrange for a sample to be delivered to the university. Connecting to the server, the researcher sees instrument settings and a menu of possible functions, such as "move slice forward", "zoom in", or "pan". After choosing the conditions desired, the researcher clicks a screen button to carry out the experiment. An image comes up on the screen, which the researcher can use to make immediate decisions on the next steps or download for later analysis. (Source: *Chemical & Engineering News*, 18 March 1996)

Late developers log on

Internet use in the less developed regions of the world is booming. More than 30 countries connected to the Internet for the first time in 1995, including Albania, Bolivia, Cuba, Ethiopia and Uganda. The rate of connection in developing countries—although starting off from a lower level—often exceeds the overall growth rate of the Internet.

By the end of this year, only five or six African countries will lack Internet connections. Networks connecting research institutes and hospitals have been set up across the continent, in particular through cooperation with Orstom, the French research agency for development and cooperation, and Greennet, a non-governmental organization (NGO) that promotes environmental and human rights issues via the Internet.

In India, only a dozen or so universities are connected to the Internet, according to D. Balasubramanian, director of the Centre for Cellular and Molecular Biology in Hyderabad, though he expects this number to increase to between 80 and 100 this year.

Five years ago, Peru, Bolivia and the surrounding countries had no Internet connections. Now almost all universities are connected. In Peru, an Internet consortium of research centres, hospitals and NGOs has persuaded the Government to support a 64 kbps satellite link that connects almost 300 institutions—and yet the country has only three telephones per 100 inhabitants.

Central America is becoming rapidly connected. The Mexican network covers the capital city, but also many universities in outlying regions. Universities and research centres are cooperating to provide links to smaller universities and countries in the region to reduce the new inequalities created between those who are connected and those who are not.

China and Russia have a problem in common with many countries more traditionally labelled as "developing"—the Internet's growth is restricted by poor telecommunications infrastructure. Earlier this year, the Chinese Government also restricted international Internet access by domestic service providers to lines supplied by the Ministry of Post and Telecommunications. The move was aimed at controlling the flow of information in and out of the country.

Russia has recently obtained access to full Internet services for the first time with the installation of the 110 Mbps Southern Moscow Backbone, linking Moscow and St. Petersburg, that link in turn to other centres. (Source: *Nature,* Vol. 380, 4 April 1996)

Bandwidth boost

Growth on Internet networks in Japan has lagged behind that of North America and Europe, but over the past few years the country has invested heavily in opening new Internet connections. The Internet has enjoyed strong support from several key members of the Liberal Democratic Party, the main party in Japan's coalition Government, which allocated US$100 million to various ministries and agencies to create Internet infrastructure.

Bandwidth on the link between SINET, the backbone connecting Japan's leading universities, and the United States was trebled to 6 Mbps in August 1995. A month later, a 2 Mbps connection opened between Japan and Bangkok. Later this year, a 2 Mbps connection will open between Japan and Europe.

Within Japan, SINET's links have recently been upgraded to include 50 Mbps connection for nine national universities, running the length of the archipelago from Sapporo in the north to Fukuoka in the south. Another 20 universities and national research institutes operated by Monbusho—the education ministry, which runs SINET— are equipped with 6 Mbps connections. The same network links up a further 450 private and public universities with 1.5 Mbps connections.

Internet links between countries in the region are also improving. 1.5-Mbps links between Japan, Hong Kong and Singapore are expected to be completed later this year by the Asian Internet Holding Company (AIH), a consortium of four companies from the three countries. (Source: *Nature,* Vol. 380, 4 April 1996)

US plans for virtual laboratories by Internet

The US National Science Foundation (NSF) is to launch a project to create a high-speed computer network that will allow US scientists to carry out activities—such as

collaborating in virtual reality laboratories and manipulating instruments by remote control—that are impossible to do properly on the existing Internet.

NSF also hopes that the program, known as "Connections to the Internet", will encourage the development of technologies that would allow its planned high-speed network to be grafted onto the existing network.

Since last year, NSF has been leasing a 155 megabit very-high-speed Backbone Network Service (vBNS) from the telephone company MCI. Until now, the vBNS has linked only NSF's supercomputers and has had few connections to the Internet.

In future, however, NSF will ask researchers to submit proposals on ways of using the backbone for high-speed networking. It will also fund high-speed connections from their home campuses to the vBNS, according to Mark Luker, director of both the vBNS and the new program.

With some clever engineering, some high-performance tasks can already be carried out through the Internet. But campus Internet links are becoming congested as students flock to use the World Wide Web (WWW), which uses up much more bandwidth than either e-mail or file transfer.

As a result, many researchers feel that high-performance computing has become almost impossible, while the transfer of large data files often takes a long time. But according to Luker, the need for high-speed networking is due less to the problems of congestion than to the wish of researchers to develop new ways of collaborating with each other.

The Internet was not designed for high-speed applications, which typically require not only high bandwidth but also close synchronization between computers. Instead, it was planned primarily to make the most efficient use of telephone lines, by smoothing out over both time and space the uneven stream of data packets from applications such as e-mail, file transfer and the WWW.

In particular, the design of Internet means that its response times are highly variable. Operating a telescope by remote control using Internet can be like driving a car whose response to the steering wheel may be 10 seconds, unknown, or vary from one second to the next.

Building a separate high-speed network for researchers does not solve the problem, as it would defeat a general goal of sharing network resources, and be impossible to scale up economically. NSF's vision is "a single Internet that supports all services". But simply linking the two networks together would not be a solution, as the high-speed network would be quickly invaded by hordes of web-browsing packets. A technical "fix" is first needed that would either give priority on the hybrid Internet to high-performance applications or code such traffic so that it is diverted to the high-speed backbones. (At present, the Internet treats all packets alike.)

Stimulating the development of this technical fix is one goal of NSF's new program. The agency will not merely provide researchers with a direct line to the vBNS, but will also ask universities to upgrade their networks to handle both traditional Internet traffic and traffic destined for the vBNS. This should be done in a way that can be scaled up economically to the dimensions of the Internet, adds Luker.

There is no shortage of ideas about how this prioritization could be achieved. One way would be to reprogram "routers" on the network to sort data packets according to the address of the sender, as packets from known high-speed computer users would be automatically routed to the vBNS.

NSF hopes that whatever technical solution emerges, the end-result will be an improved service, which cannot currently be bought on the Internet.

None the less, the early growing pains of "Internet II" are likely to be much greater than those of the current network. The circumstances are very different. The Internet originally grew out of university and other publicly supported networks; by the time providing Internet connections was transferred to commercial operators, it had become what economists refer to as a "commodity business", and prices were quickly driven down by fierce competition.

This time the situation is reversed. The three US national high-speed "backbone" networks are owned by telephone companies—MCI, Sprint and AT&T—while the extensive cabling in urban areas is also owned by private companies.

The current high costs of high-speed networking mean that services such as on-line video are not yet economic. With few profits to be made from an embryonic network, the commercial companies involved are reluctant to connect with each other, preferring to hold out and fight for market dominance. (Extracted from *Nature,* Vol. 380, 14 March 1996)

C. NEW DEVELOPMENTS

Institute makes quantum leap through logic gate

Researchers at the California Institute of Technology (Caltech) in Pasadena have demonstrated prototypes of quantum logic gates, the building blocks needed for quantum computers.

Caltech's quantum logic gate consists of two concave mirrors 50 microns in both diameter and length that form an optical cavity.

The researchers have shown that by forcing differently polarized photon beams into this optical trap for long enough they interact in a presence of certain atoms to give a definite output.

The presence of atoms changes the properties of the photons by providing the necessary energy for state change. The resulting photon beam changes state accordingly, equivalent to ones and zeros in conventional logic gates. As such, a controlled discrete quantum logic gate is achieved and combined with others and can form more complex, quantum logic circuits.

Although at a primitive stage, these gates appear to have a promising future either in quantum computers, or optical communications.

Quantum computing offers the promise of parallel processing performance on an unprecedented scale. At present conventional parallel computers cannot factorize the product of immensely large prime numbers as used in cryptography.

Quantum computing should overcome this difficulty by exploiting quantum-mechanical effects that result in multiple simultaneous states, highlighting all likely solutions. These can then be processed further using statistical measures to identify the solution.

Dr. Peter Shor at AT&T Bell Laboratories has already demonstrated an algorithm that has shown how such products could be factorized using quantum computing. To date, it has taken a year for more than one thousand conventional workstations working together to factorize a 129-digit product. (Source: *Electronics Weekly*, 21 February 1996)

Quantum computing and parallel processing

Computing, as we know it today, will be radically transformed with the help of quantum physics. Although as yet still at a theoretical stage, quantum computing could offer the most effective parallel processing approach yet.

The likely quantum computer will consist of elementary logic gates, as with any computer today. These are termed quantum logic gates as they exploit the quantum-mechanical properties of atoms, electrons or photons. The gates will be analogous to the transistor-based ones and their outputs will correspond to functions described by Boolean algebra.

The basic principle underlying a quantum logic gate is conditional dynamics. Here participating particles, such as electrons and photons, are manipulated so they can interact with each other and produce outputs reflecting a change in spin or energy level and phase or polarization orientation respectively.

So far, only two institutions have successfully demonstrated conditional dynamics at the single particle quantum level, the Colorado-based National Institute of Science and Technology (NIST) and Pasadena-based Caltech.

At NIST, researchers have used an ionized beryllium atom (where one of the valence electrons has been removed) to implement a quantum logic gate. When the electrically charged atom is subjected to changed conditions such as temperature, it can be made to exist between two possible states by changing the spin of its remaining electron. This is achieved by firing a finely tuned laser pulse onto it. It can be assumed that these energy states are comparable to logic states "1" and "0".

At Caltech, the quantum gates approach uses interaction of light and matter to achieve conditional dynamics for a controlled output.

Caltech's team has demonstrated that conditional photon phase shifts, up to 15 degrees per photon, can be obtained from the interaction of two photon beams in an optical resonator. Each photon beam can be tuned independently in frequency, power and polarization. Caltech's quantum logic gate consists of two concave mirrors, 50 microns in length and diameter, that form an optical cavity. Curved mirrors have the advantage of providing three-dimensional confinement of the photon beams, unlike planar mirrors.

Two polarized single-photon beams differing in frequency are injected into this cavity together with a Caesium atom. The atom's valence electron interacts with the polarized photons giving it enough energy to flick into a higher, excited state. Once relaxed (returning to its stable, ground state) the electron emits a photon that is phase-shifted with respect to the incident beams. Differing photon polarization of the input beams causes a phase-shift that varies between ±15 degrees. It is this phase-shift that is measured to detect the result of the gate's operation.

The transformation of a quantum version of the classical truth table, specifying the output as a function of up to two inputs. As such, a controlled discrete quantum logic gate is achieved. When combined with others, complex quantum logic circuits can be formed.

Scientists at other research centres, including IBM's T. J. Watson Research Centre, are analysing the possibility of engaging more than two (input) information carriers such as photon beams.

There is still a long way to go before quantum logic gate circuits appear. The hardware needs to be near perfect. Interaction with other atoms should be avoided at all costs, and echoes and noise from the equipment and electrodes needs to be prevented. Performing error correction is also of primary importance.

Although at an early stage, the gates appear to have a promising commercial future either in quantum computers or optical communications.

The objective of quantum computing is to perform computation in a more efficient way than the classical approach. Computers operate on bits in one of two possible states. By analogy, the quantum equivalent of a bit can be represented by any two-state quantum system. A two-state condition can be achieved through electron spin (±½), an atom which is confined to two states, such as a beryllium atom, or the polarization states of a photon, as used in Caltech's work.

A quantum particle can be characterized by a number of properties including spin, polarization, phase, energy level and angular momentum. The state of any one of these properties is dependent on the inputs to the logic element. Each of the numerous property combinations defines a processing result done by this element. It is the interaction of

multiple inputs on an atom's valence electrons that produces multiple outputs. This is the essence of parallel computation where multiple results are obtained from a single process.

A quantum computation consists of propagating the wave function describing the state of the computer through a series of quantum logic gates.

One application where quantum computing has been proved theoretically is Shor's factorizing algorithm (based on the work of AT&T's Dr. Peter Shor) where the large prime numbers that constitute a product can be determined.

Theoretical investigations have shown that the factorization of a number up to 100 will require around 24 information carriers (eg. photon beams) and over 20,000 elementary logic gates. Nevertheless if scaled this will still be more effective than using conventional computing. For example, it has taken up to a year and over 1,500 workstations linked to together to factorize a 129-digit product. (Source: *Electronics Weekly*, 28 February 1996)

Chaotic communications

Chaos theory promises the ultimate in secure communications, enabling systems to emit signals indistinguishable from background noise.

Researchers at the University of Birmingham's school of electronic and electrical engineering have developed a communications system that chaotically encodes a digital data stream. At the same time, it hides the signal within a noise-like structure. This is desirable especially for military applications where the "enemy" would not even know communications are taking place.

Traditional "secure" systems are not in fact so secure, because enough information is available for signal reconstruction. The chaos system offers enhanced security since the initial conditions must be known exactly. Any slight difference and the system quickly diverges. This is comparable with the chaos theory example that says weather cannot be predicted without knowing all the starting conditions which may include a butterfly's wings beating in Australia.

The claimed bit error rate (BER) of the current system is 1 in 10,000 at a signal-to-noise ratio (SNR) of 10 dB. The University is working on a system where an acceptable BER is obtained for negative SNR; in other words, the noise has more power than the signal. This would give truly undetectable communications. (Source: *Electronics Weekly*, 21 February 1996)

See current flow in superconductors

An imaging technique may hold the key to developing high-temperature superconductors that can carry 10 times more electrical current than previously possible. Using magneto-optical-flux imaging, the method is able to identify the precise location in a material where current flow stops, says scientist George Crabtree, Argonne National Laboratory, Argonne, ILL. The research, which won a Department of Energy material-sciences award, is the result of collaboration with former Soviet scientists from the Institute of Solid State Physics outside Moscow, working with Phase Metrics Inc., San Diego. (Source: *Industry Week*, 19 February 1996)

The visualization supercomputer

Silicon Graphics Inc. calls its new Onyx InfiniteReality the world's fastest and most innovative visualization supercomputer. For complex visualization, it is up to 100 times faster than its predecessor, the Onyx RealityEngine 2. For manufacturers, the new machine provides the ability to combine individual computer-aided designs into a single digital prototype. With it, designers of complex products can perform manufacturing, maintenance, and human factors studies long before an expensive prototype is ever built. The system uses the MIPS RISC R10000 processors—two to 24 for a peak performance exceeding 9 GFLOPS. (Source: *Industry Week*, 19 February 1996)

Some like it hot

Big brother may soon have a new way of watching you, thanks to researchers at Northwestern University in Illinois. They have used advanced film deposition methods to make heat-sensitive detectors so powerful that they can provide detailed images of the human body from several miles away.

The team, from Northwestern's Centre for Quantum Devices, is studying QWIPs or quantum well infrared photodetectors. Each QWIP is composed of 100 alternating layers of gallium arsenide and gallium indium arsenide phosphide. The researchers build these up, atom by atom, using chemical vapour deposition, so that each layer is about 10 molecules thick.

As with all semiconductors, electrons jump from layer to layer, forming "potential wells". But as the QWIP layers are so thin, the electrons in the wells behave like waves rather than particles and a series of energy bands form inside the well. This is the key to the QWIP's operation, explains team member Jim Hoff. The energies of these bands correspond to the energy of infrared radiation.

The QWIPs made by the Northwestern team are unique because they are sensitive to infrared (IR) radiation at two wavelength ranges, rather than one. This means that they can detect multiple IR images and are far more accurate than other IR detectors. Also, the wavelengths (3-5 μm and 8-12 μm) are not absorbed by the atmosphere. In theory, says Hoff, the QWIPs can detect an IR source from any distance.

Another advantage of these QWIPs is that the layers are extremely uniform. This means that they can be grown into an IR camera lens. NASA is building a QWIP into a camera that should be able to detect traces of industrial discharges and leaks from 3,000 ft up. The Pentagon is also following developments keenly, with an eye to using the QWIPS in improved night vision equipment. (Source: *Chemistry & Industry*, 19 February 1996)

Cellular neural network array

Taking a cue from biological systems, the University of Leuven has produced a compact analog array processor suited to image manipulation and machine vision tasks. The array has been developed as part of more general work addressing "smart" sensors where intelligence is embedded alongside sensor circuitry.

The University's Medical Integrated Circuits and Sensor Group's approach has been to develop an array of multiple, simple analog cells that implement a cellular neural network.

The analog processor comprises a 20 × 20 array of computing cells that act on input sensor data. To implement a cellular neural network each cell has an input, internal and output node, and is linked to its four nearest neighbours. Neighbouring cells exchange signals which are weighted by templates. Two signals are exchanged: one is proportional to a cell's input signal, weighted by the feed-forward template; the other is proportional to the output, weighted by the feedback template. All cells are initialized with the same template values. The University has developed a library of templates for the programmable device to perform a range of applications.

For an image-processing application, the cells receive image data and start summing and integrating signals from neighbouring cells to initiate the network's evolution. Each cell's output represents a measure of its state node thresholded at -1 and 1 and comprising a linear region in between.

All the cells execute in parallel and continuously in time. To achieve a compact design, simple circuits have been used with each transistor "fully exploited". A consequence of a compact design is that the statistical variation of the devices becomes larger, decreasing the accuracy of the computations. However, if the accuracy is overspecified, the speed is reduced and power consumption is increased.

Processing times are measured in cell time-constants. The typical execution for a non-propagating template is 9.6 μs, while the worst case information propagating template is 145 μs. The I/O circuits can be clocked at 500 KHz, achieving a processing frame rate of 25 per second. The device has been linked to a tactile pressure sensor for a robot arm control application. The system measures the object's coordinates in contact with the pressure sensor to enable detection when it starts to slip.

The device's performance has been compared with a digital signal processor. The array processor requires a factor of 20 less energy (power-delay product) than the DSP for a given computation. (Source: *Electronics Weekly*, 14 February 1996)

Chromium hydride cluster exhibits unusual magnetic behaviour

The search for molecular materials that are magnetic at room temperature has so far turned up only two: a vanadium-chromium cyanide and an enigmatic material derived from vanadium and tetracyanoethylene. Researchers have now found evidence that metal hydrides might furnish another promising route to molecular magnets. Klaus H. Theopold, a chemistry professor at the University of Delaware, Newark, and his colleagues synthesized a chromium hydride cluster whose magnetic behaviour is highly unusual. The C_4H_7 core of the cluster is a tetrahedron of chromium atoms, with five of the six edges bridged by one hydride each. The sixth edge supports two bridging hydrides. Each of the four chromium atoms is also coordinated to a substituted cyclopentadienyl ring. This compound has seven unpaired electrons, and the spins of those electrons might have been expected to show relatively weak magnetic coupling and a diminution of magnetic ordering as the temperature was increased. Surprisingly, the intramolecular magnetic coupling is so strong that the magnetic alignment persists even as the compound is warmed to room temperature. In fact, this is the strongest parallel magnetic alignment ever observed in a molecular cluster, Theopold says. Such strong magnetic interactions between spins on different atoms are necessary to produce bulk magnets at ambient temperatures. Metal hydrides might be good building blocks for such magnets, he suggests. (Source: *Chemical & Engineering News*, 15 January 1996)

Teflon protects superconducting devices from corrosion

A method to protect high-temperature superconductor (HTS) devices from corrosion could speed up their commercialization for magnetic-sensing applications. Corrosion is a serious problem with HTS devices, especially when the superconducting material is YBCO (yttrium-barium-copper-oxide), which is very reactive to water. Researchers at Quantum Magnetics, based in San Diego, CA, and IBM's T. J. Watson Research Centre, Yorktown Heights, NY, have found a way to keep moisture out of these devices. They use Teflon AF, an off-the-shelf DuPont product, as the moisture barrier. To make Teflon AF stick to the device, they use perfluorinated adhesion promoters that react with the substrate to form a surface to which Teflon AF sticks better. Adhesion is further reinforced by thermal annealing. With the barrier in place, the researchers face the challenge of opening areas for electrical contacts. They successfully developed a procedure for patterning the inert Teflon AF surface through a photolithographic wet-etch process. Quantum Magnetics is using these methods to make ultrasensitive magnetic-sensing devices incorporating HTS technology licensed from IBM. (Source: *Chemical & Engineering News*, 29 January 1996)

Microporous surface on silicon wafer shown to be bioactive

Research in the UK has shown that silicon wafer surfaces can be rendered bioactive by simple wet-etching techniques. The work suggests that silicon 'biochips' might be developed to bond directly with both living soft tissue and bone, with potential use in invasive medical and biosensing applications, intelligent drug delivery systems, and other electronic prosthetic devices. Leigh T. Canham, principal scientific officer at the Defence Research Agency, Malvern, has demonstrated that hydrated microporous silicon coatings on silicon wafers promote hydroxyapatite growth in simulated body fluid with ion concentrations close to those in human blood plasma. Hydroxyapatite $[Ca_{10}(PO_4)_6\text{-}(OH)_2]$ is a constituent of bone. Canham prepared the microporous surface by anodization of a silicon substrate. He then exposed segments of the wafer to the simulated body fluid for periods ranging from six hours to six weeks and monitored the structural evolution of the surface using scanning electron microscopy, X-ray microanalysis and infrared spectroscopy. Bulk silicon is relatively bioinert, Canham points out. "Hydrated microporous silicon could be a bioactive form of the semiconductor", he notes, and he suggests that "silicon itself should be seriously considered for development as a biomaterial for widespread *in vivo* applications." (Source: *Chemical & Engineering News*, 1 January 1996)

Hitachi promises terabit storage

Hitachi ULSI Central Research Laboratory has given a glimpse of the next development that promises terabit storage devices, namely single-electron memory (SEM)

SEM has received considerable attention in recent years, first being demonstrated at very low temperatures and more recently at room temperature. The ability to control a few electrons promises reduced power consumption per transistor and significantly higher levels of circuit integration.

Hitachi's accomplishment has been to combine a number of SEM cells demonstrating for the first time a working 8 × 8 bit memory array. In turn, the development of a working SEM IC has highlighted the obstacles to be overcome if volume manufacturing is to occur.

The SEM device uses a 3 nm ultra-thin-film transistor which exploits the Coulomb blockade effect. The effect works by confining a pool of electrons to a small region such that the stored charge energy is greater than the thermal energy of an external electron, stopping it from entering. The trapping of one or more electrons in a pocket stores information and manifests itself in a constricted current flow.

The cell has the gate, or word line (WL), parallel to the channel, which covers the region between source and drain. Hitachi chose the arrangement for compactness although it

admitted it was uncertain of its working until confirmed by the built IC.

The cell comprises a vertical source and data lines (DLs) straddled by the horizontal word line. Each source line (SL) is shared between adjacent cells, to reduce overall area. The device's operation is word-line based; all cells coupled to the word line are simultaneously erased/written/read.

The SEM has a 10 μs write/erase time. This is faster than flash memory since the number of electrons to be stored or erased is five compared to 100,000 of flash. It also promises repeated write/erase cycle endurance, with Hitachi confirming that 1 million cycles are possible. The device's shortfall includes a retention time of between an hour and a day, unacceptably short for non-volatile store. This, however, is expected to be prolonged by further thinning the film. A further technical challenge is the threshold variance across the device: while it is small, it is still larger than is acceptable for manufacturing. (Source: *Electronics Weekly*, 14 February 1996)

A better chip

Scientists at the University of Illinois (Urbana-Champaign) report an alternative way to manufacture silicon microchips that extends the lifetime of the chips as much as 50 times that of chips produced conventionally. The scientists use deuterium rather than hydrogen during the annealing step. The result, they say, is more rugged chips that last longer and are better able to withstand harsh conditions, such as temperature extremes and radiation. The scientists say the process is inexpensive, with the use of deuterium equal to roughly one thousandth of a wafer's cost. (Source: *Chemical Week*, 28 February 1996)

Creating order with disorder

Bringing order out of chaos can require a little disorder. That is the unexpected conclusion of physicists at the Applied Chaos Laboratory of Georgia Institute of Technology, Atlanta. They worked with computer simulations of a variety of coupled non-linear systems, including a series of chaotic pendula and a system with 100 identical oscillators. The researchers found that a 30 per cent variation in the length of pendula or behaviour of oscillators produced the most regular behaviour patterns. Less disorder would not prompt changes, while more disorder simply overwhelmed the patterns. Implications of the research range from improving the performance of electronic systems by exploiting variations in their components to new techniques of controlling disease processes such as epilepsy. (Source: *Industry Week*, 5 February 1996)

Prototyping as a production process

Rapid prototyping has not yet fulfilled its popular paraphrase as "desktop manufacturing", but it is coming closer at the University of Dayton's Research Institute. Researcher Richard Chartoff's team is adapting a rapid-prototyping system to serve as a fast production process for ceramic parts. The equipment, developed by Helisys Inc., Torrance, CA, was originally designed to laminate 3-D objects out of paper (laser-cut part cross-sections). By substituting "tapes" of ceramic powders held together by a polymer binder for the paper, the research team is able to quickly produce a 3-D ceramic shape that, when fired, can serve as a fully functional part. They also demonstrated the ability to impregnate the resulting porous part with a variety of materials. (Source: *Industry Week*, 5 February 1996)

Image processing for large colour pictures

A team at NEC, headed by Yoshiharu Aimoto, has developed a 7.68 GIPS, 3.84 Gbit/s, parallel image processing RAM (PIP-RAM) that dissipates less than a watt.

The chip is aimed at image processing large-scale full-colour pictures.

It integrates a 16 Mbit DRAM, arranged as an array of one hundred and twenty-eight 128 kbit segments, with 128 processor elements on a single 19 mm × 17 mm chip using 2.5 V, 0.38 μm, 64 Mbit CMOS DRAM process technology. Four redundant processor-memory segment pairs are included to improve yield.

The architecture is single instruction stream, multiple data stream and all processors are controlled by a single external instruction.

Each processing element includes an 8 bit ALU, a shifter, 24 general-purpose registers and five special-purpose registers.

Mixing memory and processor technologies on-chip gives rise to three difficulties: restricted speed random access, high-power dissipation and lost synchronization between RAM and processors.

These have been addressed and solved by the NEC team by using a page segmented access scheme, clocked low voltage differential charge transfer and multi-phase synchronization DRAM control.

The page segmented accessing seeks to divide the memory into optimum sized pages. Large pages give fast access, small pages give low power dissipation. The column and row addressing to the chosen page size is also optimized to minimize the number of lines that change state when segments within a page are addressed.

The PIP-RAM moves 1,024 bits of data between the memory and processors at each transfer leading to potential power dissipation problems. The differential charge transfer scheme has been introduced to limit this. Data lines are in differential pairs and only swing 0.4 V to change state. Line capacitance is kept to 2 pF.

Synchronization of both internal and external transfers is maintained by a multi-stage phase locked loop and a timing controller. (Source: *Electronics Weekly*, 14 February 1996)

Accepting analog inputs; producing digital outputs

The world produces a lot of parallel information and presents most of it in analog form. Modern computers, however, access data in serial form and process it digitally. In between are A to D converters which chop up worldly signals and feed them into the digital domain.

Analog computation suits the processing of natural signals but is prone to drift and loss of precision and also generates analog outputs.

A group from Tohoku University, Japan, has merged digital and analog processing techniques using a technology called neuron-MOS (νMOS). The architectures they have created accept parallel analog signals and produce digital decisions, removing the need for conventional A to D converters.

Applications demonstrated so far are a motion vector detector that works in 100 ns and real-time centre of mass tracer for moving images.

Processing is performed by analog units with names including matching cells, summers and winner-takes-all circuits. These circuits are not conventional (op-amp) circuits. They are collections of multi-gate FETs, floating gate FETs and analog switches that perform traditional analog computer operations.

The νMOS matching cell calculates the absolute value of the difference of the two input voltages. A summer adds the amplitude of several inputs together, using multiple gates on a MOSFET. And the winner-takes-all circuit has n analog inputs and n digital outputs, where the only active output is the one associated with the lowest value input. This circuit works by comparing all the inputs with a high-speed ramp. The first input to be exceeded by the ramp locks out the other outputs.

Two-dimensional motion vector search is performed by splitting an image consisting of variable intensity pixels into one-dimensional horizontal and vertical strips. Segments of strips at right angles through an object are then assessed by the movement analyser to determine the X and Y parts of the movement vector.

In a ±4 pixel device the value of a series of pixels on a strip (say eight) from a time (t) are stored onto nine rows of matching cells, each offset by one cell. The rows represent the sample at t offset by ±4 pixels. A series of pixels from time t+1 are then stored in the other input of the matching cells.

The matching cells now have the magnitude of the difference of the t and t+1 pixels at their outputs. Matching cells with pixels of similar amplitudes have low amplitude outputs.

Summers then add up all the outputs in each row and the winner-takes-all circuit picks the row with the lowest total difference. This is the row with the offset that best matches the actual object movement made between t and t+1 in the chosen axis.

The centre of mass circuit is far more complicated and solves the equation $X_G \cdot \sum M_i = \sum M_i X_i$ using components as exotic as an n and p-channel FET pair that share a floating gate that is charged by no less than 18 control gates. (Source: *Electronics Weekly*, 14 February 1996)

Strong-ARM debut

Digital is presenting Strong-ARM, its high-speed implementation of the ARM architecture. The chip delivers 184 Drystone MIPS at 162 MHz while dissipating 0.5 W. If the internal chip voltage is raised from 1.5 V to 2.0 V the speed can be increased to 215 MHz with a dissipation of 1.1 W. External interfaces are 3.3 V.

Digital has added its well-known high-speed expertise to the low-power, small-chip, ARM architecture to crank up its performance.

Two of the areas that Digital addressed are reduction in chip voltage and widespread use of conditional clocking within the chip.

Analysis of a previous Digital design showed that the 0.5 W power requirement could be met by using its established circuit techniques with 2.0 V operation and slight adaptations to make the chip fully static. A 20 mW idle and 50 μA sleep mode have also been introduced.

The clock was originally distributed on a single monolithic node. This is fast and simple, but not applicable to low-power conditional clocking. The improvements included local buffers to allow narrow distribution wires and separate clocks for different regions. The regions are: pins, bus interface control and write buffer, core, Icache and Dcache. This allows regions to be clocked at different rates and linked when intercommunication is required. (Source: *Electronics Weekly*, 14 February 1996)

Three steps to IC making

Chemists at Simon Fraser University in Canada have found a simpler way to lay metal tracks on semiconductors. The three-step process uses photo-active metal compounds. To place a copper wire on the circuit, a solution of copper-containing molecules is made. This is dropped on a spinning wafer to cover the entire surface. Then an appropriate wavelength of light is shone on the wafer surface in the desired circuit pattern. The coating left on the surface illuminated by the light decomposes. The copper sticks to the wafer where the light was—forming a circuit. The third step is to wash away unexposed metallic compounds. (Source: *Electronics Weekly*, 7 February 1996)

Sony develops optical data storage technology

Sony claims to have developed an optical data storage technology with far more capacity than current compact disks and digital video disks. The technique uses a blue-green semiconductor laser with a wavelength of 515 nm, compared to the 780 nm sources used in CD players. Sony is aiming for 1,000 hours of storage operation and has recently achieved 100 hours of continuous operation. (Source: *Electronics Weekly*, 7 February 1996)

Samsung makes 2 bit per cell memory using NAND flash

Workers at Samsung have made a 2 bit per cell memory using trickier NAND flash technology rather than its simpler NOR brother.

The state of cell in a NAND flash array is transferred through up to 15 neighbouring cells before it reaches the bit line. The cumulative differences in these cells can swamp the subtle changes in the active cell that have to be detected for multi-bit flash to work. A 3.3 V 128 Mbit NAND flash memory is organized as a 16 kbit row by 4 kbit column array of 2 bit per cell cells.

Each of the four possible program states of the 2 bits is represented by a different voltage on the cell. Each state has an 0.4 V distribution and a 0.8 V gap between it and the next state. Accurate programming is achieved using a 0.2 V step-measure-and-repeat-if-necessary procedure. If cells in the NAND string are programmed at random the cell error can be made up to an unacceptable 0.6 V. To avoid this, programming has to be restricted to a "bottom cell first to top cell last" sequence. Cells programmed in this way are self adjusting and voltage error is only 50 mV.

A high program voltage is required to cover the range of cell voltages needed for multi-bit operation. The high voltages are liable to corrupt adjacent cells in the string. Samsung has developed a technique called local self boosting to reduce this corruption. This turns the adjacent transistors off (0 V to the gates) rather than the normal practice of maintaining them at Vpass. The effect of this is to isolate the high voltage from cells that are not being programmed, keeping disturbance to less than 0.1 V. The program bit line voltage (0 V) is still passed to the cell because the sequential programming means cells above it are still erased.

The memory has been fabricated in 0.4 μm, triple-well CMOS. Read throughput is 14.0 Mbit/s, program throughput is 0.5 Mbit/s. Chip size is 7.11 mm × 16.46 mm. (Source: *Electronics Weekly*, 14 February 1996)

Sun demonstrates 'paperback' Java-based Internet computer

Sun Microsystems gave the first public demonstration of an Internet computer based on its Java computer language during the recent Uniforum Unix trade show in San Francisco. The device, the size of a paperback book, was connected to a computer display running Java-based applications. The device was a proof of concept prototype

and that other manufacturers will be producing computers based on the design. Oracle is also developing a range of business applications that will be bundled with the computer.

Internet computers of the type being touted by Sun and Oracle have no local data storage. Instead, they use Internet connections through standard modems to access data and applications stored on remote servers. Such computers may cost as little as $500 compared to standard PCs that cost about $2,000. (Source: *Electronics Weekly*, 21 February 1996)

Toshiba claims chip advance

Toshiba claims to have developed a 0.5 V chip technology that will offer a 97.5 per cent reduction in power consumption compared with 3.3 V logic. The circuit structure and control methodology has been developed at Toshiba's ULSI research laboratories in Japan.

The company claims that the problem with low voltage operation of conventional circuit types is excessive leakage.

Low-voltage circuits need low threshold voltage (V_t) transistors which are prone to switching errors because of their high leakage. Ideally the V_t of the transistors in a low-voltage circuit would be variable, but all the transistors on a chip have the same V_t determined by the substrate composition.

The proposed structure allows each transistor in the circuit to have its threshold voltage controlled individually. Transistors that are in the on state get a low V_t to maintain high speed operation whereas transistors that are off have their V_t raised, reducing leakage.

Varying the V_t exploits the fact that threshold voltage decreases when the electrostatic level of its substrate is high and vice versa. Silicon-on-insulator technology is used to separate transistors electrically and achieve individual control. The substrate control signal comes from the transistor's gate. The result is a V_t of 0.2 V for on transistors and 0.5 V for off transistors. (Source: *Electronics Weekly*, 21 February 1996)

New RISC core

Toshiba Electronics claims that its 32 bit RISC core, the TMPR3901F has performed to 52.2 Drystone MIPS at 50 MHz. The core was expected to be available for ASIC integration in mid-1996. The core is manufactured in 0.4 μm CMOS and with 4 kbyte instruction and 1 kbyte memory caches measures 26 mm^2. At 3.3 V and 50 MHz, power consumption is claimed to be 400 mW. (Source: *Electronics Weekly*, 14 February 1996)

Scanner-on-a-chip

Wolfson Microelectronics has put all the signal processing circuitry for high-performance colour scanning onto a single chip. It will make the colour scanner a consumer-priced item.

The chip, the WM8044, is also being designed into combination products having a copier, scanner and fax all in the same box. In development is a scanner chip which will add the scanner function to the PC box itself.

Although Wolfson sees the big volume in the low-cost end of the business, it has begun with a chip for the high-performance scanner market. Wolfson's scanner chip converts at 6 million pixels a second and corrects for the non-ideal input from the CCD on a pixel by pixel basis—a technique for which applications for patents have been filed.

In order to cut time to market, Wolfson has licensed a Texas Instruments (TI) high-speed, pipelined A/D cell which it incorporates in its scanner chip. TI is the foundry for the chip using its LinEPIC process and is a second source. Production units were expected to be available from June 1996.

The WM8044 is currently being evaluated for design-in at 10 Taiwanese scanner manufacturers. (Source: *Electronics Weekly*, 10 April 1996)

Diamond's promise as a semiconductor material

Diamond is amazing stuff. Apart from being the hardest and least compressible material known, it is also the most thermally conductive and is transparent to all wavelengths between infrared and ultraviolet.

Aside from its mechanical characteristics, diamond shows extraordinary promise as a semiconductor material, with most potential in high-power, high-frequency, high-voltage applications.

Much of the extraordinary performance potential of diamond stems from its high band gap of 5.5 eV. Silicon, with a band gap of 1.1 eV, will not work above a temperature of 200° C because thermally generated electron begin to dominate conduction. Diamond, on the other hand, will work up to 700° C. In fact, one of the issues with diamond is to get a good performance at room temperature as it works better as it gets hotter.

For a given thickness diamond will block 20 to 50 times more voltage than silicon, making it a better bet for high-voltage applications. The smaller dimensions allowed by the high blocking capability, combined with the resultant higher field gradients, increase carrier speed to 40 and 100 times that of silicon or gallium arsenide.

Semiconductors are often judged by "figures of merit", the higher the value the better the material. Diamond has the highest rating of all semiconductors for both Johnson's and Keye's figures of merit. Johnson's is applicable to power microwave applications and Keye's covers digital integrated circuits among other things. Figures of merit are always a bit controversial, but these two suggest that diamond has a lot to offer the electronics industry.

Making diamonds economically was once considered in much the same way as turning lead into gold, impossible. The argument stems from the fact that diamond is not the most stable form of carbon at low pressure, while graphite is. Unless the temperature is over 1,500° C and the pressure is 60,000 atmospheres, much more graphite forms than diamond. Experience has shown that this is not true as there are other factors governing the relative rates of formation. Diamond films can now be made at less than 200° C in a partial vacuum. The key to diamond alchemy is chemical vapour deposition (CVD).

Several CVD techniques, including simply directing a fuel-rich oxyacetylene flame onto a cooled substrate, have been developed for diamond film production.

The substrate choice is critical if good quality diamond is required. Diamonds can be deposited on diamond (homoepitaxy) or another material (hetroepitaxy). A diamond substrate is the obvious choice for growth, but large ones are extremely difficult and expensive to make. In addition, it is also almost impossible to separate the deposited diamond from the substrate. Substrate-sized single crystals of diamond can be laid down using homoepitaxy, but the largest substrates are only a few millimetres across at the moment.

The choice of substrate for hetroepitaxy depends on many factors, but silicon is becoming a favourite because much is known about it, and its crystal structure is similar to that of diamond. Films 100 mm in diameter are being regularly grown using hetroepitaxy, but they are either amorphous or polycrystalline.

Several attempts have been made to grow large crystal on silicon. The US Navy Research Laboratory has sponsored development of a mixed homo/hetroepitaxy technique. It works because silicon and diamond have the same crystal structure.

Square pits are etched into the surface of a silicon wafer. The use of an etchant that follows the silicon lattice results in pits the shape of inverted square pyramids. As crystals of silicon and diamond have the same structure, the pits are exactly the same shape as the end of a diamond crystal. The wafer is dipped into a suspension of tiny diamonds, which wedge into the pits. This results in a field of diamond crystals all aligned in the same crystal axis. Diamond is deposited onto the surface and the layer that grows connects the "seed" diamonds. Spacing and small angular errors result in some grain boundaries forming, but experiments show that the resultant layer is very similar to monocrystalline diamond. Another type of carbon that is coming under scrutiny is called tetrahedrally bonded amorphous carbon (TAC). It is carbon with a mixture of graphite (SP_2) bonds and diamond (SP_3) bonds.

Diamond shows huge potential as a semiconductor material and, judging by the amount of patent activity, difficulties like n-type doping and hetroepitaxy are getting a lot of attention.

The size of polycrystalline diamonds no longer seems to be a problem. The latest piece of diamond news has been the fabrication of an 11 inch diameter diamond weighing half a pound, made as part of a Lockheed-Martin sponsored project at Florida University. The crux of making this monster was evenly seeding the substrate. This problem was finally cracked from an unusual direction, colloidal chemistry. Ordinary abrasive diamond grit was graded and sieved into an aqueous solution to form a colloid. A clever bit of surface chemistry made the substrate positively charged, which attracted the natural negative surface charge on the diamonds. (Source: *Electronics Weekly*, 6 March 1996)

Diamonds sparkle in UV detection

A group at University College London has developed a diamond-based ultraviolet detector that is set to be commercialized within the next year.

Ultraviolet light is used increasingly in industry, but current silicon-based detectors are extremely inefficient.

Quantum efficiency is a measure of a sensor's effectiveness. In this case it indicates that more than one electron is produced for every UV photon that strikes the detector.

Silicon sensors respond to visible as well as UV light. The filtering needed to remove the visible component reduces quantum efficiency to less than 0.01.

The sensor is a photoresistor, made on the surface of a polycrystalline diamond film. Photons striking the detector surface cause electron-hole pairs to be formed.

These drift apart in the electric field between two interdigitated surface electrodes and contribute to the current flowing in the external circuit. (Source: *Electronics Weekly*, 6 March 1996)

"Fastest" data exchange

Hitachi has developed what it claims to be the world's fastest data exchange in the form of a 3.5 GHz superconducting 2 × 2 cross-point switch.

Superconduction is the key to the increased speed. The previous record holder, said Hitachi, reached 2 GHz using specially prepared semiconductors. The use of superconductors has also reduced the power consumption to 0.16 mW.

The switch is a so-called three-junction superconducting quantum interference gate fabricated using a 2 μm niobium process.

A single crosspoint uses the equivalent of 33 OR gates, controlled by a three-phase power supply acting as the clock. (Source: *Electronics Weekly*, 13 March 1996)

NTT develops 0.4 V CMOS for solar power

Nippon Telegraph and Telephone (NTT) is developing a low-voltage CMOS process to enable portable equipment to be solar powered. It has already produced a CMOS DSP device running from a 1.1 V supply. The company has now developed a device operating off 0.4 V—similar to that generated by a single solar cell. The device is based on NTT's multi-threshold (MT) CMOS process, integrating both low-threshold and high-threshold transistors on a single die. The DSP chip previously detailed reduced energy consumption to one tenth that of conventional designs. NTT claims the 0.4 V devices reduce consumption to one hundredth of the level required by LSIs running at 3.3 V. (Source: *Electronics Weekly*, 13 March 1996)

Low-power transistor

Researchers at the University of Virginia have developed a low-power transistor called a two-dimensional metal-semiconductor FET (2-D MESFET).

The device is part of a group of "heterodimensional" semiconductor components under development which exploit effects occurring between two- and three-dimensional structures.

For the MESFET, the channel is a thin rectangular layer on a GaAs substrate. The drain and source connections are at opposite ends and there are metallic Schottky barrier gates at the edges.

What is described as a two-dimensional electron gas exists in the channel when conducting. The width of this gas, and hence the current flow, is controlled by biasing the gates.

Because the channel is two-dimensional rather than three, only a few electrons are needed for the device to exhibit transistor-like characteristics.

At room temperature the experimental device required less than 500 electrons. More remarkable, the team estimates only five electrons are necessary in the channel at the threshold of conduction.

Based on this, the 2-D MESFET is claimed to bridge the gap between conventional (>10^4 electrons) and quantum (single electron) devices.

The technique is transferable to silicon, silicon-germanium and silicon-on-insulator technologies.

A direct-coupled FET logic inverter constructed from 2-D MESFETs exhibited a switching voltage of 0.35 V and a noise margin of 0.26 V when operated from an 0.8 V supply. (Source: *Electronics Weekly*, 13 March 1996)

Silicon based light demonstrated

ATR Optical and Radio Communications Research Laboratories of Japan has demonstrated green electroluminescence from a silicon based semiconductor. Silicon is generally regarded as unsuitable for use in solid state devices that emit light and consequently more expensive III-V materials like GaAs and InP are adopted. Details are sketchy, but H. Mimura of the laboratory has used an N-type wafer, specially treated to form 3 nm "porous" crystals as the basis. The wavelength of the emitted light is reported to be correlated with the crystal size. (Source: *Electronics Weekly*, 13 March 1996)

MIT leafs through paper for electronic book

Researchers at the Massachusetts Institute of Technology (MIT) are developing digital paper for use in an electronic book.

Project leader, Dr. Joseph Jacobsen says the book will have the feel and weight of a few hundred pages-sized hardback, with each page being reconfigurable. Data could be downloaded from a database on the Internet and pages displayed by pressing buttons on the spine. The enabling technology is digital ink particles only 50 μm in diameter that are black on one side and white on the other. Similar to toner in laser printers, the particles adhere to a paper-like synthetic surface. When subject to an electronic charge, the particles flip showing either white or black. So far, the researchers have managed to flip particles but have yet to form words. (Source: *Electronics Weekly*, 27 March 1996)

Single-button TV remote control

A small UK research and development firm, Diverse Devices, has developed a low-cost, single-button remote control that may soon become an integral part of TV sets, PCs and other entertainment devices.

The device, TOBI (The One Button Interface), is based on pulsed direction and range (PLADAR) technology and has already been licensed by a leading UK virtual reality company.

By using a single-button and an on-screen menu, the remote control replaces the myriad cursor keys of conventional controllers. The receiver, fitting into a TV set for example, detects the angle of the transmitted signals from the remote and highlights the appropriate menu-bar on the screen. The company claims the device is up to one hundred times cheaper than the other, more complex remote controls.

The handheld remote control device has four directional PIR (Pyroelectric Infra Red) diodes, mounted at 45 degrees to each other. Each diode acts as a source of a unique pulse-code modulated (PCM) signal. The signals are transmitting sequentially and are identified at the receiver by their unique coded signal.

The receiver, comprising conventional PCM decoder, amplitude sampling circuit, demultiplexer and an 8-bit microcontroller with integrated A/D converter, recover the four cosine amplitude-dependant signals.

An algorithm derives the orientation of the transmitter from the ratios of the amplitudes generated by the two pairs of diodes. It is these ratios that determine the cursor X and Y coordinates. (Source: *Electronics Weekly*, 27 March 1996)

Micro-channel cooling record

Researchers at Purdue University, Indiana, have claimed a world record for heat extraction by removing 25,000 W/cm^2 from a surface using flow boiling micro-channel technology.

Electronics is seen as one of the more promising applications of micro-channel cooling.

Micro-channel heat exchangers use thin channels, roughly the size of a hole down a hypodermic needle. A working fluid is pumped into the channel and boils as it is heated. The microscopic bubbles formed are quickly swept from the channel surface by the fluid flow, taking heat with them.

For the given sized box, a convection-cooled unit can dissipate 40 W while an air-blown version removes 400 W. The micro-channelled cooled package will accommodate over 3 kW.

A further application that is foreseen is the extraction of heat from future nuclear fusion reactors, where energy fluxes of 10,000 W/cm^2 are expected.

The working fluid in the micro-channel cooler is Fluorinert, a chemical from 3M that is claimed to be non-electrically conductive, non-toxic and environmentally sound. (Source: *Electronics Weekly*, 3 April 1996)

Projection technology

The emergence of Texas Instrument Inc.'s (TI) digital-light-processing (DLP) technology is challenging the projector markets based on the CRT or LCD approach. Competing on brightness, clarity and definition, projectors using the TI technology also can be smaller and lighter and can present advantages in image uniformity and saturation, says VIEW Corp., Newport News, VA. The company says the DLP technology in its DiaMonD D-400 projector makes possible computer and video presentations to large groups in normally lit rooms. DLP, the key performance factor, is based on thousands of digitally controlled and individually activated micro-mirrors on a single miniature microchip. Reflected light creates the projected images. The DiaMonD D-400 weighs 23 lb and measures 15.5 in. × 12 in. × 7.75 in. (Source: *Industry Week*, 4 March 1996)

Understanding superconductivity

While industry dreams of high-temperature superconductivity that is closer to room temperature, researchers are seeking the explanations that might make it possible. The latest milestone is the evidence in favour of a certain type of electron behaviour. Called the d-wave model, it is one of two that have been popular with theoretical physicists. One is the s-wave form of electron pairing, in which charge-induced vibrations in the material hold the pairs together (as in conventional, low-temperature superconductivity). The other is the d-wave form where the electrons' magnetic spins are critical. Collaborating with IBM Corp. scientists from the T. J. Watson Research Centre, Yorktown Heights, NY were researchers from the State University of New York's Buffalo and Stony Brook campuses. (Source: *Industry Week*, 4 March 1996)

Crystal picks SRS technology for audio chip

Crystal Semiconductor's latest audio chip for multimedia systems, the CS4237, includes sound retrieval system technology from SRS Laboratories. The company claims this is the first single-chip audio subsystem to support the immersive three-dimensional sound system. The device is pin-compatible with the CS 4236, the firm's motherboard audio standard device. The SRS system takes normal audio signals and modifies the stereo output to give a 3-D effect with only two speakers. A listener needs no fixed position for the spatial effect to work correctly. (Source: *Electronics Weekly*, 20 March 1996)

Super-dense disk drive

IBM Storage Systems has developed the Shima-V 2.5 in. high-capacity hard disk drive for the growing mobile or notebook computing market. When introduced two years ago, it was a breakthrough product, offering the equivalent of desktop computer storage. Its 810 Mbytes represent over 50 per cent more storage capacity than its nearest competitor.

The Shima-V drive is based on IBM's magnetoresistive (MR) head technology and No-ID formatting. Conventional thin-film heads use a single inductive element for reading and writing, limiting their ability to accurately differentiate data stored at high linear densities. In contrast, MR heads use

separate write and read elements, each optimized for its separate function. This makes it possible to store more data per track, so that fewer heads and disks are required to reach a particular capacity.

On most disks, information stored in the ID fields (the headers preceding each data sector) consumes about 15 per cent of the total available space. IBM's unique No-ID sector formatting eliminates this overhead by removing the ID fields from the disk surface and storing this information in solid-state memory. The result is increased storage capacity and overall performance. (Source: *Machine Design*, 21 March 1996)

Philips LCD revolution

New reflective polarizers from Philips Research Laboratories, Eindhoven, the Netherlands, are being used to spectacularly increase the light output of liquid crystal displays (LCDs). Contrast between pixels in an LCD is normally obtained by blocking or transmitting light that has been polarized; the usual method is by absorbing the light of the unwanted polarized direction. By using reflective polarizers and recycling this unwanted reflected light, the light output of a laptop computer or video camera can be considerably enhanced or, conversely, the power consumption can be considerably reduced.

Remarkably, these polarization filters also contain LC molecules, although not active in the usual sense. Photopolymerization is used to fix these cholesteric molecules in a stable plastic film; the molecules arrange themselves parallel to each other within each layer of the film. However, slight orientation changes between layers cause a helical structure to form with its axis normal to the layers, and this has been exploited by varying the helix pitch—and hence wavelength of light transmitted or reflected.

Further details are available from: Dr. Marianne Vincken, Philips Research, Prof. Holtslaan 4, 5656 AA Eindhoven, The Netherlands. Fax: (+31) 40 2744947; e-mail: vincken@natlab.research.philips.com. (Source: *Adv. Mater.*, 1996, *8*, No. 3)

Colorado firm announces 12 ns EDRAM

Twelve nanosecond enhanced dynamic random access memory (EDRAM) has been announced by Colorado-based Enhanced Memory Systems. The EDRAM architecture combines DRAM and SRAM on a single chip. The read/write speed of 12 ns is available within a memory page, whereas random access speed to any page is 30 ns. Component configurations are 4 M × 1, 1 M x 4 and 1 M x 4, offering write-per-bit organizations. Memory modules are to be produced at 4, 8 and 16 Mbyte densities.

The memory is aimed at applications including communication routers, DSP systems, workstations, servers and 3-D rendering. (Source: *Electronics Weekly*, 6 March 1996)

Oxley claims UK first with X-ray lithography switch

As part of an optical matrix switch design, Oxley Developments claims to be the first UK company to use three-dimensional deep X-ray lithography to make a micro device. The picture shows the master model of the actual matrix switching element, which is a precision reflector used to redirect light between optical fibres.

Although the switch is relatively large, at 2 mm × 1 mm, the maximum dimensional error allowed is 0.2 μm.

Current technology, 0.35 μm chips can be made using deep ultraviolet light (UV) because the focused image from the manufacturing mask only has to have a depth of field or around 1 μm. The switch needs the same accuracy, but a depth of field nearly 1,000 times deeper.

To get this depth of field requires a very short wavelength, around 0.2 μm, which is in "hard" X-ray territory. Not only does this require a synchrotron, but also very special masks.

The X-ray source used is the 2 GeV UK national synchrotron source at Daresbury. The masks are either beryllium or diamond, which are transparent to X-rays, with at least 15 μm of gold on top where the X-rays are not required.

A metal substrate supports a layer of polymethylmethacrylate (PMMA, the same material used in perspex) whose bonds are broken by several hours' exposure to the X-rays.

The disrupted PMMA is washed away and the resultant topology is nickel plated. The metal formed is then the basis of a mould for mass-producing copies of the switching element. (Source: *Electronics Weekly*, 6 March 1996)

Mitsubishi, Hitachi in 64 M AND flash bid

A 64 Mbit AND-type flash memory has been developed by Hitachi and Mitsubishi Electric as a result of their 1994 co-development agreement.

Hitachi says this class of memory device allows the construction of cards with lower power consumption and size than hard disk systems.

Based on a 0.4 μm 3-polysilicon, three metal- fabrication process and organized as 8 M × 8 bits, the device has a 50 ns serial access time and data erasure of 512 byte blocks taking 1 ms. Chip size is given as 140 mm^2.

Other features include status polling and delete functions and an automatic page write function. The 19-pin device runs at 3.3 V, dissipating 145 mW during read and erase cycles and 180 mW during write cycles. A deep power-down mode has a claimed power consumption of 18 μW.

Conventional flash memory to date is based on NOR and NAND technology. The NOR type was pioneered by Intel, and is used by most other manufacturers, but suffers from large cells and requires a high external power supply for write operations.

NAND-type flash was developed by Toshiba and is also used by Samsung. This allows higher integration but suffers from low yields due to thin oxides in the fabrication process. Also, the units in which data is erased are larger than those in which data is written. (Source: *Electronics Weekly*, 6 March 1996)

Communications trio break the terabit barrier

Terabit per second transmission rates over fibre optic cable—a capability thought to be unachievable this century—has been cracked by three companies: Fujitsu, AT&T Bell Laboratories and NTT.

Each of the companies presented papers at the Optical Fibre Communications Conference held in San Jose, CA last week describing how they had separately achieved terabit per second (Tbit/s) transmission, although they are not expected to be in commercial use for many years.

All three companies achieved Tbit/s transmission via wavelength division multiplexing (WDM)—sending more than one wavelength of light at a time through the fibre, and optical time division multiplexing (OTDM).

For example, Fujitsu achieved 1.1 Tbit/s communication by multiplexing fifty-five 20 Gbit/s channels onto a single-mode fibre.

The systems use multiple laser wavelengths of around 1,550 nm, with wavelength separations of between 75 and

400 GHz (0.6 to 3.2 nm). (Source: *Electronics Weekly*, 6 March 1996)

New dendritic shapes

Scientists at the University of Illinois (Urbana-Champaign) report synthesizing a novel hexameric structure out of dendrimers. The stable complex results from hydrogen bonding between six identical dendrimer molecules. The group says the work could lead to more precise control of dendritic architectures and that the structure, which forms a cavity, holds promise in encapsulating and delivering drug molecules. (Source: *Chemical Week*, 13 March 1996)

Optical chip may widen information superhighway

A new type of photoreceiving chip developed by researchers at the University of Michigan's College of Engineering promises to increase the capacity of data highways. It holds the world record for high-speed optoelectronic signal detection, according to Pallab K. Bhattacharya, professor of electrical engineering and computer science. The chip can accept data transmitted as laser pulses at speeds of up to 24 gigabits/sec. Most present-day photoreceivers can only handle transmission speeds to about 11 gigabits/sec.

The chip integrates a light detector and amplifier in the same semiconducting layers, eliminating connecting wires that increase fabrication costs of hybrid photoreceivers. The circuit includes a p-i-n photodiode to detect incoming light and a heterojunction bipolar transistor to amplify the high-speed signals. The chips are produced in Michigan's solid-state electronics laboratory with a one-step molecular beam epitaxy process commonly used throughout the semiconductor industry. Once fabrication techniques are standardized, the device will be simple and less expensive to produce. (Source: *Machine Design*, 7 March 1996)

Genetic algorithms

Genetic algorithms (GAs) are being used to improve the synthesis of digital VLSI circuits at the University of Wales College of Cardiff.

Using an iterative evolutionary process, genetic algorithms refine a design until it meets the desired specification goals.

Previous techniques using GAs have successfully been applied to various aspects of VLSI design such as cell placement, channel routing and design for test. Higher level structural synthesis, however, is significantly more complex requiring multiple parameters to be satisfied.

Research at Cardiff's School of Engineering has led to the development of an algorithm that synthesizes a large range of logical circuits, such as adders, decoders and multiplexers.

The GA takes an initial circuit design using one or more cell-based design libraries. The circuit representation is compatible with industry standard tools.

The algorithm compares the created layout with the desired circuit and calculates fitness values for the parameters being tested. In a typical example, fitness values are given to gate delays, circuit area, interconnect length and functionality. These are placed in a weighted average to give a final score for the circuit layout.

Through evolution of the circuit, the GA tries to improve on the parameter scores until an evolved generation meets all the specifications of the circuit. The number of iterations is said to be around 60 in most cases.

The researchers claim the solution has a flexibility, speed and capability for synthesis unmatched in any published work. The system copes with designs using hundreds of gates, but this is now being extended to around 1,000 gates. (Source: *Electronics Weekly*, 1 May 1996)

Technology cuts out multi-chip module steps

MicroModule Systems has qualified a substrate technology that reduces the number of process steps used to manufacture multi-chip modules. The company expects the technology to result in a 20 per cent cost reduction in the building of multi-layer thin-film substrates. The substrate technology is based on copper and benzocyclobutene (BCB) and has been developed by MicroModule in collaboration with Dow Chemical. The development provides higher density interconnects for multichip modules used in such applications as workstations and PCs where both performance and compactness are required. MicroModule Systems used its TwinStar dual Pentium processor module to qualify the process. (Source: *Electronics Weekly*, 24 April 1996)

Optical junctions

Switching light pulses between different lines is a problem that has plagued telecommunications companies since they began using optical fibres. Currently, the only switches that can shuffle the connections are expensive and relatively unreliable. Researchers at the University of Southampton think they may now have cracked the problem by developing a simple and cheap way to change the light's course by reflecting it off sound waves.

Tim Birks and Philip Russell heat and stretch two optical fibres until their light-conducting cores fuse and form a narrow circular waist. Before and after the junction, the fibres remain independent.

Light travels down an optical fibre by bouncing from one side of the core to the other. The two fibres in the new device are "tuned" to carry signals travelling with slightly different angles of bounce, so light travelling up one fibre will not usually cross to the other. But by altering the bounce angle of the light, the switch can make it cross the junction and continue along the other line.

The main advantage of the new switch is that it does not interrupt the flow of light. Today's switches require the fibre to be cut and reattached on each side of the device. This presents enormous practical difficulties because the cores of optical fibres are only a few micrometres across, and realignment is rarely perfect. As a result, some of the light pulse is lost at each junction, and too many switches can mean losing the entire signal. With the fibre switch, the light signal is preserved. The switch relies on standard fibres and needs very little energy. (This first appeared in *New Scientist*, London, the weekly review of science and technology, 6 April 1996)

Deuterium processing stabilizes silicon semiconductor devices

Replacing hydrogen with deuterium in the processing of silicon semiconductor chips could significantly increase the operational lifetime of the chips. The application, discovered by Karl Hess and Joseph W. Lyding, electrical engineering professors at the University of Illinois, Urbana-Champaign, may be the first use of deuterium as an industrial processing chemical.

The use of hydrogen for annealing and passivating microchip surfaces has been adequate for computer technology so far, observe Hess and Lyding. However, as the industry moves deeper into nanotechnology, devices will become smaller and be driven harder. They will need to be more robust and have longer lifetimes.

Lyding had previously used a scanning tunnelling microscope (STM) to stimulate hydrogen desorption from silicon surfaces. He found that deuterium was about 100 times more difficult to remove from this surface than hydrogen. In discussing these results with Hess, they realized that changing from hydrogen to deuterium might retard transistor aging without changing the operative chemistry at the surface.

Lyding's STM experiments suggest that a large isotope effect may be part of the reason deuterium treatment extends semiconductor lifetimes. High-energy electrons may cause some of the silicon/hydrogen (or silicon/ deuterium) assemblies to assume an antibonding state, which produces a force that accelerates hydrogen away from the silicon surface. The acceleration is much lower for deuterium because of its larger mass.

The complex processes associated with degradation of the interface are further complicated by interface reconstruction and defect chemistry. At this stage of development, it appears that a simple exchange of deuterium for hydrogen is all that is required. No special equipment is necessary. (Extracted from *Chemical & Engineering News*, 18 March 1996)

Efficient etching

Thin films of conductor or semiconductor on a silicon base are vital components in the electronics industry, but is not always easy to get thin films onto such a surface, keep them uniform and smooth, and then etch a useful pattern into the film. Canadian researchers have recently devised a novel method of getting a thin film pattern of metal onto a substrate. Their technique could help in building photovoltaic cells and in making metal interconnects for other electronic devices more quickly, efficiently and accurately.

Ross Hill and his colleagues at the Simon Fraser University in Canada have used films of metal-organic molecules to create a patterned layer of copper on a silicon surface for the first time. They found a copper-containing organic material — $Cu_2(H_2O)[CH(CH_2)CO]_4$— that is non-volatile so that it sticks to silicon. It also forms a high-quality film so there are no spots in the film that react differently from others.

However, the compound's key property is that it is light sensitive. Shining an arc lamp on a particular point in the film "burns" off the organic part of the molecule leaving behind the copper, explains Hill. A light-based etching technique avoids the high temperatures or highly corrosive materials often needed for other etching processes. This could allow the Canadian team to build very-large-scale integrated circuits with multiple layers, creating electronic devices on a silicon surface.

Hill has also adapted the technique to lay down other metals and used other ligands. He adds that the sensitivity of the metal organic materials to light could be increased allowing higher resolution patterning using a finer light beam or laser. (Source: *Chemistry & Industry*, 5 February 1996)

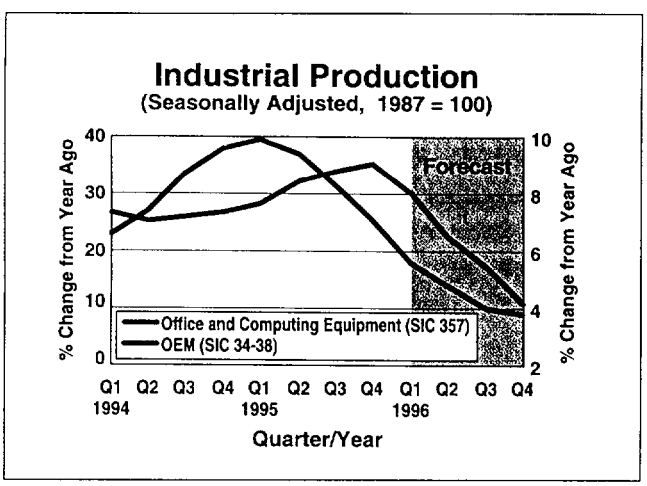
D. MARKET TRENDS AND COMPANY NEWS

Market Trends

Industrial production for office and computing equipment soars

Industrial production figures for the office and computing equipment sector were at an all-time high at the end of 1995. This segment is comprised of computers, peripherals, software, storage devices, electronic office equipment, LAN (Local Area Network) hardware and NICs (Network Interface Cards). The annual growth rate for this sector topped out at an amazing 35 per cent, although it is forecast to moderate throughout 1996.

The strength of the sector is much more pronounced when compared to the total OEM (Original Equipment Manufacturing) grouping. The OEM grouping, which includes computer and office equipment, represents a larger universe of manufacturing activities and finished products. Annual growth rates for the office and computer sector have increased throughout the year, while rates for the total OEM sector peaked at mid-year and began to slide. Average annual growth rates for the office and computing equipment sector have been three to six times higher than those of total OEM.



Data: Department of Commerce
Forecast: Cahners Economics

The industrial production figures for the OEM grouping is a good benchmark to gauge the relative strength and direction of the office and computer equipment sector. This is particularly true on the demand side since a larger proportion of computers and related devices go into or are used in the manufacture of other finished products.

Consumer demand and increased business investment were the primary drivers in the office and computing equipment sector. The future looks good even though manufacturers will face moderate economic growth and a high installed PC base in the US markets. Growth rates are expected to moderate through 1996 but remain at healthy levels. Cahners' forecast calls for an almost 11 per cent growth rate for 1996. The only factor that could appreciably alter the forecast would be an increase in demand from abroad. If the Japanese and European economies do improve and begin to see increases in capital expenditures, office and computer equipment will remain an integral part of their business investment. (Reprinted with permission from *Semiconductor International Magazine*, March 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Personal computer market remains strong

One of the principal drivers of the worldwide semiconductor market has been the increased demand for PCs. This demand is likely to continue as more households plan to buy PCs. A recent consumer study by Dataquest revealed that 15 per cent of US households plan to buy a PC within one year. In addition, over half of first-time buyers have incomes of $40,000 or less, while almost one-third of first-time buyers report incomes of between $41,000 and $60,000. The home PC is fast becoming a primary consumer purchase; this trend bodes well for computer manufacturers.

Furthermore, a significant portion of current PC owners are planning to buy a new computer. A full 30 per cent of these respondents have incomes of $40,000 or less. Close to half, 49 per cent, have incomes of between $41,000 and $80,000. Intended purchases drop off with those who reported incomes in excess of $81,000. Only 8 per cent of those with incomes up to $100,000 and 13 per cent above that figure plan to upgrade their PCs over the next year.

Income level of households intending to purchase a PC within one year

Income level (Thousands of $)	Current PC owners planning to purchase	Intended first time buyers
less than 30	14%	27%
31-40	16%	25%
41-60	26%	28%
61-80	23%	10%
81-100	8%	5%
100+	13%	5%

Source: Dataquest: Homeward Bound Survey, Dun & Bradstreet

In the short term, computer manufacturers are poised to make very good gains in both the entry-level and trade-up markets. Their challenge will be to retain healthy margins while better meeting the needs of prospective first-time purchasers. (Reprinted with permission from *Semiconductor International Magazine*, Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

CAD/CAM/CAE software sales grow

World-wide sales of mechanical CAD/CAM/CAE packages will increase by 18.2 per cent to $2.5 billion for 1995, according to forecasts by Daratech, a Cambridge, Massachusetts-based market research firm. The driving force behind this growth is a global economy that continues to strengthen, fuelling capital investment on the part of manufacturers. At the same time, software vendors are updating established packages with more capabilities in solid modelling, EDM/EPD integration and ease of use. These

products now appear to be capable of delivering on the visions promised by their developers and winning the confidence of users, according to the forecast. (Source: *Machine Design*, 7 March 1996)

Peripheral market shows huge growth

The market for multi-function peripherals is showing considerable growth as consumers equip their home offices with electronics products that combine fax, printer and scanner functions within one unit. US market research firm, International Data Corporation (IDC), estimates that the market for multi-function peripherals (MFPs) grew by 800 per cent in 1995 compared with 1994. In 1994, in the US market, about 53,000 units sold while in 1995, more than 473,000 MFPs were sold for about $328 million. "As small and home offices continue to grow in number, these consumers with limited space and financial resources are looking for products to provide copying, faxing, printing and scanning, all in one package and for one affordable price", said a senior analyst at IDC. (Source: *Electronics Weekly*, 28 February 1996)

More growth for microcontrollers predicted

The microcontroller (MCU) market grew more than 30 per cent in 1995 pushed by the success of 8-bit MCUs, according to Dataquest. The company is forecasting no slow-up in growth, with revenue set to double by 1999, reaching $20.1 billion. (Source: *Electronics Weekly*, 20 March 1996)

EECA in puzzle over 4 Mb DRAMs

At a time when hugely expensive semiconductor factories are springing up everywhere, a chip mountain looms. The industry's measure of growth in North American chip sales plunged to its lowest point since allegations of Japanese chip-dumping in the 1980s. The "book-to-bill" ratio slid to 0.93 in January, as supply outstripped orders. Chip makers claim that this is no more than a blip.

Whether 1996 will see shortages of 4 Mbit DRAMs or a renewal of dumping is an open question, according to the European Electronics Components Association (EECA).

Earlier this year, DRAM prices slipped close to the level where anti-dumping actions could be triggered before the rise in spot market price to $7/8.

However, according to Dr. Eckhard Runge of EECA, the cutbacks in 4 Mbit DRAM production by the Japanese and Korean manufacturers in response to the price collapse in the first quarter, could result in a shortage of 4 Mbits later this year. (Extracted from *Electronics Weekly*, 3 April 1996 and *The Economist*, 17 February 1996)

Euro DRAMs up with Asia

Europe's DRAM manufacturing efficiency seems to have caught up with the best in Asia—something which most people thought was a year or so away at best.

According to Samsung of Korea, the world's No. 1 DRAM manufacturer, their revenues per wafer of 4 Mbit DRAM are $9,000, while according to sources close to Siemens, Europe's No. 1 DRAM manufacturer, their current 4 Mbit wafers are yielding over 700 dies per wafer. At the world market price for a 4 Mbit which prevailed throughout most of 1995—$13—that works out at $9,100 per wafer. This suggests that Siemens' yields are close to, or even better than, Samsung's.

Siemens' manufacturing costs accordingly work out at $1,050 per wafer, which is about the same as analysts' estimates for the cost of a 4 Mbit wafer from Sub-Micron Silicon Technologies, the joint venture IBM-Philips DRAM manufacturing plant at Sindelfingen in Germany. It is also below the costs of Japanese companies NEC and Hitachi, which are said to be $3 per 4 Mbit chip. The lowest-cost US producer, Micron Technology, is said to be able to make a profit on the 4 Mbit when it is selling for $3.

The European chip industry may be catching up with the Asians on manufacturing cost, but it is slipping behind on revenue-per-wafer. Rose Associates told the ISS conference in Dresden that in three years the average revenue per square inch of silicon has increased from $28 to $53 but every major European producer failed to match the industry average. (Source: *Electronics Weekly*, 14 February 1996)

Price fall forces DRAM changes

Memory makers have responded swiftly to the collapse of DRAM prices.

Responses have included bringing forward technology introductions, changing product focus and moving to cheaper locations.

NEC is to start sampling a 64 Mbit synchronous DRAM (at $500) and intends to mass-produce the device in the third quarter. It is also ramping up 16 Mbit production to 18 million units a month by the end of the year and 20 million by March 1997.

The Koreans are also moving to higher technology 16 Mbit units at the expense of 4 Mbit production.

Samsung will increase its production of 16 Mbit chips from 11 million a month to 14 million from the second half of this year. Hyundai plans to triple production of 16 Mbits from 5.3 million a month to 17 million a month by the year end. And LG Semicon says it will be on 10 million 16 Mbit DRAMs a month by then.

Production of 4 Mbit chips is being transferred to lower-cost production areas. Hitachi is following NEC in transferring 4 Mbit production to mainland China as a response to collapsing 4 Mbit prices (now at $5 or $6).

Hitachi is to build a 1.5 million unit a month, joint-venture fab in Suzhou City, Jiangsi Province, in association with the Singapore Economic Development Board.

Major UK buyers do not expect the DRAM price to drop for the rest of the year. (Source: *Electronics Weekly*, 27 March 1996)

Chip forecasts take turn for the worse

Chip companies around the world are preparing gloomy forecasts as slower growth in the PC market leads to reduced demand for chips and falling prices.

Texas Instruments forecasts a 20 per cent rise in the chip market for this year compared to last year's 45 per cent increase. The top five Japanese DRAM makers predict only a 15 per cent increase in profits compared to a 55 per cent increase last year.

Hitachi, Toshiba, NEC, Mitsubishi and Fujitsu all expect a 20 to 30 per cent decline in chip prices this year. However, the 4 Mbit DRAM has already halved in price to $6.

That is why the five major chip companies plan to cut back 4 Mbit production by 36 per cent this year from a collective 42.5 million units a month to 27 million units a month.

They also plan to double the production of the higher-priced 16 Mbits from a collective 29 million units a month to 57.5 million units a month.

The moves have largely been caused by the reluctance of US consumers to upgrade their PCs or make a first-time purchase. The growth in US households buying a PC for the first time has been almost static.

The slower growth has led a number of US PC companies to cut prices by up to 29 per cent to stimulate sales. (Source: *Electronics Weekly*, 13 March 1996)

Japan loses 3 per cent of chip market

As the US-Japan chip trade agreement nears its expiry date and Japanese trade officials refuse to consider an extension, market figures show that the foreign share of the Japanese chip market has soared by 3 per cent in a single quarter.

The US based Semiconductor Industry Association (SIA) said that foreign chip makers had a 29.6 per cent share in the fourth quarter of 1995 compared with 26.2 per cent in the previous one.

US chip makers want to extend the Japanese-US chip trade agreement, which guarantees at least a 20 per cent market share in Japan to foreign companies, but Japanese trade and industry officials say that a new trade agreement is unnecessary. (Source: *Electronics Weekly*, 27 March 1996)

Company News

Some semiconductor manufacturers develop faster

A 1995 survey of high-technology companies revealed that some semiconductor manufacturers were significantly faster than their peers at bringing new products to market, according to the consulting firm Pittiglio Rabin Todd & McGrath (PRTM, Mountain View, CA).

The survey, sponsored by National Semiconductor and AT&T Microelectronics, included over 210 high-technology companies, including 43 semiconductor manufacturers, and found that a lower time-to-market (TTM) average improved the companies' financial performance. Study participants included Motorola, Philips Semiconductors, Advanced Micro Devices and Texas Instruments.

While the average company reduced the time to bring new products to market by an average of 9.5 per cent between 1992 and 1994, the top 20 per cent of semiconductor manufacturers brought new products to market in about half as much time as their peers. For instance, survey results indicated that for a complex project, most companies took an average of 150 weeks to bring a product to market, versus the best companies' average of only 90 weeks. Researchers defined top companies by measuring factors such as the amount of money wasted due to cancelled development projects, the ratio of profit to the cost of successful new product development and the amount of revenue contributed by new products.

The TTM performance difference comes at a time when companies depend more heavily on revenue generated by new products. Between 1992 and 1994, the share of semiconductor company revenue from new products jumped from 43 to 57 per cent. A company that is faster to market benefits in two ways, according to PRTM. The first benefit is the cost savings, since development costs increasingly mount over time. Also, a company reaps greater profits if it markets its new products more quickly, because it captures greater market share.

The performance difference between the better companies and the average was more marked in semiconductors than the other sectors studied, such as electronic systems and medical devices. This is an indication of the specific problems semiconductor companies run into as they develop new products.

One problem is the semiconductor manufacturers' difficulty of managing many small projects distributed over the engineering team versus the usual situation in the computer industry of a large group working on a single product. Another problem semiconductor manufacturers face is the coordination of process technology with new product design.

PRTM's 1995 Product Development Benchmarking Study indicated that competitive pressures shortened product lifecycles and rapidly-changing technologies are driving companies to attempt to reduce TTM by over 20 per cent.

Even with such significant strides, the performance difference between companies will still exist. PRTM identified a set of management practices associated with better performance, such as integrating new development techniques and the early use of simulation. Another differentiator was a focusing of resources on fewer projects that proceeded rapidly through the development cycle. (Reprinted with permission from *Semiconductor International Magazine*, March 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Semiconductor sector boosts Wacker-Chemie

Wacker-Chemie has announced year-end sales up 8 per cent to DM 3.9 billion, pulled along by the "exceptional development" of its semiconductor division.

This booming business reported sales jumping 20 per cent to DM 1.12 billion. The group's other businesses also performed well. Polymer turnover grew 7 per cent to DM 1.15 billion, while ceramic sales, geared mainly to silicon carbide, grew 7 per cent to DM 208 million.

However, sales within the silicon division, which developed strongly in 1994, rose only 3 per cent to DM 1.2 billion—affected by the dollar and other currency depreciations, according to the Munich-based business. (Extracted from *European Chemical News*, 19 to 25 February 1996)

PowerPC out of focus in IBM desktop plans

In a review of the future of PowerPC, IBM is reported to have decided to de-prioritize the microprocessor as a CPU for desktop PCs.

Instead, IBM is said to be prioritizing Intel's x86 as the CPU for desktop PCs and is focusing its PowerPC effort on workstation and server applications and as an embedded microcontroller.

According to IBM sources, IBM's OS/2 group in the UK was told that the priority for this year was to focus on the x86 architecture.

According to sources within the PowerPC consortium—Apple, Motorola and IBM—it has also been decided that IBM will not port OS/2 to the PowerPC.

IBM in New York said that the company's focus on PowerPC is on the 603 and 604 versions. The 603 is a low-power version of the PowerPC optimized for hand-held applications and is the processor used in Apple's upcoming "Internet computer" called the Pippin.

The 604 version of the PowerPC is the one optimized for high-end applications like servers and workstations.

Because of PowerPC's success in attracting VME and embedded applications, it is thought that IBM will be reluctant to stop development of the architecture.

However, after nearly five years, a tacit admission that the combined forces of IBM, Apple and Motorola are unable to loosen Intel's stranglehold on the desktop market will come as a bitter blow as the PowerPC's main objective was to establish a new mainstream CPU architecture. (Source: *Electronics Weekly*, 28 February 1996)

IBM leads in patents

At IBM, for the third straight year, more technology has emerged as US patents than from any other company. In 1995 the company was awarded 1,383 patents—27 per cent more than any other firm. Its previous records include 1,298 in 1994, and 1,087 in 1993. Samples include:

- A way for a user to configure a computer network using a front-of-screen display, saving the hassle of sending and installing command files. (US Patent No. 5,394,522);
- A mobile networking system that brings digital-data capability to present cellular-phone systems. (US Patent No. 5,404,392);
- A method and system that allows a microprocessor to carry out several instructions simultaneously instead of serially. (US Patent No. 5,465,373);
- A new formatting technique that allows up to 30 per cent more data to be stored on magnetic hard-disk drives used for computer data storage (US Patent No. 5,438,559).

(Source: *Industry Week*, 19 February 1996)

NEC to use more overseas components

NEC wants to source more components and materials from non-Japanese sources and to site more manufacturing facilities outside Japan, according to the chairman of NEC, Tadahiro Sekimoto.

Sekimoto said he was refashioning NEC for the year 2000 as a "virtual company" linking all its suppliers and distributors via the Internet, using a single integrated database for operating information. NEC wanted to raise the value of its manufactured output derived from non-Japanese factories to 67 per cent in 1999 from 54 per cent in 1995. (Extracted from: *Electronics Weekly*, 27 March 1996)

Compaq considers developing PowerPC machines

Compaq is considering developing PowerPC desktop systems and servers, and licensing the PowerPC platform system specification from Apple and IBM.

Such a deal would significantly boost the beleaguered PowerPC market.

Sources close to Compaq report that the leading PC maker has been discussing manufacturing deals with Motorola and Mitac International to produce Compaq branded PowerPC systems.

Compaq is interested in the PowerPC platform because it could help keep its lead in PC desktop and server markets.

Compaq is under intense competitive pressureasother companies target thesesectors. By offering a PowerPC platform system, Compaq could expand its market among customers that want to run systems with a choice of ix operating systems including Mac OS, Windows NT, Unix, Solaris and Netware.

Compaq's move is certain to prompt similar moves by its competitors and will significantly boost the PowerPC architecture, which has lost momentum due to Apple Computer's problems, and IBM's decision to abandon plans to create a low-cost PowerPC platform. (Source: *Electronics Weekly*, 27 March 1996)

Cray research finds home for T3E supercomputer

Cray Research's first T3E supercomputer has been installed at the Pittsburgh Supercomputing Center.

The distributed memory, massively parallel, scalable computer is said to be running six applications, including quantum chemistry and biomedical applications, in parallel within one month of operation. The system will be upgraded eventually to 512 processors.

Each processing element of the computer is based on a Digital Semiconductors' Alpha 21164 microprocessor with local DRAM ranging between 6 4 Mbytes and 2 Gbytes. The system can be configured with up to a maximum of 2048 processors and four terabytes (4 Tbytes) of memory, achieving a peak processing performance of 1.2 teraflops. (Source: *Electronics Weekly*, 24 April 1996)

E. APPLICATIONS

Nanotechnology now

Nanotechnology is now on the verge of practical applications that include laboratory diagnostics, enzyme-based bioreactors, drug delivery devices and biochips for computers, according to US technology consultant Roger Cubiccioti of Biotechnology Development Associates in New Jersey. He has described some nanotechnology machines he developed far enough to qualify for patent applications. For example, he can combine two, three or more enzymes into a single molecular structure to make an enzyme-based bio-reactor. This vessel uses biological molecules to create products such as drugs and hormones.

Keeping the enzymes in tight proximity gets around the rate-limiting factor in multi-enzyme reactions, which is the distance the product of the first enzyme has to travel to be acted on by the second enzyme, said Cubicciotti.

The key to building a bioreactor is nucleotide-directed molecular assembly, according to Cubicciotti. He builds up oligonucleotides of 10-50 bases that bind tightly to molecules (called "effector molecules") of nearly any size and shape, such as enzymes.

The same techniques can be used to make drug delivery devices, said Cubicciotti. These would combine a molecule that recognizes a therapeutic target with an appropriate drug. A switch mechanism would release the drug when the target is bound. For example, a protease inhibitor to treat HIV might be paired with a compound that binds a coating protein on the virus.

Such a device is really a molecular switch, said Cubicciotti, and could be used in a nanotechnology computer using different effector molecules.

Greg Fahy, a researcher at the US Naval Medical Research Institute, is researching a nanocomputer, based on switches that could resemble Cubicciotti's, but which could cram more computing power than now exists on Earth—about 10 billion pentiums' worth—into a sugar cube and run on 50 watts.

"The next question", said Fahy, "is what kind of information content can you pack into a cell compared with what might be biologically important?" Twenty megabytes, the quantity of data storage necessary to code every protein in the body, could fit easily inside 2 μm^3. The volume of human cells ranges from about 80-2,000 μm^3.

Fahy imagines tiny nucleic acid repair robots inside the cell, which store all the information about every protein in the body. They would be ready to dissemble infectious viruses, mend molecular damage and even reverse the ravaging effects of ageing. (Source: *Chemistry & Industry*, 5 February 1996)

Altera provides DSP design

Altera has produced a free design kit that simplifies the implementation of DSP function blocks using its FLEX programmable logic families.

Programmable logic is finding increasing application in DSP designs, proving remarkably effective when used as co-processors for micros or even as a direct replacement for traditional DSPs.

Altera's DSP kit allows the user to input a digital filter design which is used by the software to generate a filter implementation onto its FLEX 8000 and FLEX 10000 CPLD families. Using the tool, the user can simulate the design and view the results. Other design blocks offered by the kit include floating-point building blocks and 2-D convolvers. (Source: *Electronics Weekly*, 28 February 1996)

Wireless heart monitor has 120 metre range

Engineers at the Georgia Institute of Technology have revealed details of a wireless heart monitor that works at a range of 120 metres. Called the vital signs monitor (VSM), the unit is much like a hand-held police speed trap and measures movement in the chest wall of the subject. It was originally designed for military use, but is now being developed to see through walls and rubble as an aid to civilian rescue. Other applications, such as baby monitoring are projected and eventual cost may be as low as $200. (Source: *Electronics Weekly*, 14 February 1996)

Plasma displays for use in TVs

The first plasma displays suitable for use in TVs will be mass-produced from October at an initial cost of $5,000 says Fujitsu.

The displays are the world's only 42-inch plasma panels available commercially.

Although Fujitsu has had 21-inch displays available for two years, they are considerably more expensive than CRTs and are not used by TV makers.

At 42 inches, however, the screens are bigger than CRTs and naturally much thinner. Fujitsu's panel is only 75 mm thick, allowing a TV to be hung on the wall. Fujitsu is currently supplying panel samples to TV manufacturers, including Thomson, Nokia, Philips and Bang and Olufsen in Europe.

Production quantities will start at 5,000 panels a month rising to 10,000 a month when the factory being built at Miyazaki is fully loaded.

Fujitsu's intention is to build a second factory for plasma displays which will be capable of producing 100,000 displays a month. When that factory starts up, the price should come down substantially.

Unlike TFTs, plasma displays have a wide viewing angle—the display is clearly visible from the side—and are therefore useful for public information displays as well as TVs. (Source: *Electronics Weekly*, 21 February 1996)

Electric fish monitored to detect water pollution

A new biodetector to look for water pollution has been developed at Le Centre International de l'Eau de Nancy (NANCIE), an international water study centre at Nancy, France. Based on bioelectricity—the phenomenon that enables certain fish to probe the environment with a self-generated electric current—the Centre has detected the presence of pollution by monitoring electric fish.

NANCIE's biodetector is *Apteronotus abifrons*—a tropical fish that monitors its environment by emitting a continuous series of low-amplitude electric pulses at 1,000 Hertz.

The fish is being used in surface-water monitoring facilities as a pollution detector. The water to be analysed is sampled continuously, heated to a stable temperature in compliance with the fish's biological requirements (between 77° and 79°F), and then distributed to test tanks containing one fish each. Pairs of electrodes are used to collect electric data from the fish. The data are analysed in real time

according to the frequency and form of the electric signal. These electric signals vary significantly when toxic substances are present in the water.

Owing to variations in sensitivity, homogeneity and response times, the biodetectors used to date (e.g. trout, seaweed and mussels) were not totally reliable.

The Centre has worked on a number of international projects, helping to rehabilitate sanitation systems in Algeria, Russia (Moscow) and Monaco, and has conducted research projects for the US Environmental Protection Agency and the National Office of Drinking Water in Monaco. (Source: *Sea Technology*, February 1996)

Wearable computer

At first we carried computers. Now we can wear them and interact via speech recognition and generation. With the Mobile Assistant, the user's hands are free to perform such tasks as inspection, maintenance, diagnosis and repair. The hardware includes an integrated heads-up display and a belt-mounted base unit and battery pack. The battery is rated for up to a four-to-six-hour duty cycle, says Computer Products & Services Inc., Fairfax, VA. An optional VGA colour binocular display visor offers the possibility of a virtual reality training mode. RAM is expandable to 16 MB and the hard drive to 525 MB. (Source: *Industry Week*, 4 March 1996)

A step towards the paperless desk

By integrating the scanner into the keyboard, Compaq Computer Corp. eases document management while saving desktop space. Activated by the presence of paper, the scanner transfers the document verbatim into the computer. Compaq also suggests using the device to eliminate the need for a fax machine or copier or as a way to send documents via e-mail. A combination of Xerox Textbridge Optical Character Recognition and PaperPort software allows PC users to incorporate scanned documents into other applications and manipulate them. Introduced with the company's Presario PCs, the scanner keyboard is also available for any 486-based or better industry-standard PC says Compaq. (Source: *Industry Week*, 4 March 1996)

Trio goes biometric

A biometric-based smart-card verification system has been jointly developed by Sandia Imaging Systems, AT&T Bell Laboratories and XLVision.

Security functions such as signature and fingerprint identification are carried out using a chipless "Dataglyph" card and reader. Dataglyph is a data-encoding technology distributed by Sandia for wallet- and pocket-sized media.

Dataglyph cards store between two and three thousand bytes of data on one side which can include stored text, digitized photographs, graphics and software. Unlike magnetic strip cards, Dataglyphs do not require dedicated space on the card's surface. (Source: *Electronics Weekly*, 13 March 1996)

Toshiba in CD-ROM first

Toshiba has launched a six-time rotational speed CD-ROM for the notebook PC market. The company claims this is the first drive of its type with a sufficiently small form factor required for notebook PCs.

The data transfer rate of 900 Kbyte/s has been achieved by increasing the SSP device speed and by improving the pick-up and motor performance.

Desktop PCs are already switching from quad-speed to six-time rotational speed drives providing greater responsiveness and faster data download rates. (Source: *Electronics Weekly*, 13 March 1996)

Smartcards

At the last count my wallet contained over 15 plastic cards, each with its own individual unique purpose, none of which could be considered remotely smart. In one hit the smartcard could reduce this number to one and reduce the threat of credit card fraud.

Initially, smartcards were single-purpose only. They were either a financial card, phonecard or a loyalty bonus card. Then two or more of these applications were merged on the same platform, thrust together by technological advances and customer needs. Now the multifunction smartcard is seen as a real value-adder for new services.

Although the idea of having an all-encompassing smartcard sounds wonderful, there are obstacles which may slow down its arrival. The biggest barriers are market acceptance and a lack of commercially-priced technology.

Semiconductor makers can provide enough memory and processing power to support multifunctionality in smartcards. But according to some, having lots of memory on a card may not be such a good idea. The more different applications used on a single smartcard, the more security and software is required. Each application will use its own exclusive source of memory capacity which will introduce redundancy and raise the costs.

A regular bank card typically has a memory of 4 Kbyte EEPROM and a GSM card 8 Kbyte EEPROM. But for a unified-operations platform the memory requirement will shoot up.

Increasing the memory on board the smartcard also increases costs. And not many organizations are willing to introduce an expensive card on the market, at least not yet.

The market is shaping up in such a way that common applications are grouped together and offered on a single smartcard. This is the case with organizing financially-based applications together, such as credit/debit cards and electronic purses, or grouping private records together such as ID cards, drivers' licence, passports and health cards.

Another market is computers. Any PC can be turned into a centre of secure activities by means of adding a smart card reader.

The hybrid card is another type of multifunctional smartcard. This is a contacting and contactless smartcard, which can be used as an electronic purse and for access control.

The biggest potential stumbling block in the arrival of a true multifunctional smartcard will be to gain cooperation from competing brand names to share a single card. If any company is to share a smartcard space it will usually do it with a firm it is not in competition with. In order to solve this issue all eyes turn to marketing and its persuasive techniques.

Memory will stay the primary issue for smartcards even beyond the year 2000. Other issues to be addressed will be its mechanical reliability, low power requirement and security. (Extracted from *Electronics Weekly*, 7 February 1996)

Mixed response to smartcards

Whilst suppliers and operators are debating over whether to share smartcard space and how large the logo should be, there are others who are concerned about the mixed response to smartcards around the world.

The majority of European countries and many others have, or are just about to launch, large schemes based on multifunction smartcards. Germany is rolling out over 40 million financial smartcards in January of 1997; Finland

uses phonecards as electronic purses; France has the multi-purpose health card; Brazil is to roll out a combined national insurance/tax/ID smartcard and Mexico has its "tortilla" welfare card. The UK has been fairly slow in accepting multifunctional smartcards and one valiant effort has come from Mondex, which is running the electronic purse pilot scheme in Swindon. The UK's interest in multifunctional smartcards may soon change, especially with the latest scheme from UK payment group APACS (Association for Payment Clearing Services), which is to start testing them during 1996 and early 1997. (Source: *Electronics Weekly*, 7 February 1996)

Researchers invent computer that identifies odours

Combining fibre-optic chemical sensors and neurological computer networks, researchers at Tufts University are building a system that mimics the human sense of smell. While optical sensors developed by Tufts' researcher David Walt have been used to detect gasoline in water, glucose in blood, or illicit drugs in urine, they can only handle one chemical at a time.

Using biological principles and an array of sensors in which each one reacts to a certain degree to each compound, the researchers built a machine which then looks at the array's total response to an odour. Their machine, with 10 sensor probes able to record responses of up to a million substances, can differentiate between alcohols that differ by one carbon atom, and identify five-carbon esters that smell like bananas.

While odours are limited to chemicals that produce gas at room temperature, this device will also work on liquids, enabling it to check food quality, search for environmental contaminants, or detect substances in the blood. It will even work on solids, if the sensor is placed against a smear of the substance in question. Other possible uses include checking a building's air quality by snaking optical fibres through the ventilation system. (Source: *Machine Design*, 7 March 1996)

Pulsed power and its applications

Our intuition that a sharp pulse of energy will achieve more dramatic results than a continuous flow is proved correct in a variety of applications.

Pulsed power, the electrical manifestation of this phenomenon, was born in secret. Fundamental work in the field was performed by Charlie Martin and his team at the Atomic Weapons Establishment (AWE), Aldermaston. In the 1950s, researchers at AWE were investigating ways to better control explosives and they needed to see inside an exploding bomb. The solution they came up with was an incredibly powerful X-ray machine. Enter pulsed power.

To X-ray an explosion much greater energy is needed than used for medical purposes. X-rays are produced by applying a voltage across a vacuum diode. The greater the voltage applied, the better the X-ray penetration, the intensity depending on the current. While currents up to 1 MA and voltages up to 1 MV needed to be produced, the up-side was that to freeze the action, only a short pulse, less than 1 μs was required. Its short duration made handling the power possible.

Martin and his group devised some original, but simple pulsed power circuits to achieve very intense X-rays. Since then, pulsed power has been applied in numerous research applications, using techniques and theory developed at AWE. For example, Mick Shaw's group at the Rutherford Appleton Laboratory (RAL) has used pulsed power to build a very big laser indeed (called Titania). It is used to analyse the effects of extremely intense light on various materials. A laser beam is created 42 cm across.

The same techniques have also been used to drive linear particle accelerators, such as the one at CERN, to accelerate projectiles in military research and to create high energy beams as part of the Strategic Defense Initiative (SDI or Star Wars). But recent advances at the component level are opening the door for a range of commercial applications. Pulsed power is being used in linear accelerators to treat cancer patients; it has created pulsed magnetic fields for metal forming; prototype systems have destroyed pollutant gases more effectively than chemical methods. It has also been applied to material surface cleaning and medical sterilization.

The common factor between these applications is that energy is applied as a pulse.

A series of high-power pulses is often more effective than the same average power delivered as a constant.

In fact, power semiconductors have developed to the stage where many of these applications have become viable for the first time. For such applications, they offer more practical solutions due to their greater reliability and stability compared with spark gaps or valve technology. Nor do they suffer the same degradation with age. However, they still have limitations.

Power semiconductors' incursion into pulsed power started over 20 years ago when thyristors started replacing ignitrons in arc-welding machines used by the automotive industry. The thyristors used for arc-welding can handle 3,000 A, 415 V for 100 pulses with a 20 per cent duty cycle.

The most recent Westcode device can handle a single pulse of 200 kA, 30 kV with a rise time of 16 kA/μs. This was designed specifically for CERN's linear accelerator work and is made up of 10 thyristors in series. Thyristors which can handle this type of power do so by distributing the functions of the device across a wide area of silicon and by having large areas of metallization for efficient heat dissipation.

CERN's 10 thyristors are triggered simultaneously using a pulse transformer with a single primary coil and 10 secondaries. While semiconductors have many advantages over spark gaps and thyratrons, they cannot match these devices for switching speed. Applications like pulsed radar, which require pulse power at radio frequencies, must still rely on conventional technology.

However, a vista of exciting applications has opened. While much of the original work was done for military research, perhaps one of the most significant applications will be in environmental protection. Pulsed electron beams have been demonstrated to convert common pollutant gases like hydrogen sulphide and nitrous oxide into harmless substances. Such a system shows great promise because it uses less energy than thermo-chemical methods.

Advances in switching components are also making it possible to remove the soot from diesel engine fumes, without restricting the exhaust flow. (Source: *Electronics Weekly*, 20 March 1996)

Apple's Pippin hits Japan in bid for Internet stardom

The world's first "Internet Computer" saw the light of day with the launch of Apple's "Pippin" in Japan.

The device will be manufactured by Mitsubishi Electric which is ready to start making 30,000 Pippins a month. In the first year of sales the Japanese consumer electronics company Bandai, which developed Pippin under licence from Apple, says it expects to sell half a million units.

Pippin uses the PowerPC 603 processor, 6 Mbytes of DRAM, 1 Mbyte of VRAM, CD-ROM drive, MPEG decoder and a modem for $600. A keyboard is optional.

Pippin will not be launched in the US until September 1996 and Europe will not get the machine until the end of the year.

Non-Japanese Asian sales will be pursued "as soon as possible", says Bandai.

Bandai will provide an Internet access service with the Pippin, which uses the domestic TV set for the display. Bandai hopes to get revenues from network memberships as well as sales revenues and, in time, hopes to add other revenue-producing services such as stock prices or banking services.

Bandai says its version can also be used as a games machine, a POS/POI (point of sale/point of information) terminal, an Internet terminal, or an inexpensive corporate learning platform. (Source: *Electronics Weekly*, 20 March 1996)

Active pixels make light work

Advances in CMOS image sensors coupled with digital control circuitry have made practicable single IC cameras. Such devices are expected to find use in myriad areas ranging from PC peripherals and videoconferencing through to emerging wireless applications.

One such camera-on-a-chip is an analog 256 × 256 pixel sensor developed at NASA's Jet Propulsion Laboratory (JPL) for high-performance imaging and poor light applications. Each pixel consists of a photogate imaging sensor, which converts light to charge; and four transistors which perform the read-out, selection and reset functions.

The digital control circuitry alongside the pixel array provides the start command, mode control and settings such as the integration time and windowing parameters—the device can read out any window of interest within the 256 × 256 array. The device outputs a differential analog signal as well as synchronization signals indicating the end of a row and frame, and sampling information.

The device can achieve a readout rate of 30 frames/s. It can also be run in a differencing mode where each pixel output represents the difference between the present and previous frame.

The device operates from a 5 V supply and has a power consumption of less than 10 mW.

The noise figure of the sensor is 13 electrons r.m.s. (each impinging photon generates one electron on average), while its dynamic range is 75 dB.

JPL is working on adding A/D conversion on-chip to create a digital camera-on-a-chip. It has already developed a 1024 × 1024 pixel sensor which includes an A/D converter; however it is a "dumb" device and does not include any digital control circuitry. (Source: *Electronics Weekly*, 14 February 1996)

Fasteners for electronics

Electronics drive much of today's technology, but among the chips, lasters and circuit boards lies the hardware that holds it all together. These fasteners must not only pass cleanroom requirements for assembly, but maintain the integrity of clean, sealed components over the lifetime of the product.

Consider the fasteners used in a typical computer disk drive. Sealed in an airtight enclosure, tiny screws, only 0.030 in. long, must sit firmly and stay tight and must not gall or break. One line of fasteners that meets these requirements is from Camcar. They are made of Camtronic Y, a non-magnetic, lubricious stainless steel, and are available in sizes from M2 to M3.5 for use in Class 100 cleanrooms.

The computer industry was also behind the development of the ACR Phillips II drive system. The ribs and ridges greatly increase stick-fit without magnets or clamps, and without compromising off-angle driving (up to 7°) for difficult-to-reach fasteners.

Rugged stainless inserts are also common, particularly in avionics and aerospace. When weight is a concern, coiled inserts are an even better choice. One drawback with common coiled inserts, however, is that the installer must twist a tang on either end of the coil to wind it into the hole, then painstakingly break it off. Addressing this deficiency, Kato Spring Inc., Duluth, GA, now makes a tangless coil insert with an internal hook that installs easily and leaves nothing to short nearby electronics. (Source: *Machine Design*, 21 March 1996)

Lab-on-a-chip speeds up drug discovery

SmithKline Beecham (SB) and the David Sarnoff Research Center have formed a joint venture in the US called Orchid Biocomputer, to develop a computer chip capable of carrying out thousands of chemical experiments simultaneously. The main aim is to use the chip to reduce the development cycle times for new drugs.

The chip will be about the size of a business card. Using 10,000 microscopic test tubes and reservoirs, and minuscule electronic pumps, valves and chemical sensors, the chip will allow the simultaneous synthesis of molecules and measure their reactivity with molecules from the body that are the targets for drug action.

Two main types of reactions will be performed by the chip. A chemical synthesis reaction, during which potential new drug leads are generated, and a biological screening reaction, which tests the synthesized compounds for their biological activity against a specific pharmaceutical target.

The microchip will be part of a larger system designed to automate experimentation. The chip is being designed to be put into a benchtop-sized instrument that can be programmed by the researcher to carry out specific experiments. There will be no need for laboratories to change their existing computer equipment in order to accommodate the device. The research and development programme is expected to run for about two years. (Source: *European Chemical News*, 8-14 April 1996)

Memory cards

A digital camera with flash based memory cards will have the image storage capacity to be used time and time again without needing a new roll of film.

The beauty of these memory cards lies not only in their memory capacity but in their size as well. At present they have come down to a quarter of the credit-card size of the conventional PC Card (PCMCIA) memory card format.

The stage is set for revolutionary change in the solid state memory card market, but designers will once again face the choice between not one or two, but three competing and incompatible card formats. It is still far too early to talk of an industry standard yet.

Currently there are three proposed formats of miniature memory cards promoted by SanDisk, Toshiba and Intel. Only SanDisk's Compact-Flash is available as a product; nevertheless all three formats have their own set of supporters, from camera makers to GSM phone suppliers.

Inevitably the three miniature card formats are electrically incompatible, and the stage is set for another standards battle. Each group of miniature flash card designers

claims that they can satisfy the toughest of requirements commanded by various handheld device manufacturers.

As mobile phone makers keep reducing the size of their phones, their requirement for reliable and cheap miniature memory increases. It appears that the current miniature card sizes are still too large.

Miniature card-based data modems and memory will be used with cellular phones enabling them to store, send and receive faxes, e-mail, voice mail and other data information.

The same cards will also be used in pagers, laptops, cameras, camcorders, videos and various portable, handheld devices.

Solid state memory cards are typically based on flash memory and hence provide non-volatile storage, holding data indefinitely without the need for batteries. They only use power during the read and write processes. Industry analyst Dataquest suggests that by 1997 the market for flash cards will be $900 billion, an almost tenfold increase on what it was in 1994. (Extracted from *Electronics Weekly*, 27 March 1996)

Synopsys develops power tool

Synopsys has launched a tool capable of optimizing a synthesized circuit's power consumption. The tool, Power Compiler, is an optional add-on to Synopsys' core Design Compiler synthesis engine which optimizes a circuit for area and speed.

Being able to design an ASIC with a target power consumption in mind is a key requirement for designers of portable equipment. Until now they have been unable to specify a digital circuit's desired clock period or area but analyse the power consumption after the fact. (Source: *Electronics Weekly*, 3 April 1996)

Six IBM MPEG-2 devices

IBM Microelectronics has announced six MPEG-2 devices, comprising three encoder and three decoder chips.

The devices are intended for use in professional broadcast applications, multimedia PCs, workstations and digital set top boxes.

The MPEGSE10/20/30 encoder chips provide real-time MPEG-2 video and audio compression and can operate alone (the SE10) or in combinations of two and three devices. The SE10 performs the I-Frame (actual picture) coding while the SE20 and SE30 combined perform predictive and bi-directional frame coding.

In comparison, LSI Logic's VISC system uses five devices and C-Cube Microsystems which use seven although C-Cube expects to have a single-chip solution before 1998.

The decoder devices, the MPEGCD10/20/21, are available as either video only or video/audio decoders.

IBM claims its system requires less memory than competitors' devices. A three-chip system needs 6 Mbytes of page mode DRAM and 256 Kbytes of fast SRAM. (Source: *Electronics Weekly*, 3 April 1996)

Cochlear implant

A connector company and a Swedish dental implant maker are working with University College, London, to develop an electrical connector for the human body.

Percutaneous connectors, as they are called, have a difficult life. Despite the best efforts of the body's immune system and the hostile external world, the connector must remain reliable if further surgery is to be avoided.

The project aims to remove certain disadvantages of inductively coupled cochlear implants used to restore hearing to some deaf people. The connector approach increases bandwidth, allowing more sophisticated nerve stimulation, and is thought more reliable.

The shell, attached to the skull bone and protruding through the skin, is titanium, which is acceptable for the immune system.

The 11 contacts of the connector are used to supply nine electrodes embedded in the cochlea and two ground connections. One of the earths is connected to a local muscle and the other is used to discharge any static. (Source: *Electronics Weekly*, 1 May 1996)

UK researchers make clever gestures to help handicapped

Researchers at City University, London, are developing computer systems that recognize and act on gestures, body language and sign language.

The group is seeking to assist the disabled community, particularly those too severely impaired to use keyboards or communicate with gestures.

Techniques from virtual reality are being used to map body movements, while artificial neural networks are being used as analysis tools. It is hoped that the techniques can be applied for the recognition of sign language to benefit the deaf community. First results are encouraging. Dr. David Roy, a research fellow in the Department of Systems Science said: "Neural nets can now classify and recognize 12 movements of an arm from a severely disabled subject who has no functional use of the arm". (Source: *Electronics Weekly*, 1 May 1996)

Tiny factory cleans up dirty water

A factory on a silicon chip, complete with conveyor belts, mixing vats and separation systems, could help water companies to detect dangerous micro-organisms in the water supply.

So far the parasite detection "factory" exists only as a collection of parts, but Ron Pethig and Julian Burt at the University of Wales at Bangor are embarking on a three-year research programme to put all the pieces together.

The mixers and movers in the tiny factory use a phenomenon called dielectrophoresis to harness the electrical charges generated by every living thing.

The most basic components of the factory are the conveyor belts that shunt the organisms around. Each is made up of a series of electrodes 50 micrometres wide, laid along tracks in a similar way to railway sleepers. Each electrode generates a series of electric fields that rotate in sequence in the direction of travel, with the first electrode synchronized with the fifth, the second with the sixth and so on. These fields push the micro-organisms along.

Circular arrangements of the electrodes can trap organisms, and a layout resembling the teeth of an opening zip can be used to separate different organisms that respond to the fields in slightly different ways. The electrode conveyor belts and traps are carved out of silicon semiconductors just like the transistors in a microprocessor.

If the researchers wish to tag a particular organism to distinguish it from any other particles in the sample they can label it with a tiny polystyrene bead coated with antibodies specific to that organism. The beads are either held in a tiny reservoir on the chip, or the sample can pass through a tagging reservoir before reaching the chip. The bead changes the way the micro-organism moves in an electric field and makes it easier to spot. Pethig says that simple image-processing techniques will be used to spot whether particular parasites are present by the way they spin or move in the traps.

Eventually, the researchers want to make the chips disposable. Pethig says the factory could have far wider applications. For example, cells that become cancerous often begin to respond differently to electric fields long before other tests would single them out as cancerous.

Bangor's parasite detection factory is part of a wider trend towards miniaturizing chemical and biochemical processes. For example, a team at the Oak Ridge National Laboratory in Tennessee is developing a DNA analyser that fits on a chip.

The chip works with samples 100,000 times smaller than normal, and can perform an analysis using enzymes in five minutes rather than an hour. (This first appeared in *New Scientist*, the weekly review of science and technology, London, 13 April 1996)

Laptops break through storage barrier

Portable PCs, expected to go on sale in June 1996, will enable travellers to carry an officefull of information in a machine the size of a large notebook.

The computers use an unusual disk-reading head to break the old storage barrier for portables of a billion bits per square inch. The same technology has allowed Matsushita to produce audio cassette players that minimize background hiss.

Like microchips, the heads are made from a thin film of silicon. They rely on magnetoresistance: the electrical resistance of the head changes with the strength of the magnetic field coming from the surface over which it passes. These changes in resistance produce variations in an electrical signal.

The heads are very sensitive, so they can read very small magnetic domains on the tape or disk at high speed. IBM's new disk drive packs 1.3 billion digital bits into each square inch of disk surface. This allows a laptop computer to store over 16 gigabits of data.

The analog thin-film heads track the tape surface very closely, so they capture a strong signal even from old and damaged recordings. Because the signal is strong it needs less amplification, so there is less of the background hiss which plagues analog cassettes. (This first appeared in *New Scientist*, the weekly review of science and technology, London, 27 April 1996)

Optical computing: correlation is now causation

After three decades of research, a form of optical computing should make it to the marketplace in 1996. OCA Applied Optics, of Garden Grove, CA, has developed the first light-based processor that can be plugged into a personal computer. The processor is called an optical correlator.

Correlators are specialized devices designed to find "targets"—from car parts to cancer cells—inside "scenes" presented to them. They work by converting images of both the targets and the scenes into mathematical expressions known as Fourier transforms. A Fourier transform is a coded version of an image that shows the thickness, spacing and direction of every line in that image in a consistent way. The consistency and simplicity of Fourier transformation allows a computer to compare images easily and, usually, accurately.

This can be time-consuming, especially if the image is big.

The advantage of an optical correlator is that the processing is done by the basic physics of the system. A lens can be made to produce a Fourier transform of an image directly by shining what is known as "collimated" light (i.e., a beam of parallel rays, in this case a laser beam) through an image of the scene made up of liquid crystals. When the collimated beam is focused by a lens, the result is a pattern the composition and brightnesses of whose elements corresponds to the mathematical terms of the Fourier transform.

An optical correlator is, in effect, an analog computer, rather than a digital one (though the results of its computations are then digitized for transmission to its host PC). By missing out the step-by-step processing that digital computing requires (and also by working at the speed of light), it arrives at its result very rapidly.

OCA's correlator (which works at 1,000 correlations per second), takes advantage of new electro-optic components, such as tiny lasers, fast liquid-crystal displays and high-resolution detectors. (Extracted from *The Economist*, 4 May 1996)

New sensors detect NO quickly

Nitric oxide has numerous roles within the body ranging from controlling smooth muscle to neurotransmission (*C&I* 1995, 828). But detecting it at its site of action is hard. Now UK researchers have come up with a sensor that overcomes previous problems and could help in the study of the chemistry behind heart attacks, septic shock and stroke.

Danny O'Hare of the University of Brighton and Michael O'Shea of the University of Sussex have developed a sensor for detecting NO which would allow a better understanding of how the heart responds to the trauma of oxygen deprivation, as NO levels change as the heart muscles contract and relax. This could help in the development of drugs to control the chemistry of muscle contraction, leading to more effective ways of limiting heart damage.

NO is difficult to detect because it is so reactive, says O'Hare. As soon as it forms, it reacts with neighbouring molecules or receptors so that it exists in very tiny amounts at any one time.

Previous researchers have used spectrometric techniques to measure levels of NO in samples, but these are limited because readings cannot be taken instantaneously. Another problem is that NO reacts with ubiquitous superoxide radicals—produced by metabolic processes—to form peroxynitrite ions, which fog the signal by responding in the same way as NO itself.

Current NO sensors that can be inserted into living tissue need lengthy, complex preparations. Also, they are so susceptible to damage—even from the immune response of the tissue under study—that they can only be used once without complicated cleaning and polishing.

O'Hare's new sensor uses a robust graphite epoxy composite fibre only 100 μm in diameter which incorporates a NO-sensitive iron compound. If NO reacts with the iron complex, it produces a change in electrical current that can be calibrated to a specific concentration of NO.

According to O'Hare, it takes only a day to make 20 to 30 sensors. Each sensor can be quickly cleaned after use by slicing off the end with a scalpel and reconditioning it.

The team is also using the sensor to follow the course of septic shock where white blood cells respond to invading microbes by making NO, but in quantities so high that they damage healthy cells as well. Understanding how the enzyme that catalyses the production of NO in this process works could lead to an effective drug therapy. (Source: *Chemistry & Industry*, 5 February 1996)

Smartcard security

Palm reading was once an activity generally carried out at the local fairground by a medium. These days palm prints are one of a growing number of personal identification parameters collectively known as biometrics, which are quickly turning into an unavoidable part of our daily lives.

Biometric user authentication addresses the need for security in financial transactions and is of particular importance for the potential introduction of the smartcard.

The technology is rapidly becoming an intrinsic part of any identification or financial clearance system. To establish the user's identity at the point of sale (POS), or in a self-service environment, becomes a main objective of smartcard system developers.

Until biometrics stepped onto the scene, financial transactions were given the go-ahead only if the user would prove to be owning something or knowing something (a PIN or password). But this did not prove identity.

Biometric verification is entirely based on examining individual human characteristics. These can be physical (palm prints, fingerprints, retinas, irises, faces) or behavioural (dynamic signature, speech, keystroke dynamics).

In the case of behavioural characteristics there is a great deal of variation in measured parameters. Differences can be incurred by various background environments and state of health or mood of the individual. Hence, behaviour-based biometric systems typically incorporate complex computational algorithms which identify differences in patterns they have been presented with. Physical biometric checking is not so challenging, as human physical characteristics rarely change.

In biometric verification, passwords and PINs, used in classical authentication, are now replaced with reference-containing parameters extracted from selected biometric characteristics. To biometrically establish an individual's identity means a direct comparison between a reference and on-the-spot measured parameter.

As with classic authentication, the system will generally allow three consecutive tries of the same biometric characteristic.

The algorithms used in any biometric verification systems originated from military or scientific research organizations and have evolved into three groups: the statistic algorithms, the oldest form known; the dynamic programming approach, which has evolved from speech recognition algorithms, and algorithms based on neural networks.

For higher security the reference is typically stored on the smartcard itself. Although it can reside on a computer database and can be accessed on-line, authentication can be carried out at the POS or over telephone lines.

There is a project, named CASCADE (Chip Architecture for SMart CArds and secure portable DEvices), which looks into making the card do its own processing and biometric authentication work.

If authentication is to be carried out on the smartcard, then a high level of processing power, as well as memory, is required on the card. Memory is necessary to store the templates/references and this information varies with the type of biometric verification. For example, for signature verification with KAPPA (Kent Automatic Pattern Processing Algorithms) the template will be about 300 bytes, whilst the template for a vein pattern is around 400 bits.

The hardware specifications that will support biometric authentication have significantly come down in performance and price since the technology's inception. Any 386 specification PC, for example, will be sufficient for performing the authentication. There is no longer a need for custom-made boards, densely populated with DSP chips, as was the case not so many years ago.

The second generation of biometrics technologies is already emerging, pushed by the latest developments in computer science, ICs, opto-electronics and so on. Currently there are six types of commercial biometric systems available: fingerprint scanning, hand geometry, eye scanning, signature verification, face recognition and voice verification.

But biometric verification does not stop at fingerprints or hand shapes. Every part of the human anatomy potentially offers individuality and this is intensely exploited. Currently, still at research or prototype stages, are vein pattern checking, ear geometry and body odour verification.

The speed, accuracy and low price of the biometric systems are critical parameters for their eventual commercial acceptance. At present, voice recognition offers the lowest of costs in terms of hardware and signature verification follows closely behind.

Although it appears that the hardware and the algorithms needed for biometric authentication are not of critical importance, there are still some key issues that need addressing. Amongst them are the infrastructure and the markets. Large international financial institutions like Visa, Mastercard and Europay are currently all bringing out draft standards for smartcards. Identity checking is one of the issues they address. Whether they decide to use PINs or biometric checking is still to be determined. It is expected that biometrics will play a key role in smartcard operation, although not for some years to come.

The first applications expected will be fairly small in size, such as access control, add-on biometric checking devices for computers and POS terminals, and possibly credit card control. (Source: *Electronics Weekly*, 7 February 1996)

Biometric checklist

Retina/iris scanning has been defined as the most accurate biometric system yet, but it is highly invasive and as such will face resistance from the general public. Companies currently researching this area are EyeDentify and IriScan.

Fingerprint checking systems can be obtained from companies such as the Central Research Laboratories (CRL), Cambridge Neurodynamics, SEPT and VLSI Vision. Some of them are involved in developing hand geometry systems as well.

Voice recognition is researched by Domain Dynamics, Vocalis, Gemplus and others, whilst facial recognition is mainly researched at universities such as the Universities of York, Aberdeen and Essex.

Signature checking has been addressed by AEA Technology, BTG, Rolls Royce Aerospace and others.

The Vein check project that looks at vein patterns is currently being developed by BTG. The hardware necessary for checking the vein patterns on the back of a hand consists of a camera, near infrared LEDs (860 nm) and a 386 specification PC. A black and white image is captured by the camera from the illuminated hand. The image is then digitized into a 400 bit road map which is then rotated and compared with references, carried out by algorithms, to verify identity.

"We believe these (veins) are as unique to each individual as fingerprints, but without the social connotations. It is non-invasive and publicly acceptable. Fingerprints can usually get damaged through work".

The vein-pattern checking technology is only 18 months to two years away from commercial application such as access control.

One example of dynamic signature verification is the technology that BTG recently acquired from the Rolls Royce Aerospace division. This hardware consists of an acoustic metal plate, a pen, an ultrasound microphone and a PC. The digitized tablet detects the sound a pen makes on the paper.

Voice verification has long been of primary interest to Cambridge-based Vocalis, which is currently involved in a EU-funded project called CAVE (CAller VErification for banking and telecommunications). The hardware for CAVE is based on RISC processors and uses Vocalis's IVR (Interactive Voice Response) platform. This system makes use of both text-dependent and text-independent speaker verification technologies. (Source: *Electronics Weekly*, 7 February 1996)

F. SOFTWARE

Intelligent agents "hound" the Net

UK-based pattern recognition software company Cambridge Neurodynamics has introduced an Internet information mining tool called AutoNomy. The tool generates autonomous agents, that the company calls AutoNomy Agents or "hounds", that search for information on net servers. The generation of the hounds is claimed to be intelligent in that the search precision is self-refining with AutoNomy learning the user's requirements. The servers searched can be prioritized or chosen at random. The software is claimed to broaden the search if too little information is found, and bring back data for approval once located. It is claimed that, given time, it searches the whole Net. Pretrained Agents are also available: Press Agent compiles personal daily newspapers tailored to the user's preferences, and Mail Agent prioritizes incoming e-mail by analysing its contents. (Source: *Electronics Weekly*, 28 February 1996)

Modem versus Ethernet Internet access

The January 1996 issue of *The Institute* looked at the initial results of a questionnaire on electronic communications (EC) that was sent to a thousand IEEE members. It is clear from the results that many members are connecting to the Internet at both home and work. The connection from home is almost always via a modem and a telephone line. The kind of connection at work will most likely depend on whether the company (private or public sector) has a computer system with Internet access. If the company has such a computer system, your PC may be connected via an Ethernet cable; if not, then your connection is likely via a modem and telephone line to an Internet service provider.

The differences between these two linking mechanisms—Ethernet and modem—will be considered. There are also differences depending on whether you are sending e-mail messages or browsing the Web, because the resource requirements are so different. We will look at each of these two applications in turn, but first it is useful to look at the common point—your Internet connection.

Your Internet connection

Let us start with a typical company network. This assumes the company has a computer system that is connected in some kind of network. This company may be the one you work for and which provides you with Internet access as part of your job, or it may be the company whose business is to provide Internet access on a fee-for-service basis.

- **Ethernet**. Ethernet is the name of a type of cable commonly used to connect computers in a local area network (LAN). These computers are located on-site in the company. This cable provides a high-speed and wide bandwidth path for the data flow between the computers. In most cases the company connection to the Internet also has high speed and wide bandwidth— but not necessarily! Thus we need to distinguish between connection speed within the LAN, and between the LAN and the Internet.
- **Modems**. Off-site computers are normally connected to the company computer system by the use of telephone lines and modems which are much slower than Ethernet cables. The difference in speed can be anywhere from 1,000:1 to 10:1. The upper ratio applies when the Ethernet connection is lightly loaded. Even when the Ethernet is heavily loaded, it is still an order of magnitude faster than the telephone line/ modem combination. The Ethernet link is faster because it is digital and most telephone lines are analog. The newer ISDN (integrated services digital network) telephone systems are digital and much faster than their analog counterparts. (Only about one per cent of survey respondents report having ISDN service.) Modems perform the analog-digital conversion and this adds to the slow-down.

A LAN typically connects a number (perhaps 20) of personal computers (PCs) of virtually any kind (IBM or IBM-compatible, Mac, or small Sun, Silicon Graphics or H-P workstations, etc.) to several servers within a department or group. This set of computers is also connected to the rest of the company computer system. There is often a modem pool to connect off-site PCs to the LAN. The servers may perform one or more of several functions, acting as a common source of software packages for word processing, spreadsheet and database applications, file storage and backup, as well as being the host machine for electronic mail (e-mail).

This host is usually a computer running Unix. Unix is the most common operating system (OS) that enables several users to use the machine at one time (multi-user) and individual users to run several programs at the same time (multi-tasking). The Unix OS includes a basic e-mail program, sendmail, that utilizes the Simple Mail Transport Protocol (SMTP).

On systems that provide true "full Internet access", all the EC tasks—e-mail, telnet and FTP (file transfer protocol) use the same underlying TCP/IP (transmission control protocol and Internet protocol). This use of standard protocols is the key reason why users can interact with each other using a wide variety of hardware and software over the Internet. The use of proprietary software by some commercial service providers restricts what users can do.

E-mail

The e-mail package can be located on either the host or the PC. PINE and the older ELM package are installed on the host. PCmail and Eudora are examples of e-mail packages that are installed on PCs. If your PC happens to run Unix, you have the choice of a Unix-based package. All of these packages interact with the basic sendmail program that connects with the network while providing you with user-friendly features. The amount of information that is passed between your PC and the host is relatively small. The host is always connected to the network and stores the mail it receives until you power up your PC and decide what to do with it.

To use e-mail, you need a terminal emulation software package on your PC that connects with the host—for example, ProComm and BW220. These packages either help you send commands to the e-mail package on the host (PINE, ELM, etc.) or help your PC-based e-mail package (Eudora, etc.) interact with the basic sendmail program.

- **Ethernet**. If you are connected via a fast Ethernet cable and you do not pay for connect time, you may not be concerned about the time it takes to be connected to the host and perform message composing, editing, reading and so on.

- **Modem.** If you are connected via a relatively slower telephone line and modem combination, or if you pay for connect time, you may prefer to use a PC-based e-mail package that enables you to prepare and read messages off-line at your leisure and connect briefly to transmit messages between PC and host. In either case, the newer, faster modems with data compression and automatic error correction may well be worth the extra investment. The data compression typically gives you an effective speed increase of four times.

Web browsers

Installed on PCs, these are based on Windows (not DOS), Mac OS, or X-Windows (Unix). The most common examples are Netscape and Mosaic. Their use requires your PC to be connected as a node on the Internet, which means that your PC must be assigned an IP (Internet Protocol) address by your system manager. This is the person who controls your access to the Internet and authorizes your log-on ID.

- **Ethernet.** If you are connected via Ethernet to a company LAN, you will have a permanent IP address. This is a fast connection that will not cause delays in screen writing (especially when the Web page contains high-density graphics). The major causes of delay are most likely the network bandwidth limitations and traffic congestion. Some Web server sites are over-loaded because a lot of users access their pages. Some sites have not installed a connection to the Internet that is adequate for the traffic they are generating.
- **Modem.** If you are connected via a modem, you need either a permanent IP address or a temporary one that is assigned each time you log on. You also need a SLIP (Serial Line Internet Protocol) or PPP (Point to Point Protocol) connection. PPP is a newer and more general protocol than SLIP.

  Such a SLIP or PPP connection requires two conditions—one, you have a communications software package on your PC that supports a SLIP or PPP connection; two, the network that provides your Internet connection has a modem pool that supports the SLIP or PPP. A third condition (in reality a precursor to condition two) is that the network must have a full Internet access (or service) connection to the Internet.

Summary

There are two main causes of delays—traffic congestion and modems. Some users turn off the graphics display, an option in their Web browser. This may be effective in speeding up your display response time if the graphics are only "window dressing". However, some Web pages are using graphics for content and you may lose important information. Installing the hardware and software that is right for you takes both time and money. If you have an Ethernet connection at work and a telephone/ modem connection at home, you will need different software to match the differing requirements. (Source: *The Institute*, February 1996, B. Alden, p. 4)

Japanese into English in under a day

The Japanese Information Centre is reported to have developed software that translates written scientific Japanese into English. A fee-based Internet service is expected that will turn around a 20,000 character document in under a day. The program should also be available on CD-ROM for the AppleMacs and Windows in the summer, priced around ¥55,000 (£340). (Source: *Electronics Weekly*, 6 March 1996)

Organizer for drawings and data

AutoCAD Data Extension (ADE) Release 2, a productivity and data integration toolset, helps users organize and integrate multiple drawing files and related databases into a single AutoCAD environment.

The Query Engine, the heart of ADE, helps AutoCAD R13 users work with large and complex data sets. ADE lets users "query" drawings based on user-defined criteria, which can be based on any combination of drawing properties, object locations, or on information stored in related databases. This flexibility speeds up users' work because ADE lets them focus just on the specific data they need. For example, a draughtsman could define and query only the drawing in a specific area from the HVAC, electrical, and floor layout drawings in an architectural project, make changes to all three drawings simultaneously, and save back those changes to the original drawings. Further details from Autodesk Inc., 111 McInnis Parkway, San Rafael, CA 94903, USA. Tel.: (415)507-6093. (Source: *Machine Design*, 7 March 1996)

Translating engineering data

Translating engineering data from one format to another can be a nuisance. Most CAD systems, for example, employ data formats that are incompatible with each other. Even widely encountered screen formats, such as the Windows Clipboard are nearly useless until converted into generic forms such as Tiff or PCX. IGES translations are worse. The neutral file format used by most CAD packages provides one way for moving drawings and models from system to system, but IGES translations often appear with gaps between surfaces, warped surfaces, or lost comments and notes. Models may be so fragmented they are unusable. To avoid IGES translation problems, engineers may turn to several other formats such as DXF or STEP.

The five most important files and formats for engineers are probably IGES, STEP, DXF, SET and VDAFS. SET is a national drawing translation standard from France while VDAFS, from Germany, has a similar function. In ten years, STEP, the standard for the exchange of product model data, may be the most widely used.

IGES

This national standard, also called ANSI Y14.26M, defines common CAD entities in a neutral format that other CAD packages can understand. The standard supports most features CAD systems generate, such as notes, geometry, views, and both CSG and B-rep solids. However, the diversity of CAD systems and developers causes trouble.

For example, CAD systems typically define native drawing entities in ways that are incompatible with other brands. A line may be defined by beginning and ending points in one system or by a starting point, length and direction in another. The complexity grows for more complex figures such as ellipses, arcs, and splines. Also, a few CAD systems create entities with unique functions found nowhere else. How they translate into IGES is the developer's responsibility. The forms they take when translated into a CAD system are of lesser concern. What is more, the specification is open to a lot of interpretation. Because each CAD vendor writes its own IGES translator, translations back and forth can vary.

Other problems stem from the accuracy built into the modelling systems. This difficulty arises regardless of what standard is used to move information.

Strategies for attacking translation problems might include dedicated translators. These custom packages are

tuned for translations between specific versions of software such as from Mainframe Cadam Version *x.y* to AutoCAD Release *y* DWG files. When available, dedicated translators are particularly useful for converting legacy data from systems that are no longer supported into a specific CAD format. If the vendor has such a translation program, file conversions are fast and straightforward.

Another method of solving translation problems involves translating only the needed information.

When a project calls for translating many drawings, users can turn to IGES utilities, software tuned to look for frequently encountered errors and correct them. They are usually able to work on a drawing-by-drawing basis or in batch mode.

To automate the correction of model errors, users may write a script, a description of what the utility should look for and how to correct it. Consequently, they must know what works and does not work in IGES transfers , and then write the script to fix it.

Love it or hate it, IGES is not going away soon. Version 5.3 of the neutral file was recently submitted for ANSI approval. It supports more solid-model entities. But there will be no development past Version 6. Engineers can still look to DXF, the drawing exchange format from CAD software vendor Autodesk Inc., as one way to avoid IGES hassles. DXF has become a de facto standard because it is used widely by other CAD packages. The format has frequently served as a 2-D image translator. However, as AutoCAD takes on 3-D functions as well as 2-D, DXF has also been updated to handle more than 2-D entities.

The company says it will ensure upward compatibility (DXF Release 12 will read drawings from R10). Downward compatibility comes either from use of special saving modes or conversion utilities. (Source: *Machine Design*, 7 March 1996)

Translation assistance from the Internet

The Internet contains a wealth of information on file translations, but it is fairly well hidden. Here are a few of the useful sites:

http://elib.cme.nist.gov/nipde.events/pro_role.html describes the function of US Pro.

http://elib.cme.nist.gov/nipde/orgs/ipo_org.html provides information on the IGES PDES Organization.

http://elib.cme.nist.gov/nipde/projects/std00066.html discusses the IGES 3-D piping AP (application protocol) that may soon become part of IGES.

http://elib.cme.nist.gov/nipde/stds/wh-iges.html presents a brief background on IGES and US Pro, meeting agenda, and phone numbers of committee members.

http://elib.cme.nist.gov/nipde/orgs/nist_ipo.html presents information on the specification for an IGES figure viewer. Its purpose is to define a viewer for IGES figure graphics files which can be freeware or possibly shareware, and which can join the ranks of "helpers" for World Wide Web clients. The site also lists companies with software that manipulates IGES files independent of their source or destination.

http://www.iti-oh.com/otherpde.html from ITI provides a partial list of the application protocols that will eventually encompass STEP. A link takes readers to documents of the initial 1994 release.

Niche problems, however, are unlikely to have widely advertised solutions. Though software to make the translations may be commercially available, finding it may be exasperating. The search engines on the Internet may turn up a few useful but well-hidden packages. Lycos, one of the more efficient search sites (*http://www.lycos.com*) boasts of having catalogued 91 per cent of the Internet. Searches work best with two or three key words. For example, to find software that would help project engineer Hottinger translate Tiff images into CAD formats, we typed in the string "Convert Tiff to DXF" as search words. The 30-second search turned up 20 matches, the first three of which looked most promising. They are CADleaf from Carberry Tech., Lowell, MA, RxVectory from International Digital Imaging in Salt Lake City, Utah, and Imagenation from Spicer Corp. in Kitchener, Ontario, Canada. (Source: *Machine Design*, 7 March 1996)

Sorting out file acronyms

Dozens of organizations and formats influence data transfers. Those functioning and fading include:

ASCII the American Standard Computer Information Interchange, provides 256 codes for letters, accents and symbols common to European and Greek alphabets.

DXF is the Drawing Exchange Format initiated and supported by Autodesk. It has become a de facto standard because most 2-D CAD packages support it. The format had been relatively unchanged for several years. Recently, Autodesk updated it to carry solid models generated by the Spatial modelling kernel.

IGES or Initial Graphic Exchange Specification is controlled by the IGES PDES Organization or IPO. The US Product Data Association or US Pro, is the parent organization of IPO. It, in turn, is supported by NIST, the National Institute of Standards and Technology, and accredited by ANSI, the American National Standards Institute.

One little known advantage of IPO is that it is a volunteer organization with meetings open to interested parties. Meetings take place three times yearly and often include workshops and tutorials. The second meeting in 1996 was scheduled to be held at Baltimore from 21 to 25 April. The third is in Toronto from 6 to 11 October.

PDES Inc. is an international government consortium accelerating the development and implementation of STEP.

SETis a file standard established by French automobile and aerospace manufacturers.

STEPis a growing international standard (ISO 10303) that will spell out more stringent measures for moving models and drawings. CAMP's Gary Conkol says the organization's pace of activity, which accelerated in the last two years, will continue.

TIFF, the Tagged Image File Format, is a proprietary format maintained by Adobe Systems, Inc., Mountain View, CA.

VDAFSis a neutral file established by VDA (Verband der Automobilindustrie) in Germany for exchanging only geometry.

(Source: *Machine Design*, 7 March 1996)

Fractals speed up downloading

With the benefit of fractals, World Wide Web users can look forward to the faster downloading of graphics and video methods, according to Integrated Systems of Reading (UK).

At their home Web site, the company is making available fractal compression technology as shareware. This includes Fractal Imager, an image conversion tool; Fractal Viewer, a stills decoder; and CoolFusion, a video decoder.

The company's aim is to make its fractal technology the de facto standard for images on the Internet. (Extracted from *Electronics Weekly*, 6 March 1996)

Software foresees safety features

The outcome of an explosion at refineries and other processing plants where building and plant layout is very complex may be predicted by new computational fluid dynamics (CFD) software. It is being developed by an unnamed petrochemical company with help from the Manchester-based aerodynamic specialist Flow Science. Software development is still in an early phase where basic block shapes are being developed but in the longer term specific components of a known size will be incorporated. Initially, the technology will not be commercially available although it could be sold when further developed.

The CFD program will aid in the assessment of possible damage and consequences of major incidents to reduce the level of danger to which staff and emergency services may be exposed. It can also predict the propagation path, including direction and speed, of noxious gases or smoke, allowing staff to move to the safest areas. These factors can be integrated into crisis management plans.

Flow Sciences will use its wind-tunnel facilities to model the flows around basic structures such as compressors, storage tanks, machinery housings and pipe clusters. It will enable the flow fields and turbulence levels of the various structures to be measured including the forces experienced by the structures. The data will then be incorporated into the CFD program. (Source: *European Chemical News*, 26 February - 3 March 1996)

Java computer language to transform the Internet

Sun Microsystems' Java computer language has generated a tremendous amount of excitement in its ability to liven up static Web pages and possibly give rise to a whole new class of computer devices that are radically different from today's PCs.

Java enables software developers to create small Java programs, called applets, which can be downloaded as a user browses a Web page. That Java applet can provide animation, real-time data display and can even be configured to provide a wide set of applications such as word processing, financial spreadsheets and database applications.

But one of the key reasons Java has attracted so much attention is that Java applications are hardware-independent. Once a Java applet is created, it can run on any hardware platform that supports the Java Virtual Machine specification. So instead of creating hardware-specific programs, such as a Windows 95 program which only runs on Intel or Intel compatible hardware, Java promises complete hardware independence.

This hardware independence is why Java is being championed so loudly by Java supporters which include Oracle, Netscape Communications, Silicon Graphics, IBM, Hewlett-Packard and many others. They see Java as being able to break the lock Microsoft and Intel have on the PC standard. If you could build computer devices that support Java, they could be used for a wide range of common computer tasks, using the Internet to communicate and also access applications.

A Java terminal, sometimes referred to by other supporters as an Internet terminal or Internet PC, was demonstrated at the recent Uniforum show in San Francisco. The device was about the size of a paperback book and used Internet connections to download and run some Java applications. Sun is apparently not interested in building Java terminals but it will help companies to design such systems. A Java terminal-type system would be useful for large corporations who have thousands of PCs and face problems managing those computer resources. Issuing worker with Java terminals would make it easier to support users since everything would be done through the network. And while Internet bandwidth for consumers is very tight, which would make downloading applications very slow, within large organizations there are high-speed networks already in place which would greatly speed up the performance of the devices.

Internet terminals are also being loudly championed by Oracle, which has been showing a prototype system it developed based on an ARM microprocessor that downloads applications and stores data on remote Internet servers and does not have any local data storage in the form of a floppy or hard disk drive.

Java, surprisingly is not a new technology, even through its name is new. Java started life as Oak and was developed at Sun's FirstPerson subsidiary in 1992.

Java still has some problems. As a computer language, it is still not complete. There are very few Java development tools available as yet, although Borland International is working on producing some. It is also not suitable for a wide number of tasks, such as distributed computing and as an operating system.

Although its key feature is hardware independence, it is precisely this feature which also makes Java-based programs slow in running. To speed up Java performance, Sun says it is working on special chips that will accelerate Java applications.

Sun is working on two families of Java chips. PicoJava targeted at the low end for devices such as smart phones and office machines. UltraJava chips will support multimedia applications with lots of graphics, audio and 3-D animation. But the need for Java-specific chips undermines the idea of hardware independence.

Although Java faces some major issues, it has at least pointed a way forward towards an Internet future in which the main role of the Internet will go beyond the viewing of static pages and towards a multimedia-rich Internet that will have a much wider application, and offer a new way of using and distributing applications.

If you have Netscape 2.0 you can see Java demonstrations at the following address: http://www.gamelan.com/. (Source: *Electronics Weekly*, 13 March 1996)

Java: jive?

Java, Sun Microsystems Inc.'s new programming language, is the first attempt to base a language on the assumption that certain Internet computing resources are always available. Until now, languages have focused on one side of the computing equation, either the desktop (desktop-centric) side or the server (server-centric) side. Java is the first to concentrate on how everything plays together (network-centric).

Based on C++, Java is a true programming language, not a mark-up language like html, whose syntax and vocabulary are extremely limited. And while it is also object-oriented like C++, Java is simpler, more robust, easier to use, and more portable.

Sun has made Java simpler through conscious omission and addition of language features. Structures that often create problems—such as operator overloading and automatic coercion, or type casting—were avoided, while useful techniques—like dynamic method resolution, developed by Brad Cox, who created the C-based object-oriented programming language, Objective-C—were added. Java is more robust because an automatic memory management technique called garbage collection, which ties up loose ends when dynamic memory allocation is used, is inherent in its programming model.

Java is also easier to use and more portable, too, because it is an interpreted language from which features unique to a particular computer architecture or operating system were banned. One advantage of using an interpreter

is that Java applications are hardware-independent. The Java compiler generates what Sun calls bytecode—a high-level, machine-independent code—which can be downloaded to the user's machine. Once downloaded, the code is converted into a machine-usable form by a Java interpreter, which is supplied either by being included with a Java-aware Web browser or by design of new hardware specifically to run it.

Adding Java in either way is possible because the language is based on a virtual-machine concept. That is, it is created with the idea that all machines have input and output devices to let people interact with them. Rather than being tailored to a particular input or output device, Java deals with them generically and lets the hardware or application vendor take care of the implementation particulars. Thus, there is no need to compile unique versions of an application for each platform.

Another plus in using the virtual-machine idea is that Java code has minimal expectations for the operating system and hardware. Thus many of the bells and whistles that have been added to PCs and operating systems over time can be eliminated. Since Java's virtual-machine functions can be supported in the simplest way, a Java interpreter and applications can run quickly even on a machine with limited memory and a slow processor. In many ways, Java itself defines a very basic operating system that would allow hardware manufacturers to get new computing architectures into the mainstream without asking users for a massive investment in new application software.

In comparison with C++ applications, those written in Java offer many advantages. The latter are faster in distributed environments, more adaptable, and more secure. Because all their class libraries are multithreaded by design, Java applications are inherently faster when running in a multiple-processor environment (which is what a network is), and they are more adaptable because they can access code stored on any available server. Security is enhanced because Java builds in protection against viruses and tampering by using public-key encryption. Contact: Sun Microsystems Inc., 2550 Garcia Ave., Mountain View, CA 94043. World Wide Web, http://java.sun.com. (Source: *IEEE Spectrum*, March 1996)

High-speed animation of mechanical designs

VisLab Version 1.3 software interfaces with I-DEAS Master Series mechanical design automation software, letting users quickly turn CAD/CAM/CAE models into high-quality 3-D animation sequences and realistic images. Designed to render in hardware rather than software, VisLab animates sophisticated 3-D images in seconds. Using new antialiasing techniques, the software allows users to render any image of any size using any portion of the available screen. VisLab supports most modelling packages and file formats, including DXF, IGES, SLA, BYU and Inventor. Further details from Engineering Animation Inc., 2625 N. Loop Dr., Ames, IA 50010. Tel.: (515)296-9908. (Source: *Machine Design*, 7 March 1996)

Engraving software

Cimigrafi 3-D software lets users create text and sculptural relief artwork on any curved form. Through Cimigrafi's Windows interface, users can trace scanned artwork, format and fit text, and apply the figure to the base part in raised or sunken relief. The software's milling module plots and previews the machining toolpath on screen.

Special functions automate the conversion of line art to machinable toolpaths. Trace and Picture-to-part modules convert colour or black-and-white images to relief contours, and automated pattern wrapping fits artwork to cones or cylinders to make intaglio or embossed rollers. Various decorative textures are easily created, providing many ornamental engraving effects. Further details from Cimatron Technologies Inc., 3600 Billings Court, Burlington, Ontario L7N 3N6. Tel.: (905)639-0802. (Source: *Machine Design*, 7 March 1996)

Automatic meshing in 3-D

Femap Version 4.4 features an advanced meshing module that makes it possible to directly import and mesh CAD solid models, then perform structural analysis in any of 20 different finite-element analysis programs. The 3-D automatic meshing module can import and directly mesh ACIS solid models from AutoCAD Release 13 and Designer, MicroStation Modeler, or any other ACIS-based solid modeller. Solid models from other CAD systems can be imported and meshed via a stereolithography interface. The meshing module is available as an option for 32-bit versions of Femap for Windows 3.1, 95, and NT, and in bundled versions of Femap including MSC/Nastran for Windows. Further details from Enterprise Software Products Inc., Box 1172, Exton, PA 19341. Tel.: (610)594-2454. (Source: *Machine Design*, 7 March 1996)

Digital builds a better Web searcher

A recently opened Web site specializes in letting users quickly sort through the eight billion words and 16 million pages currently on the World Wide Web and Usenet discussion groups, according to the site sponsor, Digital Equipment Corp. Most other search engines ignore the Usenet.

The site is a needed addition to the Web and discussion groups, a resource much like a library without a card catalogue. Finding information by simply surfing or jumping from site to site is time-intensive and wasteful. Searching the Web with the *http://altavista.digital.com* site makes use of Boolean operators *and, or, not* and *near* to focus the search on critical areas. Another unusual feature is a field that lets users apply key words to sort uncovered files. (Source: *Machine Design*, 7 March 1996)

Microsoft develops Pegasus operating system

Several major computer and telecommunications companies are planning to introduce handheld computer devices based on a secret operating system under development at Microsoft.

The operating system, code-named Pegasus, is Microsoft's third attempt to develop a small operating system based on Windows for use in handheld computers and smart telecommunications devices.

Sources close to Microsoft report that Casio, NEC, Epson America, Compaq Computer, AT&T Wireless Services and SkyTel are among the companies that are developing products using Pegasus. The computer companies are building prototype computer devices that will run Pegasus while telecommunications companies are planning to use Pegasus for smart phones and two-way pagers.

Microsoft is expected to unveil Pegasus by the middle of 1996 and also announce software development tools, software developers and a host of companies licensing the operating system.

Microsoft's Pegasus could prove a major boost to the handheld computer market which has failed to live up to forecasts of large market growth. (Source: *Electronics Weekly*, 21 February 1996)

G. COUNTRY NEWS

European Community

Funding declined for new lithography technique

The European Union has decided not to fund a project on ion projection lithography, even though this is regarded as a promising and extremely cost-effective technique for deep submicron lithography. An application for funds to develop the technology had been made, together with a prototype ion projection lithography system, in collaboration with the Advanced Lithography Group (Maryland, USA) under the European Framework IV.

Ion Microfabrication Systems (Vienna, Austria) is leading a group of European companies including the Central Microstructure Facility of the Rutherford Appleton Laboratory (Oxfordshire, UK), the Fraunhofer Institute (Berlin, Germany), ASM Lithography (Veldhoven, Netherlands), Jenoptik (Germany), SGS-Thomson (France/ Italy) and Siemens (Munich, Germany).

Although the European consortium plans will now be abandoned, the Advanced Lithography Group will work with some of the present European partners, including Ion Microfabrication Systems, which will integrate all of the parts that make ion lithography equipment. The Rutherford Appleton Laboratory will continue to develop a mask manufacturing process, and ASM Lithography will supply the off-axis alignment and control system. (Reprinted with permission from *Semiconductor International Magazine*, March 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

EC report calls for "bit-tax" on data sent via Internet

A "Bit-tax" on information sent over the Internet has been recommended in a report for the European Commission.

The motivation for the report is that insufficient revenue from taxation methods such as value added tax (VAT) is predicted in future as data sent by conventional means diminishes.

Chairman of the EC's study group, Luc Soete, said: "A larger share of our production and economic activity is focused on information and communication. We must make sure we have a national tax base which includes these activities."

Soete thinks a bit-tax would eliminate the problem of off-shore tax havens—companies based outside the EU do not have to pay VAT. (Source: *Electronics Weekly*, 27 March 1996)

Improved optic bid by JESSI

Improved optics have been developed as part of JESSI (Joint European Submicron Silicon Initiative) that promises to further the production of ICs with 0.25 μm or smaller feature sizes.

The tolerances of the lenses, developed by Carl Zeiss and Heraeus Quarzglas, have been improved by an order of magnitude. The project developed ultra-pure optical materials and addressed the shaping and polishing techniques.

Surfaces of lenses up to 200 mm in diameter can be polished, using an ion-beam, to an accuracy of better than 5 nm, a tenfold improvement.

The work has also benefited ASM Lithography, a JESSI partner, enabling it to become a manufacturer of the lithographic equipment needed for the next generation of devices. (Source: *Electronics Weekly*, 3 April 1996)

V-chip TV technology under EU discussion

A move to bring censorship technology to the TV industry is to be discussed by the European Commission and by each of the 15 EU member States.

In February, the European Parliament proposed a series of amendments to the broadcasting directives, one of which was the use of V-chips. The V-chip approach, to be adopted in the US, uses a DSP device to enable selective blocking of programmes deemed unsuitable for viewing.

However, there are significant practical difficulties. If the V-chip is to work, all programmes in Europe must be classified. This would require the harmonization of standards across all 15 member States.

The US does not face such problems having only four major networks as well as less rigorous regulations on programme control. Also, the US primarily uses cable where the operator controls the transmissions. No modification to existing TV sets is required.

Pressure groups are against the initiative as it takes responsibility for censorship away from the broadcasters and gives it to the viewers, likely to result in a reduction in programme standards.

Both Motorola and Zilog manufacture V-chips for the US market. The Zilog device, designated the Z89300 TV control and on-screen display chip, uses 16-bit DSP video and control technology and proprietary software to decode extended data services (EDS). It is the EDS, transmitted during the vertical blanking period, that contain the programme ratings. (Source: *Electronics Weekly*, 6 March 1996)

Esprit project on automated telephone banking

An EC Esprit-funded project involving the University of Edinburgh is to attempt to develop and test an automated telephone banking system—one of the first practicable public applications of speech recognition technology. The project, funded to the value of £458,000, also involves the University of Aalborg (Denmark), banks and Brite voice control systems and Agora Conseil of France.

Employing speech recognition techniques for automated banking is simplified and the size of the vocabulary used is limited. The difficulties it faces, however, include the large number of users the system needs to be able to recognize, and the quality of the received speech.

The project will involve three trials involving 200 to 300 users to gauge the public's response to the technology. The initial trial will involve acquiring peoples' IDs and banking numbers. If this proves successful, the second trial will look at allowing users to access account details. The final and most sophisticated trial will address users performing more complex tasks such as setting up standing orders. (Source: *Electronics Weekly*, 24 January 1996)

Esprit Framework IV ADEQUAT project

IMEC, an independent European microelectronics research establishment in Leuven, Belgium, has been selected to coordinate advanced development work on 0.25 μm/0.18 μm CMOS in ADEQUAT+, a new 15-month project funded under the Esprit Framework IV programme.

The project, involving 85 people, will cost 23.2 million ECU (approximately US$30 million). The project aims to

develop interconnect processing steps and modules for 0.25 μm CMOS by the end of 1996. These back-end modules will be combined with 0.25 μm transistor (front-end) modules developed in the predecessor ADEQUAT-2 project completed in September 1995. The implications of low-voltage 0.25 μm applications will be assessed through a low-voltage test circuit to be selected from several options. Concept testing and patterning feasibility for 0.18 μm front-end modules should also be completed by the end of 1996. The lithography process is expected to be established a year later, with front-end and back-end modules in place by early 1998 and 1999, respectively.

Other partners in the ADEQUAT+ project include research centres DIMES (Netherlands), Fraunhofer Institute (Germany) and GRESSI (France), together with GEC Plessey Semiconductors (UK), Philips (Netherlands), Siemens (Germany) and SGS-Thomson (Italy and France).

The ADEQUAT+ project is guided by the semiconductor components divisions of major European IC companies. The predecessor projects, ADEQUAT-1 and -2, have established firm links with the JESSI Technology project "Joint Logic" and a similar link will be set up with its successor (the SHAPE project). ADEQUAT-2 recently received a 1995 JESSI Recognition for its outstanding achievement and management. (Extracted with permission from *Semiconductor International Magazine*, January 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Europe develops multi-layer interconnects for Joint Logic Project

Collaborative European work has led to the development of advanced multi-layer interconnects. The wafer processing has been carried out at various sites, such as the Centre Commune (Crolles, France), which is operated jointly by SGS-Thomson Microelectronics and CNET (the research arm of France Telecom) with technical participation by Philips Semiconductors. The TEM samples have been made and studied by Philips Research (Eindhoven, Netherlands).

This work forms part of the European Joint Logic Project that has led to European manufacturers using advanced techniques to produce 0.5 μm CMOS devices in high volume. These techniques include tungsten plugs, sandwich-metal construction and optimized spin-on-glass planarization. The 0.5 μm process using three levels of metal, stacked contacts and planarized interlayers was qualified in 1994 for 3.3 V operation. Development work on a 0.35 μm CMOS technology has been started in connection with the ADEQUAT programme that is working towards 0.25 μm CMOS technology. (Extracted with permission from *Semiconductor International Magazine*, November 1995. Copyright 1995 by Cahners Publishing Co., Des Plaines, IL, USA)

Project advances phase-shift lithography

Industrial and academic researchers from across Europe are collaborating in the JESSI T40 project Manufacturing by Phase Shift (MAPS) to develop phase-shift mask technology for the ultrafine optical lithography industry. They aim to apply their work rapidly to the industrial manufacturing environment. This project is structured as a coherent approach to a European phase-shift mask for i-line (365 nm) and DUV (248 nm) lithography. It will be able to meet the requirements for 16 Mb and 64 Mb production with feature sizes down to 0.30 μm. The MAPS project started in January 1994 and will end in December 1996.

Embedded phase-shift mask (PSM) technology uses a single optical layer of a selected material to provide both attenuation and phase shift. It has been selected as the European mainstream system, as it is easier and cheaper to manufacture than half-tone PSM. It also offers better uniformity and process control. However, both types are being manufactured and investigated as part of MAPS.

The MAPS project is led by Siegfried Steuber of Siemens Mask Shop (Munich, Germany) working with the following European partners: Alcatel-Mietec (Belgium), ASM Lithography and Philips Research (Netherlands), Compugraphics (Scotland), The Central Microstructure Facility of the Rutherford Appleton Library (England), Matra MHS and GRESSI (France), SGS-Thomson Microelectronics (Italy), the Siemens Semiconductor Group, Sigma-C and Temic (Germany).

The project is divided into four subprojects: data conversion software, led by Sigma-C (Christian Kalus), PSM manufacturing, led by Compugraphics (Andre Hawryliw), industrial application of phase-shift technology, led by SGS-Thomson (Paolo Canesstrari) and optical proximity correction (OPC), led by Philips (Mart Groef).

The project will focus on PSM fabrication using a single layer for phase shifting with i-line and deep-UV lithography based on chromium and MoSi materials. The final phase of the project will optimize the economics of the process, including yield and turn-around times.

The partners expect that PSM prices will be about two to three times the cost of conventional high-quality masks with a European market volume starting at a few million dollars per year. (Reprinted with permission from *Semiconductor International Magazine*, April 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

New rules for technology transfer

The European Commission has agreed not to include market share testing in new regulations governing block exemptions for technology transfer agreements, overcoming objections from industry bodies such as CEFIC.

The Commission says the new rules considerably simplify the arrangements governing licensing agreements. The previous rules on pure and mixed know-how and patent licensing agreements are to be merged into a single legal instrument. The new regulation was expected to come into force on 1 April and will remain valid until 31 March 2006.

The Commission claims that its more flexible approach is accompanied by a clear warning for companies with a strong market position. Provision is made for a threshold—namely a 40 per cent market share—beyond which companies will not benefit if they have obtained exclusive licensing agreements, monopolizing the market for the product and preventing access by third parties to the new technologies.

When work was first started on this regulation, the Commission stipulated that an exclusive licensing agreement granted to a very powerful licensee would not benefit from exemption. After objections by economic interest groups, it concluded that its main concern to ensure the broader dissemination of new technologies could be achieved by less rigid methods. As a result, it dropped the obligation that licensing agreements should be notified automatically whenever the 40 per cent threshold was reached.

Other features of the new rules include automatic exemption granted to all licensing agreements which provide for territorial restrictions between parties or licensees. A certain number of obligations may be included in contracts such as the right for licensors to terminate the agreement in the event of the licensee challenging the validity of the

patent. (Source: *European Chemical News*, 19-25 February 1996)

EC finalizes tariff cut on imported chips

The European Community has provisionally agreed a trade agreement with the US which halves EC import duties on semiconductors as a precursor to their abolition.

From 1 January 1996, pending final EC approval, the tariff on semiconductors imported into Europe is to be cut to 7 per cent from 14 per cent. The US-EU agreement calls for more talks to abolish all EU import tariffs on semiconductors by the year 2000.

The US Semiconductor Trade Association, SIA, estimates that the agreement will remove $1.5 billion in tariffs between now and the year 2000. US chip makers hope that the lower prices of their chips will help them gain a larger share of the growing European market, which is expected to be worth as much as $52 billion in 1998 compared to about $29 billion in 1995. (Source: *Electronics Weekly*, 6 December 1995)

MEDEA to replace JESSI

Although Europe's JESSI submicron silicon development programme has until the end of 1996 to run, its successor could be in place by mid-1996. MEDEA (Micro Electronic Development for European Applications) would pursue such projects as the development of 300 mm (about 12 inches) wafers and related equipment. While MEDEA would likely involve fewer companies and projects, its funding probably would be about the same as JESSI's US$ 3.5 billion. (Source: *Industry Week*, 4 December 1995)

India

The 'Net makes it to Bombay

The unending maze of the Internet was unveiled in India back in 1988, when the Educational Research Network (ErNET) was established under the aegis of the Department of Telecommunication and the National Centre for Software Training (NCST). Linkage remained restricted to the major educational institutes and an elite few who could afford the high rates.

On 15 August 1995 India not only celebrated its 48th Independence Day, but also inaugurated the Global Internet Access Service (GIAS), which marked a milestone in India's progress on the information superhighway.

State-owned Videsh Sanchar Nigam Ltd. (VSNL) handles the task of managing and executing the GIAS. VSNL, unlike its predecessor NCST, opted for cheaper access and a wider user-base. The service now costs between Rs 5,000 (US$ 147), for 250 hours of a text-based, dial-up access account, and Rs 2.5 million (US$ 73,500), for a 128 kb/s, TCP/IP, leased-line access account. The present user-base of approximately 2,000 was expected to grow tremendously after a student account was implemented in January 1996. The student account will cost Rs. 500 (US$ 15) for 250 hours of a text-based account.

Most Indian users are content with the service being provided. However, some maintain that the absence of a Unix prompt has crippled the power provided to the user. A user is now restricted to a menu-driven system with options, like e-mail, FTP, Telnet and Lynx, and is unable to use Unix commands such as "finger" and "talk". But VSNL has promised to give people a Unix shell, which should be in place by early 1996.

Another bottleneck is the number of dial-up lines provided by VSNL. As of November 1995, VSNL had 45 dial-up lines in Bombay. The number of lines needs to be drastically increased as more and more people request Internet access. VSNL has been swift in responding to problems, and on the whole the service seems quite sturdy and well managed.

The Internet in India is in its infancy and can only grow. India has not yet followed in the footsteps of most countries on the Internet by opening up the Internet service provider market to private organizations providing Internet services.

Eventually, government regulations will need to be set aside in favour of healthy competition for service providers.

VSNL is currently in the process of setting up its own 2 mb/s data backbone throughout the country. Amitabh Kumar, VSNL's director of operations, has big plans for GIAS and wants VSNL to grow into a world-class Internet service provider with an entire range of Internet services. Meanwhile, the Indian user eagerly tests the new and exciting waters of the Internet. (Source: *The Institute*, February 1996)

Software in India

India's software industry, which barely existed 10 years ago, has notched up sales of more than $1.2 billion last year and is growing at over 40 per cent a year. Unlike other Indian industries, it is highly competitive internationally. Around half of the industry's revenues come from exports.

Although more than two thirds of the roughly 300 software companies in the city are Indian, foreign companies such as Motorola, IBM, Texas Instruments, Siemens, Groupe Bull and Sun Microsystems have set up their own factories and account for about 70 per cent of the investment in software development in Bangalore.

Infrastructure is a problem. The bigger players, both foreign and Indian, invariably have their own generators and dedicated satellite links, which allow them to bypass the city's telephones and power lines. Som Mittal, the managing director of Digital (India), an offshoot of America's Digital Equipment, says that an Indian software engineer costs only 20 per cent as much to employ as an equivalent American. Filling in the gaps in local services by leasing dedicated satellite links and other telecommunications services adds just 7 per cent to costs.

Rather than supplying cheap hands, like many an industrializing Asian country, India's software companies have prospered by supplying cheap brains.

But for all its success, India's software industry is still small—supplying just 0.5 per cent of the world market.

Many of Bangalore's software companies are branching into product development. Rather than simply supplying engineers to work on other people's problems, they are trying to provide clients with whole new system ideas and software packages. By devising their own products, Bangalore's firms hope to avoid competing simply on price, so securing higher margins and a more reliable income. The results, so far, are promising.

India produces 20,000 computer-science graduates a year, but demand is already so high that the industry's wages are rising by 20 per cent a year. The industry's relentless expansion and the lure of still higher wages in the West means that keeping people has become the biggest headache for Bangalore's bosses. Most expect to lose 20 per cent of their employees each year.

Another problem is that one of the things that made Bangalore attractive in the first place—its congenial surroundings—is changing as industrial growth brings power cuts, clogged roads and soaring property prices. A brand new 68-acre "information technology park", incorporating its own power plant, is due to open next year and may ease some of

the problems. Some of India's software firms are thinking of expanding outside over-crowded Bangalore. (Source: *The Economist*, 23 March 1996)

Japan

Japanese companies form research association

Ten Japanese semiconductor producers have provided $50 million of start-up funding for Advanced Semiconductor Technologies (ASTI), a research organization comparable to SEMATECH. ASTI will conduct a 10-year, $350 million research project in advanced chip technologies, according to NEC's Hajime Saraki, ASTI president. He said: "We would like to seek broad cooperation from material and equipment makers inside and outside Japan."

Apart from chip design, ASTI will be involved in the evaluation of the next-generation semiconductor manufacturing equipment and materials. It will investigate semiconductor manufacturing equipment for 300 mm diameter wafers from both Japanese and foreign companies.

Founding companies include NEC, Toshiba, Hitachi, Fujitsu, Mitsubishi, Oki, Sanyo, Sharp, Sony and Matsushita. (Reprinted with permission from *Semiconductor International Magazine*, April 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Superconductivity spurs Japanese plan for NMR research

A group of Japanese chemists and biologists, backed by the Science and Technology Agency (STA), has drawn up ambitious plans to establish a state-of-the-art centre for using nuclear magnetic resonance (NMR) to study the structure and function of proteins. The proposed centre would not only use the most advanced NMR machines available, but also aim to develop new NMR technology using high-temperature superconductors.

The group is led by Akiyoshi Wada, former dean of science at Tokyo University.

The centre, or "NMR Park" as it is called, would initially use 750-800 MHz NMRs, the most powerful machines available which use conventional superconducting magnets. But, in addition to carrying out research with these machines, another aim of the Park would be to develop much higher resolution 1 Ghz NMRs, using coils of both conventional and high-temperature (high-T_c) superconductors.

Japan is advanced in the development of high-T_c superconducting wires, and is in a strong position to develop such coils. But Yoji Arata, a former professor of physical chemistry at Tokyo University who is backing the project, admits that it may take some time before it is possible to achieve the necessary resolution and stability with high-T_c coils.

Supporters of the Park want it to be a truly international centre drawing scientists from around the world, much like Japan's "Photon Factory", a synchrotron facility in Tsukuba science city.

Funds for the project would be channelled through the Institute of Physical and Chemical Research (RIKEN), which is expected formally to endorse the project. A site for the park has not yet been chosen, and it will take until at least the end of this year before STA can set a firm budget. However, a figure of US$ 500 million for the overall cost of the park is being widely quoted. (Source: *Nature*, Vol. 381, 9 May 1996)

Japanese in bid to ease man/machine relations

A group at the Science University of Tokyo have developed a face robot as part of a programme to improve communications between humans and machines.

The research is based on previous experiments that suggest over half of human interaction is conveyed by facial expressions with only 7 per cent being language-based.

Using the robot, covered with a realistic silicon rubber skin, Hiroshi Kobayshi and Fumio Hara have achieved 83 per cent recognition of six basic expressions among volunteer subjects.

The head has a mixture of 24 electro-mechanical and pneumatic actuators moving 44 areas of the face called action units (AUs). The actuators have functions like "lip corner depressor" and "nasolabial furrow deepener".

By experimentation, Kobayashi and Hara have determined that 14 actuators, moving 24 AUs, are needed to create the basic emotional expressions of surprise, fear, disgust, anger, happiness and sadness.

Applications for the research are expected to include teaching and nursing machines as well as communication recovery aids for disabled people. (Source: *Electronics Weekly*, 27 March 1996)

Interact in traffic

Japan is to launch the world's first on-line interactive traffic information service that uses telephone lines. The system, dubbed Advanced Traffic Information Service (ATIS), will supply information to PCs and in-car units via land lines and cellular links.

Although other similar services exist in various countries, they have limited expansion potential as they use a dedicated infrastructure such as infrared beacons. The Japanese authorities believe that ATIS will become a global standard with its expansion capabilities as well as providing a platform for other services such as entertainment. (Source: *Electronics Weekly*, 21 February 1996.

Japanese aim for low-temperature polysilicon TFT production

A number of Japanese companies are working towards lower-temperature polycrystalline silicon thin-film transistor (TFT) processes. These will enable glass rather than the far more expensive quartz to be used as substrates for flat panel displays. This should enable polysilicon to compete with amorphous silicon TFT displays. After Sanyo Electric announced a 600° C polysilicon TFT process, Sharp achieved one that requires no more than 500° C, and Sony has announced a 400° C process. It uses an excimer laser beam to anneal the polysilicon, rather than a high-temperature vacuum chamber. Sanyo plans to invest about $100 million to start production during the summer of 1996, using Sony technology.

The main advantage of polycrystalline displays over conventional amorphous silicon is the far higher mobility of electrons in the material. This enables the driver chips for the display to be fabricated in the polysilicon substrate instead of having to be separately fabricated on the glass. The high mobility also allows the TFT elements to be placed in close proximity to achieve improved resolution. Although Sharp and Sony are currently working on 4-inch and 5-inch displays, they both believe they will be able to use the new technology to produce panels with dimensions of up to at least 20 in. Sharp suggests that TFT panels with the driver transistors in the display substrate may eventually be up to

40 per cent cheaper than panels using amorphous silicon. (Reprinted with permission from *Semiconductor International Magazine*, April 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

Russia

IBM halts PC assembly

IBM is to stop assembling PCs in Russia, ending a two year bid to set up a local manufacturing venture there. IBM blames the shutdown on Russian tax rules which no longer favour local manufacturing of PCs.

The computer company will join other Western PC suppliers and import fully assembled machines into Russia. (Source: *Electronics Weekly*, 6 March 1996)

United Kingdom

UK and Brunei link-up on plastic deposition

Researchers from the UK and Brunei have developed a thin film carbon transistor technology which could make possible the deposition of semiconductors directly onto plastic substrates.

The incompatibility between silicon processing and plastic is the biggest obstacle to making all-plastic LCDs. Current silicon semiconductors require processing at around 250° C minimum. This is too high for plastics which would otherwise make good low-cost substrates.

The semiconductor used is tetrahedrally bonded amorphous carbon (ta-C). This is a form of carbon that has a high proportion of diamond-like (SP^3) bonding and whose conductivity is readily affected by external electric fields.

The geometry of the experimental device is such that the SP^2 layer can be etched away and prevented from reforming using the pacifying nitride layer.

To make it a semiconductor, the carbon is p-doped with boron, the easiest way to dope carbon based devices. (Source: *Electronics Weekly*, 20 March 1996)

Phone through the Internet

Telephone operators believe the Internet is good news, generating a great deal of traffic on their networks while providing no threat to their core voice telephony business. However, one US company may be about to change all that by allowing Internet users in the UK to make calls to anyone in the world with a telephone through their PCs.

International Discount Telecommunications (IDT) has demonstrated the necessary networking technology; the company will market a product called Net2Phone that combines two businesses, discount telephone calls and Internet service provider.

IDT already offers overseas customers cheap telecommunications using an innovative call-back scheme. Customers dial a US number and hang up; then the IDT telephone switch calls them back with a US dial tone. Since US international telephone rates are the cheapest in the world, customers are charged a much smaller amount than their local telephone company for making international phone calls.

With Net2Phone, customers of IDT's Internet services use their PCs equipped with a sound card and a microphone to use the Internet to reach a telephone switch in New York. The IDT system then decodes the voice signal and directs it to any US telephone number charging only 10 cents per minute.

However, if large numbers of people begin using the Internet to make calls, it could clog the system.

Net2Phone will be initially launched in the United Kingdom followed by switches in Japan and Hong Kong.

Using Net2Phone is not as easy as using a telephone and the audio quality can vary depending on location and local Internet connections. The system is half-duplex, meaning that only one person at a time can talk. (Source: *Electronics Weekly*, 6 December 1995)

Join in or lose out

The Information Society Initiative (ISI) launched by the Department of Trade and Industry (DTI) in February 1996 is aimed at promoting "the beneficial use and development of information and communication technologies". These are the technologies now converging to form a single, multi-media, electronic information marketplace.

The DTI hopes the initiative will help small and medium-sized businesses make effective use of technology. The component manufacturer not on-line to the car maker; the manufacturer with no interactive link to the customer; the service provider not marketing on the world-wide network will, says the DTI, lose out.

Two case studies could, in principle, be said to represent the industrial scene. These were a fertilizer manufacturer's use of satellite technology to give farmers a more efficient use of their products and a baker who is using a Web site on the Internet to promote his business.

Only 9 per cent of small and medium-sized UK companies use electronic mail—only 3 per cent of those extensively. That is well ahead of the rest of Europe and the Far East, but it compares poorly with around 25 per cent in the US.

With its experience of handling complex data that is a repository of information and human skill, the engineering industry has a lot to offer the evolving information society, there is a great deal of information handling technology that individual companies have yet to gain by.

As with every advancing technology, there are pitfalls. To gain from the information society, users will also have to give. While much of the information might be free in terms of cost, it is not free of moral obligation. Among the issues which the electronic marketplace raises are questions of: intellectual property rights and the need to reconcile the free flow of information with people's right to be rewarded for their creative endeavours; the security of transactions on open networks; how to stop security being used to cloak illegitimate transactions; and the need for regulatory underpinning for an open and competitive market in information.

For a company to avoid these issues by not joining the information society would be to foolishly dismiss the benefits that membership will bring. It is an observable fact that those most open and willing to share their experience, within the bounds of business common sense, are the most progressive.

Most societies exist to help people with common interests to work together for common goals. That is also true of the information society, with the added benefit that, while the DTI is promoting the ISI for the benefit of UK industry, it is in reality an open society. Its proper exploitation must eventually benefit all. (Extracted from *Machinery and production engineering*, 1 March 1996)

University develops SIMS FLIG system

A group led by Mark Dowsett of the Physics Department of the University of Warwick (Coventry, UK) has developed a floating low energy ion gun (FLIG) system. This system can carefully peel off each layer of an IC without causing the kind of disruption that would prevent any meaningful examination. The developers say that the main

feature of the system that enables it to achieve this performance is that it can operate at under 10 per cent of the energy levels of its nearest competitor while delivering 10 to 100 times more current. This enables the SIMS instrument on which the FLIG is mounted to discern layer structures only three atoms wide. (Reprinted with permission from *Semiconductor International Magazine*, April 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

United States of America

Exports and imports reach record highs

The American Electronics Association (AEA) reported that American businesses are exporting more high-technology products—such as computers, communications equipment, telecommunications products and semiconductors—than ever. At the same time, Americans are purchasing record levels of these same products from foreign countries. US companies sold $92 billion worth of electronic products overseas and bought nearly $115 billion. The result was a nearly 40 per cent increase in America's high-technology trade deficit during the first nine months of 1995.

Because American companies remain extremely competitive in the European market, much of this increase can be traced directly to a rise in the deficits with China, Japan and the Asian Pacific Rim countries.

For example, the US-China trade deficit in high-technology products increased more than 50 per cent over the same nine-month period, from $3.4 billion to $5.1 billion. As for Japan, the US/Japan electronics trade balance in the first three quarters of 1995 also worsened with a $22.2 billion deficit, nearly 7 per cent greater than the $20.8 billion deficit reported for the comparable 1994 period.

There was some bright news in the figures: in 1995 US exports to Europe continued to increase, particularly for semiconductors and telecommunications, where exports of each grew by more than 30 per cent. The 1995 nine-month US electronics trade balance with the 15-nation European Union market improved by 13.2 per cent to $10.9 billion from a positive $9.6 billion in the first three quarters of 1994. (Reprinted with permission from *Semiconductor International Magazine*, March 1996. Copyright 1996 by Cahners Publishing Co., Des Plaines, IL, USA)

H. AUTOMATION

Tiny robots like insects

Tiny robots modelled on insects the size of 50 pence pieces, called pixelsats, are being tested by NASA. Developed by Mark Tilden, the robots could be used in "swarms" to carry out complex tasks in space at a fraction of the cost and risk of a conventional satellite.

Modelled on insects, the robots use at most 12 transistors and hence are dedicated to a particular task such as part of measuring arrays or passing data between larger satellites.

Thousands of the pixelsats would be deployed in space. Even if many are destroyed, enough would remain to carry out the allotted tasks. (Source: *Electronics Weekly*, 27 March 1996)

Flexible automation reconfigures the future

Strong trends in international manufacturing techniques point to a future in which the abilities of companies to react quickly and decisively to marketplace changes will determine the winners. One need only look at such technology leaders as Hewlett-Packard and Intel to see how quickly these companies improve and diversify their products in response to market demands.

Flexible automation, or computer-integrated manufacturing (CIM), in manufacturing is one of the keys to success for such companies. It designs flexibility into manufacturing by incorporating programmable machines, such as robots. It offers two major benefits. CIM lets manufacturers make engineering or model changes without redesigning an entire work cell. As market demands shift, CIM allows other products to be made with the same work cell.

Japanese firms were pioneers in developing manufacturing methods keyed to changing customer demands. It was their JIT (just-in-time) approach to assembly, for example, that reduced inventories and enhanced quality through point-of-manufacture management.

More recently, Japanese companies have adopted CIM as the newest refinement in manufacturing. North American companies have also been working on CIM, but at a slower pace. Japan still has five times as many installed robots as the US, even though Japan's workforce is approximately half in size.

CIM integrates product development, manufacturing and sales. In manufacturing, CIM is most effective when a single product is made in quantity with no model changes. Individual customers, however, often demand distinctively individualized products. CIM can also satisfy these demands. Reasons for using CIM include:

- Coping with multiple-product, small-lot, and to-order production;
- Shortening lead times from development to production;
- Saving direct and indirect personnel costs;
- Reducing the volume of in-process stock between production stages;
- Improving the quality of products and production facilities.

Integrated manufacturing has brought the age of multiple-product, small-lot production to replace mass-production concepts. Manufacturing styles are changing drastically, going from single-purpose machines to general-purpose ones such as robots and machining centres. *Kanban,* or serial information transfer, is giving way to MRP or parallel information transfer. Specialists are being replaced by generalists, and product-oriented integrated factories by function-oriented ones.

Such flexible automation is designed to serve this market. A case in point was a pharmaceutical company that wanted to get a new product to market quickly. Fixed automation would have required too much design time. Flexible automation provided the best alternative. While setting up their process, the company not only discovered that design time was significantly reduced, but other costs were lowered as well. It was relatively simple to change the system to accommodate evolving needs.

While the flexible approach is quicker and usually more cost-effective, a cautionary note should be made: Companies sometimes try to do too much with a single robot in an effort to utilize all of its available time. The perceived up-front savings from using a single robot often results in additional costs later in the form of more maintenance and overly-complicated programs. (Source: *Machine Design*, 21 March 1996)

I. STANDARDIZATION AND LEGISLATION

Standardization

Chip makers close to X-ray standard

Reports from Japan state that US and Japanese chip manufacturers are close to agreeing on a standard for X-ray lithography, which could accelerate the development of commercial etching systems. Japanese newspapers report that IBM, Motorola, AT&T, Fujitsu, Mitsubishi Electric, NEC, Toshiba, and Nippon Telegraph and Telephone have been undertaking negotiations on the standard. An agreement on standards for X-ray lithography is essential to prevent incompatible systems from being developed which would add to the already huge cost for X-ray lithography. The new systems will be essential in producing very high density chips such as 4-gigabit DRAMs and microprocessors with hundreds of millions of transistors. Current lithography systems use visible light but as feature sizes continue to shrink, X-rays offer the promise of ever finer chip feature sizes. (Source: *Electronics Weekly*, 28 February 1996)

Mix and match specifications for PC

An open standard approach for partitioning the functions of the PC has been proposed by a group of US chip makers.

The Common Architecture standard, being put forward by National Semiconductor, VLSI Technology, Texas Instruments, PicoPower and Digital is intended to simplify the interconnection of PC components and the PCI bus, allowing PC manufacturers to mix and match any PCI bus- and ISA bus-compliant IC or subsystem peripheral to develop Windows-compatible computers.

Products implementing the Common Architecture are expected to appear in the second half of this year. (Source: *Electronics Weekly*, 3 April 1996)

Standard plan for lithium ion batteries

A working group of experts from companies including Sony, Sanyo, Duracell and AEA Technology, is soon to introduce a world standard for rechargeable lithium ion batteries and cells, as well as the associated electronic circuits.

The working group is keen to encourage an early introduction of a standard to avoid conflict among battery makers and users alike.

The lithium ion cell standard is expected to be published this year, while the battery one is still in draft format and likely to undergo changes before its final version is produced. However, the industry is split over adopting a standard as there is a belief by some that it will hinder the development of unique battery solutions for niche applications. (Source: *Electronics Weekly*, 3 April 1996)

MPEG-4 design issues resolved

Most of the architectural issues of MPEG-4, the emerging audiovisual coding standard, are now resolved following a recent meeting in Munich, Germany.

However, much work still remains in the development of the coding tools and techniques for the standard. The standard is set for completion by November 1998.

MPEG-4 will provide a universal mechanism for communicating audio and visual data. Unlike the present MPEG-1 and MPEG-2 standards based on coding video frames, MPEG-4 represents content in terms of "objects". Moreover it is not fixed to a single algorithm, but rather an extendible set of coding techniques.

The object-oriented approach will also provide the user with an unprecedented level of interactivity.

Present MPEG-4 work includes the development of a basic architecture to encode and decode 2-D video objects. While simpler 2-D objects are being investigated first, the Synthetic and Natural Hybrid Group is undertaking research in parallel, into coding 3-D visual objects (such as naturally generated CT scanner video or synthetic computer-generated graphics). To this aim, 3-D data sets are to be made available on the Web to enable algorithmic developers to operate on common data, and post their results.

A recent development in the MPEG-4 work has been the collaboration with the VRML (virtual reality modelling language) working group, which is developing techniques to allow 3-D worlds to be downloaded across the Internet.

The MPEG-4 timescale is to produce a working draft by November and freeze the technology one year later. (Source: *Electronics Weekly*, 20 March 1996)

BusNet clears first hurdle to becoming industry standard

BusNet, a method of coordinating network packet transmissions over the VMEbus backplane, has passed the first hurdle in becoming an open industry standard.

The protocol works independently of the operating system and board architecture, enabling it to be used without requiring the system designer to have detailed knowledge of VMEbus hardware.

The VME International Trade Association has granted the German company, Force Computers, permission to standardize the protocol.

Force believes that no other company has developed a system which makes boards on a bus appear as simple black boxes.

Acceptance for an industry standard is expected within a year, but versions of the protocol are already under development. Sysgo, based in Germany and collaborating with Force, has produced software that works with pSOS and LynxOS. (Source: *Electronics Weekly*, 21 February 1996)

Common architecture specification

The computer market contains multiple standards covering personal computers (PCs) running Windows and Macintosh operating systems, and workstations running Windows NT and Unix. Peripherals such as graphics cards, PC cards (PCMCIA) and disk drives are manufactured for a specific system and occasionally a specific processor.

This fragmented nature of the PC market has led to the development of a new specification dubbed Common Architecture. Now at version 0.93, the specification is being promoted as an open standard by a group of PC silicon and electronics system manufacturers headed by National Semiconductor and VLSI Technology. The group also includes Silicon Integrated Systems, Standard Microsystems Corporation and Opti with support from Digital Equipment Corporation.

The new standard provides for the partitioning of functions within a PC based upon the peripheral component interconnect (PCI) bus. The transfer of traditional industry

standard architecture (ISA) bus components to PCI is also addressed.

As a result, individual components are independent of one another, linked only via the PCI bus. Consequently, PC manufacturers will be able to buy components from multiple vendors, irrespective of their choice of PCI bridge chips and microprocessor.

One of the most important aspects of the standard is that it allows traditional ISA bus-based peripherals to migrate to the PCI bus. These peripherals include PCMCIA controllers and super I/O. Super I/O is a super-set of I/O peripherals and includes disk drives, parallel and serial ports, keyboards and mice.

They normally require the use of DMA (direct memory access) and IRQ (interrupt request) links to the ISA bus. DMA and IRQ are not supported by the PCI bus and hence the present interface chipset is complicated with a typical system having a variety of sideband signals linking the peripherals to the processor. This is undesirable as the peripherals and their respective PCI bridge chips have to be made processor specific.

The new architecture includes the existing Distributed DMA and Serial IRQ standards. Use of these effectively removes the need for an ISA bus and all side-band signals except for the Serial IRQ line.

The ISA bus and bridge become an option in the system, only required for legacy ISA cards. Future designs for super I/O can be based on the PCI bus, ultimately leading to the demise of the ISA bus.

The distributed DMA system allows for DMA transfers in one cycle, offering considerable speed improvement. The latest version of the common architecture specification claims that bandwidth usage will drop significantly. Stereo audio at 44 kHz in 16 bits drops bandwidth from 22 per cent using the ISA bus to 0.2 per cent using 32 bit burst transfers on the PCI bus.

This obviously frees up the bus for faster graphics and multimedia activities.

The main system controller chip that links the CPU and main memory to the PCI bus could, in theory, be implemented in a single chip. This was identified by the architects as a major technical challenge in terms of packaging technology. The solution offered is to use the latest high pin count packages such as plastic ball grid array (PBGA) with up to 352 pins available.

A smaller motherboard chip count will also lower overall system cost—always desirable in a PC system. (Extracted from *Electronics Weekly*, 24 April 1996)

Legislation

NEC develops protection for copyright of data on Internet

NEC had developed a digital watermark which it claims protects the copyright of audio, video and multimedia data on the Internet.

The watermark becomes an integral part of the data, allowing the original source to be identified if it has been pirated. This should complement conventional cryptographic techniques which permit only valid key holders to access encrypted data.

The technique places the watermark in perceptually significant components of the signal, making it virtually impossible to remove. To avoid perceptual degradation of the signal, the watermark is added using a method analogous to spread spectrum communications. (Source: *Electronics Weekly*, 28 February 1996)

The piracy patrollers

The Information Infrastructure Standards Panel (IISP), a large-scale, multi-industry organization based in the USA, is in the process of establishing standards to detect and prevent the hijacking of online information. The IISP is an 80-strong subset of the American National Standards Institute (ANSI). Among the members of the panel are Microsoft, IBM and AT&T; about 40 industry and standards organizations; and 10 US government agencies, including the US State Department.

When it was established, the IISP's main purpose was the study of interoperability standards for converging technologies. However, this has now been extended beyond the simple theft of data, such as credit card numbers and personal records, to the issue of security of copyright online. It is felt that the copyright question is central to the issue of the protection of information, and includes ensuring that security and privacy can be guaranteed in national, regional and global information infrastructures.

At least one possible solution is under investigation. At the IISP's last meeting, David Carver, of MIT's research programme on communications policy, proposed a universal header and transcripter that would automatically be added to electronic documents and would detail what can and cannot be copied. Another proposal from the US Copyright Office suggests an on-line copyright and registration system. The IISP is also discussing methods for ensuring payment to copyright holders and developing methods for describing and protecting materials in the national and global information infrastructure. (Source: *Communications International*, November 1995)

EC draft directive on the legal protection of databases

The latest draft directive is considered with special reference to information service concerns. The directive as a whole is criticized for its use of preceding "recitals" which number 60. These should clarify matters, but much still remains unclear. In dealing with copyright in chapter II, the draft does state the eligibility of a database for copyright protection in the case of collections and compilations. Copyright protection is afforded only to those databases that have required some intellectual thought on the part of the author in selecting and arranging. Within chapter III—*Sui Generis* Right (the right of the author to prevent extraction), it appears that the rights of even lawful users are very restrictive. The use of the indefinite words "substantial" and "insubstantial" for the amount of material that can be extracted adds to the uncertainty on this matter. Copyright protection within the draft is generous: initially it is for 15 years from the date of making it available to the public, but this is renewed if any revisions of the database are made, leading to the possibility of perpetual protection.

In conclusion, there should be no barriers to database access and subset databases should not be restricted so long as there are licensing agreements. In terms of priorities for information services, a producer publisher consensus on service contracts needs to be arrived at and electronic copyright management systems need to be developed. The increase in Internet usage and multimedia may mean that solutions will evolve anyway. (Source: *Managing Information*, 2(10) October 1995)

J. RECENT PUBLICATIONS

Electronic journals and tenure

According to recent estimates, there are more than 400 electronic journals in existence of which around 70 are refereed. Yet there is a widespread feeling that the academic establishment is reluctant to value electronic contributions to scholarship. Residual resistance seems to have its roots in concerns about the quality and integrity of electronic publications, including the issue of archiving. Other factors include the coverage by secondary sources.

Although the reward system may be slow to accept electronic publications in evaluating a candidate's credentials, more than 40 per cent of respondents in a survey of scholars in the humanities and social sciences who were polled by the American Council of Learned Societies (ACLS) felt that tenure committees should give consideration not only to printed scholarship but also to non-traditional forms such as microfilm and electronic journals.

Quality of publication was most frequently operationalized as refereed or peer review. Another variable was the perceived quality or status of the journal in which a candidate's work was published. In only one instance was there explicit mention of electronic publishing media, and in this case the implicit assumption was that publications in electronic format and electronic bulletins were of non-refereed variety. The picture is also muddied further when the unsolicited comments of administrators and senior faculty are taken into account. Some of these suggest that there may be inconsistencies in interpretation and practice, both within and across institutions. A number of institutions admitted that they had not reviewed systematically the question of electronic publications. (Extracted from: *Journal of the American Society for Information Science*, 46(9) 1995)

Electronic journals: publishing via Internet's World Wide Web

The feasibility of publishing an electronic journal which will be accepted by the scientific community has always been hampered by factors such as a lack of standardization of data transmission codes, limitations regarding the incorporation of graphics and photographs, as well as the absence of special columns, book reviews, letters to the editor, product reviews and advertisements. Standardized communication protocols such as TCP/IP have brought this dream one step closer to reality. The final step could be an electronic journal published through the World Wide Web (WWW).

Publishing an electronic journal in the WWW environment has the potential to address most of the technical and other limitations of current formats. With WWW electronic journals a few important additional facilities could even be added, such as multimedia support (graphics, colour and video) and hypertext links to other internal and external nodes, and an already standardized markup language (hypertext markup language, or just HTML) could be used. Also, more than 10 WWW browsers (graphical user interfaces running under Windows) are already available for reading WWW documents.

Other technological developments are indirectly responsible for advancing the acceptability of the Web-based journal: the existence of client/server architecture in the Internet environment has triggered the development of a new generation of information providers and, by improving throughput in general, TCP/IP protocols make possible the development of real-time network applications. Furthermore, in client/server architecture, the client program has its own interface with full graphic and iconic tools residing on the end-user's personal workstation (Extracted from: *The Electronic Library*, 13(4) August 1995)

SuperJournal project (collaboration in electronic publishing)

The SuperJournal Project is a collaboration between publishers, librarians and universities. The aim is to develop the electronic journals of the future that researchers, students and librarians find useful and usable; Electronic journals in the project will be based on quality refereed journals that exist in print today, but with electronic features such as interactivity, hypertext linking, video, animation and 3-D graphics.

Project partners include 21 publishers in the Super-Journal Consortium, the University of Manchester and Loughborough University of Technology. Each publisher will contribute journals and be involved in developing the multimedia features. The University of Manchester will develop the host infrastructure to make them available electronically to user sites. HUSAT Research Institute at Loughborough University will conduct the research on user testing and evaluation.

The first electronic journals were expected to be ready in March 1996. In the first year the journals will be tested at nine partner user community sites, including the University of Birmingham, London School of Economics, and Oxford University. The subject clusters of journals will include protein genetics, computing physical chemistry, and communication and cultural studies.

The SuperJournal Consortium itself was formed in 1993 when eight publishers collaborated on a pilot project to explore the potential of SuperJANET for journal publishing. Since then the group has expanded to include 21 society, university press, and commercial publishers. These include Academic Press, CAB International, Elsevier Science, Rapid Science, and John Wiley and Sons. (Extracted from: *Online and CD Notes*, December 1995)

Pub o' the Net

One market sure to bloom with the release of Windows 95 is Internet use. O'Reilly & Associates, one of the oldest publishers in the software field, has a complete set of paper books about the Internet. The target is the user who is deeply involved in software but is not experienced in Unix or Internet.

Three O'Reilly books are useful for new Internet users: *Networking Personal Computers with TCP/IP* by Craig Hunt, *The USENET Handbook* by Mark Harrison, and *Managing Internet Information Services* by Cricket Liu, Jerry Peek, Russ Jones, Bryan Buus, and Adrian Nye.

Networking Personal Computers with TCP/IP is a technical but readable introduction to using the TCP/IP protocol in order to network PCs that run DOS, Windows, Windows NT or Windows 95. *The USENET Handbook* tells readers how to participate in Netnews, the world's largest discussion format. *Managing Internet Information Services* is an introduction to creating information services for Internet

users. It devotes several chapters each to FTP archives, Wide Area Information Services (WAIS) databases, and Gopher and World Wide Web (WWW) servers.

Furthermore, O'Reilly is moving into electronic publishing on the Internet. It is marketing WebSite, an application that builds a Web node on top of Windows 95. WebSite users do not need to know anything about Unix to build the site. Contact: O'Reilly & Associates Inc. 103A Morris St., Sebastopol, CA 95472. Tel.: (800)998-9938; nuts@ora.com. (Source: *IEEE Spectrum*, November 1995)

TECHNOLOGY AND INVESTMENT OPPORTUNITIES

TECHNOLOGY REQUESTS

NEW PRODUCTS FOR CHEMICAL INDUSTRY
A UK company is seeking chemical blenders and formulators, and anufacture a diverse range of liquids, dispersions, emulsions, pastes and gels. The company is constantly seeking suitable new products for sale to new markets, either through anufacture or joint marketing/distribution arrangements, ideally leading to eventual manufacture. The company is also interested in providing know-how and entering into joint marketing/distribution arrangements for the sale of its own products worldwide.

(For futher information, please contact:
Mr. D. Badami, NIMTECH, Alexandra House, Borough Road, St. Helens WA10 3TN, United Kingdom; Tel:(+44-1744) 453366; Fax: +44 1744) 453377; E-mail: helpdesk@nimtech.u-net.com)

OFF-HIGHWAY VEHICLES AND RELATED EQUIPMENT
This UK company specialises in volume fabrication of components for off-highway vehicles and related equipment. The company is the preferred supplier of specialized components to the major UK manufacturers of off-highway vehicles. The company has extensive facilities for profiling, pressing, welding, etc., of medium to thick sheet metals. Recently shot blasting and a new paint plant were added.
Cooperation sought: The company would consider investing in an innovative, partly or fully developed product which might only need to be adapted to the UK market. They are also prepared to set up joint ventures, manufacturing/marketing agreements and licensing agreements with organizations worldwide, or act as a manufacturing sub-contractor for a company in the engineering industry.

(For further information, please contact:
Mr. D. Badami, NIMTECH, Alexandra House, Borough Road, St. Helens WA10 3TN, United Kingdom; Tel:(+44-1744) 453366; Fax: +44 1744) 453377; E-mail: helpdesk@nimtech.u-net.com)

GEARS, POWER TRANSMISSION OR HYDRAULIC PUMPS
An engineering company in Finland specialising in gearwheels and power transmission wishes to make new products suitable for their present machinery. The company is particularly interested in products relating to gears, power transmission or hydraulic pumps and motors. They have produced gears (diameter <50 cm), components with inner or outer teeth, power transmission mechanisms, connecting collars for hydraulic pumps, motors and extension shafts. The company has also machined heat refined steels, carbonized and special hardened steels, made polygon shaped holes and rolled outside threads.

(For further information, please contact:
Mr. D. Badami, NIMTECH, Alexandra House, Borough Road, St. Helens WA10 3TN, United Kingdom; Tel:(+44-1744) 453366; Fax: +44 1744) 453377; E-mail: helpdesk@nimtech.u-net.com)

AUTOMATIC TEST EQUIPENT FOR PCBs
Technological help required for the production of automatic test equipment for populated and unpopulated printed circuit boards for incporporation into air, water and noise pollution measuring, monitoring and control instruments.
Type of cooperation: Investment, joint venture, sub-contracting, licensing, turnkey project, equipment supply
Year established: 1960
No. of employees: 180

(For further information, please contact:
Mr. D.V.S. Raju, Managing Director, Elico Ltd., 309 Model House, 6-3-456/A/1, Punjagutta
Hyderabad 500 082, India; Tel: +91-1111140-22222.7265; Fax: +91-40-31.9840)

ASSISTANCE IN REDUCING EMISSION LEVELS OF VOLATILE ORGANIC SOLVENTS
A company in the UK is seeking assistance in reducing emission levels of volatile organic solvents. The company applies solvent based magnetic media to various substrates and uses 70 tonnes of solvent per year. Under new legislation that comes into force in June 1998, the emission levels for volatile organic solvents must be below 50 mg/m^3. The emissions of the company are currently five times this level. The company seeks an existing or traditional technological solution to the problem and is also interested in blue sky technologies

(For further information, please contact:
Mr. D. Badami, NIMTECH, Alexandra House, Borough Road, St. Helens WA10 3TN, United Kingdom; Tel:(+44-1744) 453366; Fax: +44 1744) 453377; E-mail: helpdesk@nimtech.u-net.com)

TECHNOLOGY OFFERS

ELECTRONIC DESIGN EXPERTISE, ANALOGUE AND DIGITAL MICROPROCESSOR SKILLS

This UK company can offer extensive electronic design expertise, and analogue and digital microprocessor skills. The company specialises in low-cost, high performance designs for audio, telecommunications and industrial control applications. Products under development include: audio conference system with electronic voting facilities; induction loop amplifiers; public address audio amplifiers with computer controlled routing of announcements; and access control systems.

Collaboration requested: (1) Seeking agents and distributor to market their products in Europe; and (2) Would equally consider marketing technology-based products in the United Kingdom as UK representatives of others.

(For further information, please contact: Mr. D. Badami, NIMTECH, Alexandra House, Borough Road, St. Helens WA10 3TN, United Kingdom; Tel: (+44-1744) 453366; Fax: (+44-1744) 453377; E-mail: helpdesk@nimtech.u-net.com)

SOLVING OF COMPLEX AUTOMATION

The solving of complex automation of technological processes in the engineering industry is offered. CAD/CAM systems and flexible production systems are used according to specific customer requirements. The offer includes: design of technological processes; creation of computer software; additional software for AutoCAD syste; postprocessors; conversion programmes for NC machines and robots; programmes for NC machines and robots.

Degree of development: Production

Know-how available: Training/Designs, Formulation and Technical Assistance

Source: Educational institution

(For further information, please contact: Slovak Chamber of Commerce and Industry, Regional Chamber Trencin, Dolny Sianec 1, 91101 Trencin, Slovakia; Fax: +42 831-521023)

APPLICATION OF INFORMATION SYSTEMS DURING PROJECT DESIGN AND OPERATION OF TECHNOLOGICAL PROCESSES

On offer is the application of digital information, control and communication systems, including configuration of algorithms in both process and control levels. The application of special systems in automatic diagnostis and operation of technological complexes is also offered. Computer support of project design and technological processes are also offered, together with automatic synthesis of regulation circuits (CACSD), selection of methods and mathematical models of maintenance, and preparation of input data to minimize the total production cost of processes working in conditions of higher indeterminacy.

Degree of development: Commercialized

Know-how available: Technical assistance

Source: Educational institution

(For further information, please contact: Slovak Chamber of Commerce and Industry, Regional Chamber Trencin, Dolny Sianec 1, 91101 Trencin, Slovakia; Fax: +42 831-521023)

COMPACT MICROCOMPUTER CSBC652E

The technology for production is offered. The compact microcomputer is meant for sall control systems in industry located in difficult climatic conditions. The computer consists of 16 digital inputs for 24V, 6 inputs for impulse counting, 18 outputs with switch-over relay. The range of working temperature is from -40^0C to 70^0C. The dimensions of the computer are 370x124x25 mm.

Degree of development: Production

Source: Independent research organization

(For further information, please contact: Slovak Chamber of Commerce and Industry, Regional Chamber Trencin, Dolny Sianec 1, 91101 Trencin, Slovakia; Fax: +42 831-521023)

MOBILE TELEPHONE COIN PAY SYSTEM

Coin charge system for cellular telephone that covers the public telephone service where conventional communication infrastructures are faulty or non-existent. The system has been specially designed for public transport vehicles. It incorporates a dual procedure for charging calls. The telephone operator sends the amount spent during the call in stages (constant step mode). When the system detects that the call tones have been interrupted, it charges the call according to constant rates until the stored amount is finished or the user ends the call. The initial rate and the step rate can be displayed and changed by the owner with a safety key. The system keeps a record of the statistics. A smaller version for a taxi can store the charged amounts on a central device such as a taximeter.

Type of cooperation: Manufacturing, licensing, distribution

(For further information, please contact: Mr. Fernando Arenales, Technology Transfer Department, Centro para el Desarrollo Tecnologico Industrial, Edificio Cuzco IV, P^O de la Castellana 141, Madrid, Spain; Tel: +34-1-581 55 00; Fax: +34-1-581 55 76/842 80 46)

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INDIA
INTECHMART

FOR THE SOUTHERN REGION

Bangalore, 19-22 March 1997

Out of the 26 States and 7 Union Territories of India, the 4 southern States – Andra Pradesh, Karnataka, Kerala, Tamil Nadu and the Union Territory of Pondicherry – constitute one of the fastest growing regions of the country. These states are rich in natural resources and have progressive industrial policies. These states are home to large, medium and small industries covering cement, steel, pharmaceuticals, automotive components, light and heavy engineering, leather and leather products, textiles, agricultural and marine products, software and electronics.

In order to capitalize on the potential and capabilities of these states, the United Nations Industrial Development Organization (UNIDO), the Government of India (Ministry of Industry and the State Governments are organizing the INTECHMART '97 to provide an opportunity for potential foreign investors and partners from southern Indian States to explore possibilities for joint collaboration with overseas companies. The sectors covered will be agro processing, electronics (including software development), leather (including leather products), light engineering (including auto components), and textiles (inclding garments).

For further information and registration of participants please contact:

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Information Resource Management System IRMS

A NEW SPECIALIZED SYSTEM FOR INDUSTRY MANAGERS

Developed originally and tested with UNIDO's network of national Industrial and Technological Information Bank (INTIB) focal points in developing countries, the Information Resource Management System (IRMS) is a specialized system that focuses on a wide variety of data and how industry managers use them. The IRMS is now available as an integrated information processing package.

The software basis of IRMS is UNESCO's Micro-ISIS with additional Pascal programmes for user friendliness. Menu driven and featuring pop-up/pull-down sub-menu, the system enables data entry and editing, browsing, searching, display, printing and network functions such as data import and export. A special formatting language allows data to be prepared in a form usable by other software packages.

IRMS can be tailored to individual needs, particularly decentralized networks. For example, the same basic package may supply the name of a pollution control expert at one location, record real-time data for materials balances on a manufacturing process at another, and supply information sources on technological development in aluminium can recycling at another. With the aid of a mailing sub-system, IRMS can also be used to record and index business information such as addresses, phone and fax numbers, etc., and to support office procedures.

Designed for IBM-compatible PCs (386 and above), IRMS comes as a set comprising an installation diskette, user's manual, field specification handbook and a questionnaire for data collection.

Price: US$ 100.-, plus postage and packing

For further information, please contact:

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