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EMERGING TECHNOLOGY SERIES

1 and 2/1998

Information Technology

UNITED NATIONS
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EMERGING TECHNOLOGY SERIES

INFORMATION TECHNOLOGY
1 & 2/1998

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TO OUR READERS

With the continuing importance and penetration of the Internet into all countries, readers will have noticed an increasing number of articles in the *Emerging Technology Series: Information Technology* dealing with different aspects of Internet use. In UNIDO we are particularly concerned with the use of information and communication technologies to support the growth of small and medium-sized enterprises (SMEs) in developing countries.

In order to accelerate the growth and competitiveness of SMEs, it is necessary for them to have easy access to information on, for example, skills, available financing, technology, markets and raw material supplies. They also need easy access to all the value-added or support services that are already available at national, regional and international levels. The problem faced in most countries is that services to industry are typically little known and often ineffective; there is much duplication of effort; knowledge in existing institutions does not reach or impact the private sector; and SMEs do not yet realize the importance of information and value-added services for increasing competitiveness, or are even not aware of their existence.

UNIDO's response to this problem is to assist countries to build up their national capabilities to use networking to support business processes in a commercially sustainable way. This involves bringing the public and private sectors together to build up an effective networking system of existing sources of information and support services, both at national and international levels.

The major functions of such networks can be summarized as follows:

- Providing easy access to all existing information and value-added or support services in a country;
- Promoting all the existing services to their clients;
- Providing a window for the international business community on how to do business in a country and on available business opportunities;
- Ensuring a wider audience can utilize the Internet;
- Providing training in the use of information and communication technologies for business;
- Providing an easy way to exchange information with neighbouring countries and thus promoting South-South cooperation;
- Acting as a fee-based one-stop, non-stop shop for information and support services.

In future issues of the *Emerging Technology Series: Information Technology* we will be providing more information on the approach UNIDO takes to networking together with some successful case studies.

Paul H. Makin
Scientific Editor

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A. SPECIAL ARTICLE

LEGAL ASPECTS OF INTELLECTUAL PROPERTY PROTECTION IN RUSSIA

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1. Real dangers: bears or pirates?

It is not so very long ago that in the mind of an average person in the West, Russia was associated with bears wandering around in the streets. I am not sure if this was characteristic of people from high-tech companies, but I am quite convinced that in their image of today's Russia the foremost place is taken up by the figure of a pirate.

There are lots of tales about piracy in Russia. For a country where private property is a relatively unfamiliar phenomenon, the conception of intellectual property, i.e. the intangible property right for information including copyrights, patents, licences, trade marks and trade names, is barely recognized and nearly always ignored in practice. Although civil laws protecting intellectual property presently exist in Russia, the penalties that may be inflicted according to them, are rather negligible and rarely imposed. Intellectual property rights are often violated, and pirate copies of books, videos, CDs and CD-ROMs with software are openly sold at a price that is many times lower than in the West. In this sense, literally all products are defenceless, which makes many companies, especially high-tech ones, very cautious about bringing their most recent technologies and developments to Russia.

Indeed, when Microsoft Corporation was preparing the market in the United States of America for their newest system, Windows '95*, accompanied by a massive marketing activity, many Russian end-users were already loading their computers with the same software that street vendors had offered them for less than $10. Pirate CD-ROMs containing over 100 popular software systems, which may cost more than $50,000 if sold by legal distributors, are offered for $5 to $10 in the Moscow markets.

Different surveys available in the Russian press [1-5] estimate the current local piracy level to be around 94-95 per cent. This undeniable fact certainly has a very negative influence on high-tech products including software. So, if in the near future either credible and effective actions are not taken at the government level, cooperation with Western high-tech companies will be discouraged for a long period of time.

Electronic piracy is generally defined as copying and usage of software unauthorized by the copyright owner. [6] This term mainly refers to computer programs and databases protected by copyright laws in almost every country in the world, including the Russian Federation.

Electronic piracy began to be widespread just after PCs became popular. [1] Before that, all major software for computers, such as mainframes, super- and mini-computers, was at the disposal of computer manufacturers; the end-users who used to be organizations rather than private persons, bought a related set of hardware and software. Since PCs appeared on the market, users have been given a choice. Software companies soon flooded the market with a great variety of software programs for PCs: from operating systems such as MS-DOS, Windows, OS-2, etc. to different applied programs.

It was not long before piracy turned up in this field, for these are the pirates who gain all the advantages of software distribution, but are not the rightful owners. The result is enormous losses to the high-tech companies.

According to the joint survey of the Business Software Alliance (BSA) and the Software Publishers Association (SPA) on global software piracy estimates, [7] released at the end of 1996, worldwide software piracy losses were estimated at $13.1 billion in 1995, with a 9 per cent increase over $12.2 billion estimated for 1994. Eastern Europe displayed the highest overall piracy rates, with an average of 83 per cent. The lowest regional rate was seen in North America, with an average 27 per cent rate. The survey also named the countries with high software piracy rates— Viet Nam (99 per cent), El Salvador (97 per cent), China (96 per cent), Oman (96 per cent), and Russia (94 per cent); as well as the countries with the lowest rates—United States (26 per cent), Australia (35 per cent), the United Kingdom of Great Britain and Northern Ireland (38 per cent), New Zealand (40 per cent), and Germany (42 per cent).

Material damage from piracy grew so tangibly that most countries had to take urgent measures to try and curb it, including governmental measures. Now that new economic relationships are being built up in Russia, one of the most important priorities is the development of a dynamic, home-grown software industry. However, wide dissemination of

counterfeit software products, i.e. those where the production or usage of which infringe copyright laws, is one of the factors negatively affecting the encouragement of the notion of a civilized market in the social mentality, something Russia desperately needs nowadays.

2. Kinds of piracy and the ways of introducing the pirated products into the Russian market

In practice, counterfeit software of both foreign and domestic software manufacturers comes to Russia in a number of ways. [3] As for the most widespread form of piracy, there are rogue companies which produce and/or distribute counterfeit products without the permission of the legal owners. In most cases, pirated software of this kind has a very similar appearance (packaging, documentation, etc.) to the original produced by firms possessing all property rights. The pirate products are generally sold at a far lower price than the originals, which causes immense moral and material damage to the companies holding licences. The counterfeit software is brought to the Russian markets and the other countries of Western Europe mainly from some Asian regions and Bulgaria where the copyright and ownership laws are either absent or have little effect on their entrepreneurs.

Another quite common kind of piracy consists in unauthorized commercial distribution of software systems. [2] Very often this is accomplished by making copies of counterfeit software on floppy disks or CD-ROMs, with the aim of selling them at dumping prices compared to the cost of the original software products. In this case, the end-users purchasing the pirate programs for their PCs are totally lacking the appropriate documentation and manuals as well as consultancy and technical support. Also, they are usually not given warranties for the product either: one or more files in the system may be missing or unreadable; some parts of the functions of the original system may not be accessible for no apparent reason, and the product may be infected with a virus, etc.

In many cases counterfeit software is installed on the hard disks of PCs by the hardware distributors just before putting them up for sale. [3] End-users therefore buy a PC that is ready to work, at a price only a fraction higher than the cost of the hardware alone. For the Russian market this type of software is fairly typical: many commercial advertisers offer to install any popular software packages free of charge onto the computer being purchased.

Companies possessing legitimate distribution rights for software programs can sometimes go beyond the commission granted by copyright owners. In this case, those copies produced in access of the volume stated in their contract with the copyright owner are counterfeit. Here, end-users can rely on some maintenance from distributors, but they cannot expect it from the legal owners since their copies are not officially registered.

Perhaps the following form of copyright infringement is the most common in Russia. A copy of some software system bought legally by a private person from an authorized distributor is installed or copied onto another computer belonging to a friend of the legal copy's owner. The software obtained in such a way is obviously a counterfeit. Games, text processors, electronic spreadsheets, database management systems, etc. are the most typical software products disseminating as described.

Medium- and large-scale enterprises gave rise to a specific kind of piracy. [3] Such companies became used to purchasing legal software, paying for fewer copies than would actually be installed. The last two varieties of piracy

occur only due to unawareness of the end-users on the matter of intellectual property.

As new information technologies are developed, such as more advanced means of telecommunication, more extravagant ways of disseminating counterfeit products are appearing. [8] For instance, users of a computer network may receive an e-mail message offering a new software system at a symbolic price. One can just send back an order for the system and conduct the payment in the manner required, and the software will be delivered. In this case, it does not matter at all that the two parties may physically be in quite different corners of the globe—all members of the network are potential clients for the rogue distributor.

This example emphasizes two important aspects of the piracy problem. On the one hand, it can be tackled on an international scale only, rather than within one particular country. On the other hand, some new and more sophisticated forms of production and dissemination of counterfeit software may emerge in the future.

3. Establishment of an intellectual property protection system in the Russian Federation.

The development of a legislative system of copyright protection for software was initiated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) [1] within the activities intended to regulate the relationships between the developed and developing countries concerning the transfer of high technologies. The efforts of all interested parties resulted in a new understanding of the intellectual property concept. At a conference in Stockholm on 14 July 1967, the software programs and databases for computers were defined as objects for intellectual property protection. This made it possible to appeal to legitimate ways of copyright protection for software.

Conforming to the Berne Convention, which Russia signed in 1995, the international copyright regulations suggest protecting computer software programs as literary works, and the databases as collections. Moreover, they are subject to the overall Geneva Convention on copyright and ownership. The two Conventions declare that the rights of foreign authors are to be protected by their national legislation. However, software is not listed among the objects covered by these Conventions.

Legitimate protection of copyright for software has a specific duality: [6] being a peculiar kind of scientific literature, the software programs and databases can also be regarded as combinations of commands and data processed by a computer to obtain a particular result. Therefore, many leading countries of the world had to expand their copyright laws with supplementary parts, directly pointing out that they are protected, just as other objects of intellectual property.

Enhancement of the national legislation took different lengths of time in different countries. For instance, the United States managed to accomplish it within less than two years, while Hungary took three years more; in many European countries and Japan, copyright legislation was only transformed in the mid-1980s. [1] In the former USSR, the first set of statutes concerning the copyright of computer software were adopted in 1988-1989. This consisted of over 30 statements regulating different aspects of the application of software as objects of copyright. Also, a new department was organized which was responsible for the official registration of computer software, among its other duties.

In 1991 a new stage in the of improvement of legitimate software protection was initiated when a set of four laws arranging intellectual property protection was developed by

the State Committee of the Russian Federation for Science and Higher Education. This set included the Patent Law of the Russian Federation, the Russian Federation Law "On Trademarks, Service Marks, and Appellations of Origin", the Russian Federation Law "On Legal Protection of Computer Programs and Data Bases" as well as the Russian Federation Law "On Legal Protection of Topographies of Integrated Circuits (ICs)". These laws were enacted in September 1992. Later, the Russian Federation Law "On Copyright and Related Rights" was developed and adopted in July 1993.

The development of the laws named above was carried out while taking advantage of the previous domestic experience in the field, together with that of the European Community countries, with the main approach being formulated in the Green Paper on Copyright, a report of the EC Committee supervising copyright protection. Therefore, after three and a half years of accumulating sufficient experience, the foundation for completing the Russian legislative system on intellectual property protection was established with the aim of encouraging the national computer business.

Along with improving the legitimate base, some practical actions were taken in the Russian Federation aimed at the enforcement of intellectual property protection. [6] Among those were the establishment of the Russian Agency for Legal Protection of Software Programs, Data Bases and Topographies of ICs in November 1991. The Agency started to register intellectual property rights using the improved legislation base in August 1992.

Since the new laws were enforced, the first consequences appeared some months later. According to the data of the Software Publishers Association, three months after the Law "On Legal Protection of Computer Programs and Data Bases" was enacted, the volume of sales increased two- or threefold. In May 1995, Andrey Zotov, the general director of Steepler Company, announced the statistical data showing a hundred per cent growth of sales of software products over the two previous years. [1]

To a certain extent the new legislation also affected the level of piracy. Compared to 1993-1994, where it was almost 99 per cent, according to BSA estimates, [7] in 1995 the level of piracy declined to 95 per cent. As for domestic software, the piracy level here does not exceed 80 per cent. Obviously, the measures taken by the Russian authorities and businessmen determined a positive tendency in the development of the national software market.

4. How to protect copyright in Russia

It is now time to enforce the intellectual property protection rights in Russia by different means, including instrumental, economic and legitimate measures as well as their possible combinations. [6, 8] Because Russian copyright legislation is presently quite weak, there are instrumental methods that are widely used by software developers since they are relatively easy to implement and appreciable results can be gained in the short term. The instrumental approach implies raising artificial barriers, both software and hardware based, to make copying and subsequent installation impossible. Among the techniques successfully used by programmers, it is worth mentioning the following:

- Special installation disks are used to prevent them being copied and installed after a certain number of installations have been made;
- A key disk comes with a software system, without which it cannot operate;

- Some technical features of the computer where a system is legally installed, are built into its software making it impossible to run the system on any other computer;
- An individual identification string is given to a legitimate user which has to be entered during software installation;
- Special programming techniques are used to fortify the software system against hacking, i.e. getting into the system to breach copyright, etc.

Along with the improvement of instrumental methods, however, hackers develop the appropriate tools for breaking down the protection mechanisms. This fact limits the scope of application for these methods, although the hackers are usually at least one step behind.

The approach based on economic methods implies forming a business environment where production and dissemination of pirate products becomes unprofitable. This method may be quite fruitful in Russia. There are many ways to achieve this goal. Legal users are offered different systems of privileges. Consultancy and training courses are available for them, and they are provided with new versions of software at significantly lower prices than their retail price.

Some software publishers also suggest that owners of pirate copies register them for a modest sum, thus making them legal. [8] In this way, the consultancy and maintenance become available to a bigger number of users. Gradually, these people begin to value the advantages of buying software from a legitimate distributor, which at the same time takes the wind out of the sails of rogue manufacturers.

Despite the instrumental and economic methods that can protect copyright quite effectively, the changes in social mentality to accept the intellectual property concept may stem the growth of piracy and eventually eradicate it. Legislation affects everyone dealing with software: the copyright owner, the distributors and the end-users.

The legislation of the Russian Federation on copyright protection for computer programs and databases regulates the following aspects: authorship and patenting as well as the protection by a trade mark and on a contract basis. [3, 6] The only prerequisite for the application of copyright laws is the originality and novelty of the software and databases. In other words, they have to be the product of personal intellectual creativity of their authors.

Protection with copyright legislation is an auspicious form since the copyright may be obtained quite easily and relatively cheaply. The development of a program or a database is sufficient for their authors to announce his/her rights, which apply to both published and unpublished software submitted in any objective form, independent of its medium. It should be emphasized here that the legitimate protection of a system or a database does not spread over the ideas and principles on which the software is based; nor does it relate to the ideas and principles of their algorithms and interface or to the programming languages.

Usage of the patent legislation requires meeting the following criteria: novelty, inventive level and industrial implementation. Software, being an integral part of an equipment control system where it is used to solve novel and not obvious technical tasks, may be protected by a patent. In other words, if the base of an invention is an algorithm only, the patent laws cannot be applied; otherwise, a given method of usage of the algorithm may be patentable. Patent is the only mechanism for protecting against an independent development of the same invention, albeit a relatively expensive one.

Another efficient way of copyright application is to protect a name given to a software program or a database by registering it as a trade mark. The main advantage of trade marks over copyright and patent rights is that they can be permanent. However, trade mark protection does not completely prevent the competition from copying or reverse engineering the trade mark owner's product.

Protection through a contractual agreement arranges the relationship of all parties involved, formulating their rights and duties. A feature of such contracts is that they relate to software and databases for computers. A contract is a juridical document which states and explains the formal agreement between the parties.

Copyright legislation distinguishes exclusive and property rights. It is the author of a software product who enjoys the exclusive rights which comprise authorship for a program or a database, the right to defend the form under which the author's name is indicated and the right for inviolability (holiness) of the software, as well as the right to announce the product.

Property rights may be exercised by the author as well as any other copyright owner. They determine how to publish the software, reproduce, distribute and modify it. Apart from this, property laws regulate the public presentation of the software, its adaptation, decompilation and hire.

In compliance with the Law "On Legal Protection of Computer Programs and Data Bases", private and juridical persons who do not obey its requirements, e.g. import counterfeit copies of software to the Russian Federation, violate the copyright laws and are subject to prosecution. The activities causing the violation of copyright laws, include manufacturing, reproduction, sale, hire, import, transportation and storage of the copies of software without the permission of the copyright owner.

In case of copyright infringement, any copyright owner can appeal to a court of law or to a court of arbitration to protect their rights. They may claim: [3, 6]
- Acknowledgement of their rights;
- Restoration to the state existing before violation of rights occurred, and the cessation of corresponding activities;
- Reimbursement for losses including the sum of profit gained illegally by the infringer;
- Compensation to be made according to the court resolution which may form a total of 5,000 to 50,000 minimal State monthly salaries, if the infringement of copyright was aimed at profit making;
- Imposition of a 10 per cent penalty of the sum meted out by the court in the plaintiff is favour, which accrues to the State Budget of the Russian Federation.

It is important to note that the compensation is inflicted instead of the loss reimbursement, but the penalty is put in addition to either reimbursement or compensation.

The court or the judge alone can deliver a judgement to confiscate counterfeit copies of software programs or databases as well as the materials and equipment used for their reproduction, to annihilate them or pass them either onto the State Budget or to the plaintiff, if they wish to obtain them on account of reimbursement for losses.

When an intellectual property dispute occurs, copyright owners have significant help in protecting their rights, provided the software product is officially registered in the Russian Agency for Legal Protection of Software Programs, Data Bases and Topographies of ICs. [6] The right to official registration of a software is available to the owners of the property rights on a program or a database.

The registration acts as an official acknowledgement of the property rights for the copyright owner. This is ensured by publishing a brief description of the software product in the official bulletin of the Agency. This publication also serves the purpose of advertising.

According to the laws on intellectual property protection, the official registration is not compulsory, but is necessary in case a property dispute occurs. The court may then request the Agency to provide all the information to be deposited, and consider it as a proof.

The new Criminal Code of the Russian Federation [9] enacted in 1977 states in the parts concerning software that for the authorship misappropriation, illegal reproduction and dissemination of an intellectual property object, an infringer may be sentenced for up to two years of reformative work, or to a penalty of 200 to 400 minimal State monthly salaries. For the members of a criminal group the punishment is doubled.

Enforcing the legitimate measures stated in both Civil and Criminal Codes, most of the developed countries carry out a number of organizational actions, such as establishment of specialized anti-piracy departments. [2] These departments are staffed with the specialists of the highest qualification, with skills both in law and computer science, and provided with the most up-to-date equipment.

The measures outlined above are executed at the government level. Moreover, in many countries, software developers and manufacturers consolidate their efforts to protect authorship and property rights. They have established a number of societies, the most well-known of which are: [6]
- Business Software Alliance (BSA), uniting some well-known European software publishers. It has a representative office in Russia;
- FAST—the British association for unauthorized usage of software;
- SIAE—Italian association of authors and publishers protecting their rights;
- SPA—Software Publishers Association of the United Kingdom;
- VSI—German anti-piracy association of software providers.

Societies such as these are of significant assistance to copyright owners and anti-piracy departments in revealing and averting cases of software piracy. One of the most effective of their activities proved to be the setting up of a hotline for messages of possible copyright infringements. Messengers are kept anonymous if the case is brought before a court, unless the information out turns to be deceptive— they may then be prosecuted themselves. The information obtained in such a way often results in a raid by both the society representatives and anti-piracy department officials (or police) on a company-violator when special software and equipment are used. To be efficient, such raids have to be unannounced.

5. Conclusion

In my opinion, the Russian software market displays quite a positive trend. This is proven by both an indisputable improvement of the business atmosphere in this area and a gradual decline in the piracy level.

There are good reasons to say that the current legislation of the Russian Federation on intellectual property protection corresponds to that in many developed countries. This is particularly illustrated by the latest changes in the Russian Criminal Code, which made the punishment imposed on a copyright infringer more appropriate to the damage caused by the piracy.

For the legislative measures to favour the development of a civilized software market, two integral parts have to be encouraged in Russia: an executive mechanism to ensure the laws are obeyed, and the idea of intellectual property protection within the mentality of distributors and end-users. Enforcing the execution of legislative acts can be expected to bring piracy levels down to that of the developed countries of North America and Western Europe. However, this way will not deliver the world from piracy, since there will inevitably be a certain demand for pirated software. Concentrating efforts around educating distributors and end-users, the software developing companies cannot count on quick results, but the effect will eventually be more tangible since the very base of piracy may be undermined.

The capability of Russia to make progress in at least either of these two directions will determine how dynamically the domestic software market will evolve and how the national software industry will develop.

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B. NEWS AND EVENTS

Virtual work: the challenge of telework

Increased bandwidth and the automation of telephone exchange switching have made distance working ("teleworking") a practical proposition. Five main categories of such work have been identified: multilocational, freelance, mobile, telehomeworking and relocated back office.

As yet, however, these new categories of work have not been acknowledged by the introduction of new employer-employee agreements. The legal framework underpinning employment is largely rooted in the last century, and distance workers are frequently not offered the same pay or other benefits enjoyed by those in conventional employment.

The benefits to employers of the new ways of working are threefold. Firstly, some categories of worker such as graphic designers or computer programmers are more productive when not exposed to the distractions which arise within the conventional working environment. Secondly, remote workers do not require expensive office premises, and costs such as sick pay or social security contributions can be avoided. Thirdly, employers can operate internationally, taking work wherever in the world it can be undertaken most cheaply.

Teleworkers gain from not having to commute, but there are concerns that their rights and benefits may not be protected. Trade unions have suggested that teleworkers should retain the status of a full employee and that above all the introduction of the new arrangements must be on a voluntary basis. The MIRTI Project, sponsored by the European Commission and the European Trade Union Congress, is developing guidelines for all parties involved in teleworking. (Source: *Managing Information*, 4 (10) December 1997)

Teleworking

As changing technologies foster one another, people's thinking and way of life changes. The preserved technologies are held onto until the number of unemployed caused by obsolete technologies grows faster than new jobs can be created. Libraries are affected by this phenomenon and their effectiveness for the national economy and social justice in the business cycle must be considered. The driving force of today's information revolution is digitization—the electronic transformation of data as a fundamental, basic conversion technique. The Internet is playing a decisive role as a logistical means of communication. Teleworking has its origins in the 1960s and 1970s when the oil crisis raised the problem of maintaining manpower when people could not travel to work. The answer was data traffic rather than people traffic. Although still in its toddler stage, teleworking is expected to grow substantially. Telework is defined as decentralized office work supported by information and communications technology so that the employee can access the host or server during work.

The advantages of teleworking are that employees can work independently and divide their time between work and home. They are more motivated and performance-oriented while businesses can make use of trained manpower that might not otherwise be available. Savings are made on office space; rent; cleaning; security, etc. From an economic and public viewpoint the advantages seem to outweigh the disadvantages. There are also opportunities in teleworking for the handicapped worker. It is concluded that young people will be able to manage teleworking without difficulty. Especially in times of unemployment, education and training are fundamental factors in preparing for the next economic cycle. (Source: *FID News Bulletin*, 47 (11/12) November/December 1997)

Death to the chip

Microprocessors will be economically and physically redundant by 2010, according to the computer company Hewlett-Packard, which has revealed that it is already using alternatives to computing with silicon chips.

HP is developing computers that could use quantum switches instead of transistors. Its researchers have already constructed a device called the Teramac, which is a hundred times faster than any machine currently available and provides computing power equivalent to 100 billion Pentium processors.

Instead of performing logic operations in the same way as a conventional microprocessor-based computer, the Teramac has a library of "look-up tables" containing all the data needed for computation.

This kind of machine exhibits a high fault tolerance so it will work reliably even on a quantum scale, where manufacturing errors are unavoidable. Physically, it is made up of a network of quantum dots, which provides an enormous number of possible pathways for information flow. If a fault occurs in any part of the system, the data are simply rerouted.

This radical shift in computer design is necessary, says HP, because the microprocessor industry is approaching its

fundamental economic and physical limits. The cost of building fabrication plants is doubling with each generation of microprocessors. The basic components on the chips—transistors—are shrinking, reducing the number of electrons available for switching each transistor on and off. By 2010 there will not be enough electrons on a transistor for it to operate reliably.

True quantum computing is not yet a practical possibility, however, so HP is going for the next best thing: classical computing using quantum mechanical components. (Source: *New Scientist*, 15 November 1997)

An information science manifesto

Information science is concerned with both research and design. It conducts research into the nature of information, its creation, organization, use and impact. It studies information needs and the interaction between people and information. It combines conceptual structures with appropriate technology in the design of systems for information sharing, retrieval and access, as well as information assimilation, processing and learning.

At the heart of information science are the twin concerns of understanding users in their quest for meaning and problem solutions and representing knowledge structures that support the construction of meaning and the solution of problems. User models and knowledge representation, like a binary star, revolve around each other and depend on each other. To know what is important in knowledge representation, we need to know user requirements and user thought patterns. To understand users and their backgrounds, we need to represent their knowledge and their information needs. The tension between the two poles of information need and stored information representations defines relevance, perhaps the central concept of the field. To understand relevance, we must understand the user model and the representation of knowledge and the complexities of their interrelationships.

Based on our knowledge of conceptual structure principles and on an analysis of users' problems and users' thinking, we can come up with structures that take users a step further. True user-oriented service requires substantial knowledge, knowledge of problem-solving strategies, information organization, information systems and search strategies. Skilled human intermediaries have that knowledge. Their most important contribution is helping users clarify their problems and their information needs. (Source: *Bulletin of the ASIS*, 24 (4) December 1997/January 1998)

Knowledge management: competitive advantage for the 21st century

Matter and energy are being replaced by knowledge as the primary generator of wealth. Any product is essentially a distillation of knowledge and information and each generation has added to knowledge in terms of its collection and management, implementing and recording scientific and technology developments which are taken for granted. Businesses have always been aware that what really mattered was what they know and the business world is built on the collection and use of information. The degree of skill used to harness, understand and act on this information determines the success of the company. So why has knowledge management suddenly become so crucial in the business world? The last two decades have seen enormous changes in the way in which business has been conducted. These changes have been caused by globalization; change and

competition; and developments in information and communications technology.

The convergence of information and communications technology has led to the development of new companies; rewarding ways of working; facilitated the exchange of ideas; and changed the direction of many businesses. It has also affected the speed at which situations change. The compression of business cycles and the changing market environment has helped to produce a market for management gurus and consultants in the business world. Knowledge management is a logical step forward with the integration of knowledge and information with knowledge becoming more comprehensive and its value increasing. The intellectual capital of a company needs to be converted and value management becomes important. Information and data sources should be linked together to form a knowledge network. The issues to be considered are sharing knowledge and information; information overload; information management; and an innovative mix of business, information and development skills. However, the most important issue is for companies to accept that their future depends on their ability to manage something as intangible as knowledge. (Source: *Records Management Bulletin*, No. 83, December 1997)

Three golden rules for developing an information management strategy

There are three golden rules for developing an information management strategy through an intranet, according to the Lotus Notes User Group. First, adopt a long-term vision for corporate intranet usage. In order to shape a clear understanding of the purpose an intranet will serve, it is useful to start with an information audit, looking at the strengths and weaknesses of current information production, distribution and effectiveness. Crucially, intranet development must not be a technology driven exercise, otherwise it will generally fall short in encompassing a long-term business vision and as a result fail to integrate sufficiently into the business.

The second rule is to create a culture of information ownership. It is important to ensure that the original owners of information are also responsible for ensuring that they have the means to put information onto the intranet, as well as maintaining it. Key to this happening is a cultural shift where information publishers within a company see the intranet as the primary route to issuing material, with paper seen as the follow-up. Inherent in archiving such ownership is agreeing an appropriate method for the publisher to publish.

Finally, it is important to recognize, adapt to and take advantage of the inherent qualities of electronic information. The resolution limits of screen technology mean that the volume of information on a computer screen is much less than an A4 page of paper. For this reason careful design sense needs to be applied to the use of fonts, colours, and information formatting. At the same time electronic information must be considerably more concise. (Source: *Information Management and Technology*, 30 (6) November 1997)

Human testing for mobile risk

The European Commission is to action research into the health risks posed by mobile phones. This follows recommendations from an expert group proposing that human testing should be included.

The proposals include the need for "acute exposure of healthy volunteers to fields from handsets, and investigations of possible neurophysiological effects ... and ... investigations of possible effects on the immune system".

So far, research in the area of the health effects of high frequencies, including an 18-month study by Australian researchers that found electromagnetic fields accelerated the development of cancer in rats, have been uncoordinated and have produced spurious results.

This latest research initiative will coordinate scientific bodies across Europe. It will be run under the fourth or fifth EU Framework Programme for R&D, or by COST 244, a European organization which fosters scientific links between both non-EU and EU states. (Extracted from *Electronics Weekly*, 12 November 1997)

Ion-projection lithography

Members of Europe's collaborative four-year research effort, Micro Electronics Development for European Applications (Medea), will support work being carried out with ion-projection lithography, a technology pioneered by the Viennese company Ionen Mikrofabrikations Systeme GmbH. The members include ASM Lithography (Veldhoven, the Netherlands), the Institute of Microelectronics (Stuttgart, Germany), Leica (Jena, Germany) and Siemens (Munich, Germany). The company will develop the technology, assisted by a three-year, $36 million programme with the intention of licensing it to stepper manufacturers. The Ionen system projects hydrogen or helium ions through a stencil mask at high energies to develop photo resist on a die's surface. Ion systems of this kind are viewed as an option to take semiconductors past the 0.18 μm level, into yet smaller geometries. (Reprinted with permission from *Semiconductor International Magazine*, December 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Internet via electricity supply

The Internet could literally be powering into homes around the UK by the end of 1998 if Nortel's and Norweb's "data over power lines" trial in the North-West of England is successful.

The technology allows the electricity supplier to send information over power lines at a rate of 1 Mbit/s (8 times faster than ISDN) between its substations and the homes of customers by sending the information at a much higher frequency, in the radio band (a few MHZ), than that used to transfer electricity (50 Hz).

This idea is not new and electricity companies have experimented with sending communications signals, particularly voice, down power lines before. But these did not get very far because electromagnetic noise from the power lines interfered with these data signals. Every time someone in an area switched on an electrical appliance—like a kettle or a television—a huge amount of noise for the moment that appliance was switched on would be generated. In a typical neighbourhood dozens of such occurrences happen every minute, making a continuous telephone call over power lines totally unfeasible.

Now, after three years of research by a joint Nortel and Norweb team, the companies have come up with a proprietary signalling system designed to minimize such interference. As well as that, by using Internet coding protocols, data is sent in traceable packets; once a piece of information has started to be sent using TCP/IP every packet that makes up that information is expected by the destination computer, so if a packet does go missing due to interference it will be re-sent.

All of this means that, as long as the power supply itself stays up, you can have a very reliable, permanent Internet connection to your home.

In any case, if you suffer a power cut to your home then you are going to lose your ability to access the Internet with your PC, even if it is connected through the phone line.

As far as getting the Internet connected to the substation is concerned, Norweb will simply use an optical fibre link.

And for the consumer there will be no need to mess around with dialling up ISPs using a modem or depending on a slightly faster, and much more expensive, ISDN link. Because his or her electricity supply is a permanent fixture with signals always coming from one source, unlike with the telephone, the connection will always be permanent. Also, because the electric cables are already in place the cost of installing and maintaining the communications infrastructure will be very cheap, meaning Internet services at a cost of just one third or half that which ISPs are offering now. (Source: *Electronics Weekly*, 15 October 1997)

Inter, intra, extranet: the third wave

Some companies are now implementing what has been described as the Internet's third wave—extranets. These open up parts of the organization's intranet to outside business partners and customers. The intention is to provide the basis for the fully-integrated, on-line capabilities which may become commonplace one day.

Extranets offer an alternative to placing an order by phone, but are not simply about selling. Airlines using the Boeing extranet, for example, can access engineering drawings, component maintenance manuals and service bulletins.

Salehurst, a British paper supplier, has established a system which enables its customers to access details of historic and forecast costs, usage reports, excess wastage, stock levels by location and status reports on orders being delivered.

Sweden Post's extranet includes news from daily newspapers, internal chat groups, a "track and trace" service to enable customers to follow the progress of parcels, a basic banking service (Postgirot) and a pilot service for buying shares. In this latter instance, the extranet has become more than just an extension of the intranet as it employs Netscape software to link up to *Oracle, Sybase* and *DB2* databases which are not part of the intranet.

Planning an extranet assumes that the intranet on which it is based is working perfectly. Badly organized intranets, however, can cause problems resulting from an overload of unhelpful data. If the system is not to convey entirely the wrong impression to customers, someone within the company must control the data and ensure it is up to date and relevant. (Source: *Information Strategy*, October 1997)

Best practices for telematics applications

AESOPIAN (Awareness of European Solutions and best Practices for telematics Applications) is a consortium of European IT associations. Its purpose is to develop and maintain a database of best practices in telematics, as well as diagnostic software. The group is building on earlier work undertaken by the MATISSE project.

Material has already been developed in a number of areas. Service management within telematics projects entails such capabilities as project management, user evidence,

relationship management, organizational theory, human resources management and service quality management. Some of the more successful telematics implementations have been in value chain management, especially in the application of EDI (electronic data interchange).

Developers of telematic services must consider the environment in which they operate, taking due account of how they relate to the information systems around them and how users will respond to the interface. Very few organizations will have all the required competences in-house, and must go outside to procure them. This in turn requires skills in specifying, selecting, contracting for, ordering and subsequently controlling the provision of bought-in services.

Whether developed in-house or by external contractors, complex systems demand skills in configuration management. The requirement becomes ever more demanding as systems become more complex and interconnected., and the need for the management of stand-ards more pressing. The results of the research can be found at http://www.fundesco.es/aesopian. Further information is available at the NECTAR Website http://www.nectar.org/general/projects/aesopian/index.htm. (Source: *Managing Information*, 4 (8) October 1997)

Additions to IMF

The International Monetary Fund (IMF), Washington, has accepted Israel, Singapore, the Republic of Korea and Taiwan to its roster of developed economies. However, the IMF will refer to them and the new additions as "advanced economies", rather than "industrial countries". (Source: *IW*, 23 June 1997)

World service

Inmarsat has launched the fourth in its Inmarsat-3 constellation of communication satellites. When it is finally commissioned, the satellite will give the Inmarsat-3 system, which gives direct-dial phone communication, almost global coverage. Lift-off was from Kourou in French Guiana by an Ariane 4 rocket and the satellite was placed in an elliptical transfer orbit from where it will eventually be positioned in a geostationary orbit at 28° East. (Source: *Electronics Weekly*, 11 June 1997)

Proposal to adopt GSM alternative technology

GSM, the European digital cellular phone standard, could be superseded as the basis of the next generation of mobile phones.

Two of the world's largest suppliers of GSM networks and handsets, Ericsson and Nokia, have made a joint proposal to adopt an alternative technology, based on the US-pioneered code division multiple access (CDMA) radio protocol, for the next generation of mobile phones to be introduced in Japan and Europe in 2000.

Although both companies are developing wideband versions of the GSM system, there are indications that wideband CDMA may be more efficient when offering high bandwidth radio channels in cities and towns. Japan favours an early introduction of wideband CDMA, which could force the issue in Europe.

Ericsson is proposing what it calls "an evolutionary path", where wideband CDMA infrastructure can be overlaid onto existing GSM networks. By 2001 Ericsson predicts there will be 300 million GSM users worldwide.

The proposed wideband CDMA mobile phones will support switched multimedia services such as video and Internet access, which is now acknowledged as being difficult to offer using time division multiple access (TDMA) based GSM technology.

Ericsson is pushing strongly for an early adoption of the wideband CDMA standard in Europe to head off pressure from US suppliers for the adoption of the North American CDMA standard, known as IS-95. (Extracted from *Electronics Weekly*, 11 June 1997)

Achieving a roaming point of presence on the Internet

Peering between service providers and virtual points of presence means that Internet access can be achieved more or less around the world. Once the user attempts to use the system from outside the geographical reach of a specific PTO, however, technical difficulties and increased charges can mean using the Net is far less cost-effective.

In January 1996, Sea Change of Canada and Club Internet of Hong Kong formed the i-Pass Alliance, a means of enabling users to access the Internet cheaply, when away from home. The Alliance has made agreements with Uunet, Pacific Internet and Australia's OzE-mail, permitting users to dial into the i-Pass network from over 1,000 locations.

This form of roaming access, however, may be achieved by other means. Initiatives by Oracle, a key player in the NC consortium, could see hotels installing TV set-top boxes which, by use of a smart card, could give users remote access to their intranets and e-mail services. Another possibility is that telecommunications companies might erode the Alliance's market by reducing international tariffs. A third question mark is the globalization of both the telecoms and ISP markets. BT/MCI, Microsoft and Worldcom/Uunet could provide their own global virtual points of presence if they believed their revenues were threatened by initiatives such as that from Alliance.

On the other hand, i-Pass seems to be enjoying some success in Asian markets, where the telecommunications companies are too busy implementing essential services to pay much attention to what is seen as a luxury add-on. (Source: *Communications International*, June 1997)

Legal information needs of the general public: with special reference to developing countries

The general public—accountants; police, prison, and probation officers; labour officials; court personnel; immigration officers; and other civil servants—require legal information. In addition, the general citizen needs to be kept up to date with the law. Legal information helps people to perform their work effectively within legal boundaries. Unlike lawyers, the public do not need complex legal information material but material that is easy to read and understand. This might be provided by textbooks; legal periodicals; case law materials; and reference works such as encyclopaedias, dictionaries, directories etc.; and newspaper collections. The use of library resources by the public depends on the policies of individual libraries. In the United States of America and Canada, the number of law libraries in academic institutions and the law courts are open to the public. In developing countries, accessibility to legal information has been and will continue to be a major problem.

The ordinary member of the public in the third world has nowhere to go to obtain legal information. The public library in the developing world could follow the example of the developed countries and take over the task of providing legal information to the public. As the requirement is for simple legal texts; handbooks; and basic reference books, the

public library could address this need and would be complying with the demands of the UNESCO Public Library Manifesto. Legal information could also be provided by legal aid centres. These exist in some states to provide legal advice and services to the financially handicapped. It is concluded that the provision of legal information to the public in the third world still remains largely unresearched. Unless extensive empirical research is conducted, information professionals will continue to rely heavily on hypotheses. Professionals should be sensitive to the need so that the information profession can be advanced. (Source: *Library Review*, 46 (1) 1997)

The use of satellite and CD technology to speed up Web surfing

The expectations of Internet users have been raised by a generation of TV viewers, who expect fast graphics and multimedia delivered instantly. The Internet in current form is unable to meet these expectations, although two new technologies offer some hope that today's bandwidth problems can be solved.

The first is the use of satellite. This is fast although surfing the US during peak time can still be stiflingly slow. Also, it is not possible to bolt a satellite dish anywhere users want one. There is also a cost factor—not just of the dish but also the cost of downloading megabytes. For these reasons, the use of satellite could be out of the reach of many users.

The second technology is an Intel-backed CD solution that is claimed to make some Web sites faster. With an Infinite CD-ROM, part of the Web would be located on a CD-ROM in the user's local drive and only a small part of the site would come down the wire. The technique is not new and the cross-media applications needed have been under development for over a year. The minus side is the slow speed of CD-ROM, although Western Digital's new SDX interface—which gives hard disk-like speeds—could help here. (Source: *Internet Magazine*, May 1997)

ISDN vs. DSL and cable modems

At present, ISDN represents the only affordable means of obtaining faster speeds on dial-up lines. Other technologies, however, are being heavily promoted as alternatives, with very high speeds being quoted for digital subscriber line (DSL) and cable modems.

DSL runs at speeds between 16 kbit/second and 9 Mbit/second over conventional copper lines, via a special modem which operates at high frequencies. Actually, it is an umbrella term covering seven types of service, only two of which are close to being realized: high-speed DSL (HDSL) and asymmetric DSL (ADSL).

Cable modem services are promising speeds of 30 Mbit/second over their hybrid fibre optic and co-ax networks, but their use of 10BaseT Ethernet is likely to reduce actual speed to a maximum of 10 Mbit/second. Most customers are likely to average 1.544 to 2 Mbit/second downstream and 64 kbit/second upstream—about the same as ADSL.

For the next couple of years, corporate network managers will have to bear a number of considerations in mind when choosing between ISDN, DSL or cable modems. Location will be a key concern: choices will be determined by what is available locally. Remote users needing to reach more than one site will need ISDN: DSL and cable modems are strictly point-to-point for the time being. Another concern will be bandwidth: lower speed applications will work well with ISDN, whereas the alternatives may be more appropriate for high-speed applications. As regards security,

DSL services pose the lowest security risk, whereas ISDN runs over the public network and cable modem services are shared among subscribers. (Source: *Data Communications*, April 1997)

IP addressing: playing the numbers

Demand for IP addresses on the Internet has been such as to create a potential shortage. Class B network addresses—which support up to 65,534 nodes—are now extremely difficult to obtain. Class C addresses handle only 254 nodes—most networks are larger than that—and cobbling multiple Class C addresses together is not a particularly elegant solution.

Now, however, the ISPs (Internet service providers), the Inter-NIC (the body which assigns IP addresses worldwide) and the IETF (Internet engineering task force) have come up with some solutions to this problem.

The first is subnetting—subdividing an IP network address to use it in several smaller networks. This puts to use formerly dormant addresses in a given block. Another approach is to avoid registered addresses altogether, by using the special addresses reserved for private networks. The private addresses are hidden behind firewalls or packet-filtering routers which employ network address translation (NAT). This represents a good solution for the managers of private networks, but not for ISPs.

ISPs are turning to classless inter-domain routing (CIDR). This is not a direct solution to the IP address shortage itself, but it reduces the number of routing table entries by consolidating addresses into contiguous blocks. CIDR replaces Class A, B and C addresses with a network number prefix and a mask. Together, the prefix and mask identify a block of IP network numbers.

The IETF is now moving to provide a longer term solution, by sanctioning an upgrade to the IP protocol. IP version 6 expands the number of available addresses by increasing them from 32 to 128 bits. As yet, however, it is not widely deployed, and in fact it may never entirely replace IPv4. (Source: *Data Communications*, 21 March 1997)

Online news options to fit information needs and equipment

On-line news is booming. Rare is the daily newspaper of any size that has not staked out its own corner of cyberspace. For example, The Chicago Tribune—particularly strong on local news and sports coverage—links you to Digital City Chicago, which offers maps and databases for each of the city's neighbourhoods. Meanwhile The Christian Science Monitor offers an easy-to-navigate layout, searchable archives, discussion groups, and RealAudio Webcasts.

Print media in general are still scrambling to develop an on-line business model. Some newspapers provide the full text of their print stories, banking on advertising revenue to generate some sort of income stream. Others provide selected articles, abstracts, or content that is unique to the on-line edition. What they offer in the way of archives is a mixed bag, too. By and large, you will not find extensive newspaper archives on the Web, especially for free.

On-line versions of traditional print newspapers are only the tip of the on-line news iceberg. The good news is that most non-traditional on-line news services allow for varying degrees of customization. Non-traditional Internet news services come in several flavours. Personalized news pages and content push are the dominant scenarios. There is a proliferating number of these, in every possible

The Internet is also growing exponentially. It is becoming more and more likely that you will be able to find a Web home page for a company, to download a data file of information from a government agency, and to deliver the results of research directly to someone's e-mail account. However, search tools tend to retrieve documents that have little relevance to the information you need. This may be remedied somewhat by the more sophisticated relevancy-ranking within search engines, but will always be a problem when searching a universe of material that has not been, and cannot be, completely organized or catalogued by anyone. (Source: *Online*, January/February 1997)

Solar power will be viable option

Solar energy will be a viable alternative to oil and gas within ten years, according to BP's chief executive, John Browne.

Browne, whose company develops and manufactures solar power products, insists it will be a complementary energy source.

The company hopes to expand BP Solar, its division which holds ten per cent of the world's solar market, to achieve annual sales of $1 bn over the next decade. While photovoltaic cells, from which solar devices are made, are essential silicon p-n junctions, they are relatively expensive. BP Solar is working on several approaches to improve the efficiencies of solar cells, and hence their cost.

One is the use of a laser to cut a grid into the silicon before it is plated. Burying the grid deep within the silicon increases the number of electrons held, thereby raising the cell's efficiency. The resulting proportion of sunlight converted to electricity is 17 per cent. This compares to the typically achieved efficiencies of 12 per cent.

Another approach involves the use of lenses to concentrate the light hitting the cells.

Cost can be further reduced by laying a thin film of cells made from cadmium telluride onto a steel substrate. (Extracted from *Electronics Weekly*, 28 May 1997, http://www.electronicsweekly.co.uk/)

First worldwide Internet telephony system

USA Global Link has introduced what it says is the first worldwide Internet telephony system.

The Global Internetwork service will be offered in 35 countries with rates varying between 25 cents and 50 cents per minute. The company claims that voice quality will be comparable with satellite-routed phone calls which often have a voice delay, but will be better than using Internet-connected PCS to call other PC users.

Global Link is not the first company to offer such services but it is the first to plan a worldwide one. The company is a leading "call back" firm, offering overseas clients cheap phone rates by offering access to a US dial tone and cheap US phone rates.

The company plans to install gateways in various countries that will connect local phone users to the Internet. However, there are concerns that such services will further congest the already overburdened Internet. (Source: *Electronics World*, June 1997)

Comparison of pricing structures of information

Information managers and librarians are confronted with the same information product in different electronic media. The pricing structure of electronic information involves questions of access vs. ownership and variable vs. fixed fees. Although there have been some experiments with different structures, the main method for measuring the usage of an on-line retrieval service is based on connect hour time. Although flat rate pricing for on-line searching was much discussed in the early 1990s and some contracts on this basis were set up, database producers and hosts were not willing to take the major risk of setting up an entirely new pricing structure. Another argument against flat rates was that it would not be possible to invest in product improvement and development when overall revenues decreased.

Many CD-ROM products are licence agreements allowing data access for a specified subscription period. It is a suitable medium when a limited year coverage is required and a longer update frequency acceptable. SilverPlatter has developed a new system called ERL (Electronic Reference Library) which allows access via WAN- or LAN-based systems on client/server architecture. Locally mounted databases from magnetic tapes onto in-house computers became popular with the widespread use of OPACs, but the costs for licence agreements are often much higher than for CD-ROM licences. In the beginning, the Internet was funded by governments, universities, and research institutions, but new electronic charging and payment mechanisms are being developed.

It is concluded that information managers have to choose the appropriate electronic medium according to local needs. They have to decide cost/benefit issues and determine the trade-offs. They also have to decide when it is economically justified to move from traditional on-line searches to a locally installed database. A direct comparison that calculates a break-even point can only be partly true because of the different information service characteristics. Another aspect is the sharing of workload and expense. The advancing telecommunications infrastructure will allow cooperative projects to be set up between remote partners. Marketplace competition could bring profit to the user. (Source: *FID News Bulletin*, 47, 1997)

Mainframes are back

In the late 1980s, mainframes were threatened with obsolescence. Costs were rising by 10-15 per cent per annum, users rebelled, and distributed computing based on client-server systems became fashionable. A decade later, however, mainframes are still with us, and even showing modest signs of revival, although nobody expects them to recover their previous position of dominance.

It has been estimated that two thirds of the world's data is still held on IBM servers, many of them System 390s. At a recent conference in Paris, IBM revealed that sales of System 390 machines have increased. Moreover, two thirds of IBM's top 200 customers are planning to implement S/390 parallel sysplex architecture systems. Parallel sysplex allows virtually unlimited scalability via mainframe clustering, combined with 99.9 per cent system reliability.

The switch back to mainframes has been assisted by the use of low-cost CMOS chips (encountered in everything from PCs to microwaves), which has substantially reduced the price tag for the big boxes. As computer networks expand, support costs spiral, making the centralized control afforded by mainframes more attractive. Proponents of mainframes claim that the distributed environment may suit a situation with ten or twenty users, but that systems with hundreds of users present real management problems. The fortunes of the S/390 have also been helped by improvements in its operating system, particularly the addition of a UNIX 95 interface allowing users to port leading applications such as *Oracle* or *SAP R/3*. (Source: *Computing*, 5 June 1997)

TCO and the NC

According to figures released by the Gartner Group, the total cost of ownership (TCO) for a PC is considerably more than the purchase price. They suggest an annual cost of almost $9,800—over 40 per cent of which is for staff time—to buy and maintain a networked Windows 95 PC.

A possible alternative to the PC which promises to reduce costs is the network computer (NC). Although the definition of an NC is interpreted differently by various manufacturers, essentially an NC is a "thin client": most of the code driving it resides on a central server. Despite appearances, however, they are neither cut-down PCs or "dumb" terminals, although a large market may exist for NCs as replacements for the estimated 30-50 million dumb terminals in use worldwide.

NCs are designed primarily to run *Java* programs, which are platform- and operating system-independent. In theory, at least, software can be compact and efficient, in contrast with the bloated programs encountered on the Wintel platform. Unlike PCs, which lock organizations into one source for processors and operating systems, NCs allow for flexibility of choice. They also mean that ordinary users (as opposed to power users) receive only as much (tailored) computing power as they require for their work.

Nonetheless, there are other means of reducing TCO. Microsoft and Intel have announced their NetPC, *Zero Administration for Windows (ZAW)* and Wired for Management initiatives. The Gartner Group figures also indicate that an organization which manages its PCs effectively will achieve only marginal cost savings by switching to NCs. (Source: *ITS News,* (35) May 1997)

Managed networks

Conventional outsourcing is being supplanted by the introduction of managed services, and especially managed networks, in many organizations. Examples of companies looking to others to manage their networks include Eurotunnel, Fina and the Halifax Bank. The arrangement allows the host company to retain control of the data and keep up to date with the latest technologies, in a manner not possible with outsourcing.

BT is one of the suppliers offering such facilities, having recently expanded its range of services to include managed services for desktops, networks and servers. IBM Global Services offers a diverse range of services, including reviews of the network topology and traffic patterns, local carrier facilities monitoring and backbone management.

Managed networks enable companies to relieve themselves of the aggravation associated with day-to-day network management, allowing them to concentrate on longer-term issues and on the business itself. Their introduction may also reduce costs in the short term, although this should not be the determining factor: a short-term view of IT costs may lead to higher costs in the longer run. The true benefits arise out of improved management and more flexible services, as well as the opportunity to develop a long-term business strategy for the deployment of IT.

Such benefits can only be realized, however, if the host organization has the ability to understand the statistics generated by the managed system and to make decisions based on them. (Source: *Information Week,* (8) 25 June-8 July 1997)

New technologies and users

Many of the revolutionaries in the world of information technology are in the business of selling hard- and software

to the captive user. The essential premise is that systems must be constantly renewed: if the technology is twelve months old, it is obsolete. There is, however, no compelling evidence to suggest that the new systems enrich our lives or make us work more effectively than before.

In the wider, social context, certain groups are seen to obtain seemingly unassailable advantages by their acquisition of technical knowledge, while others struggle to grasp the basics of what is required. Groups which fall behind in the rush to gain the arcane wisdom are seen as likely to be permanently disadvantaged.

The "information-rich" accept all the promises of convenience and speed made on behalf of the new systems, yet are often responding to trivial definitions of what is important or urgent. There is a concomitant fear of having to process ever increasing volumes of information in ever shorter time scales. In this respect, the captives are all of us: all of us fear not knowing enough, and believe there must be further relevant information available, if only we could find it.

Nineteenth century libraries developed rational classification systems based on subject relationships which served two purposes simultaneously. They enabled the reader to locate a specific item, but also offered an element of serendipity, in that browsing might reveal additional items. The Internet, by contrast, makes it difficult to locate a given item, but overwhelms us with serendipity. (Source: *Ariadne,* (10) July 1997)

The future of computing

Earlier in 1997, the Association of Computing Machinery organized a conference boldly titled *The Next 50 Years of Computing.* It produced some insights, but revealed that, truly, no one can predict the future of the industry with any degree of confidence. Without some vision of the future, however, no matter how misguided, organizations cannot plan ahead.

Some pundits are prepared to be adventurous. Moore's Law states that processing power doubles every eighteen months: this argues for some impressive computers in the next century. Some believe, however, that Moore's Law will soon reach its physical limits. These forecasters predict that new types of computers—for which the computational power grows exponentially rather than linearly—will be needed after that if problems such as those posed by artificial intelligence and speech synthesis are to be solved. The technologies may be those of very large scale parallel, quantum, optical or DNA computers. Other scenarios predict the development of ultra low-cost, system on a chip computers which will be embedded in everything including cars, telephones and domestic appliances.

What is becoming clear is that the computer industry—much less any single company within it—will be unable to force through technological changes by itself. Microsoft and Intel—for all their wealth and influence, and despite the importance of digital television for the computer industry—cannot force broadcasters to modify their signals so that they can be received by PCs. Similarly, computer companies are going to be increasingly subject to the power of the telecommunications companies as regards advances in networking technology. (Source: *Computer Business Review,* 5 (6) June 1997)

New computing metaphors from the living world

Increasingly, research is being directed towards understanding how living creatures interact with their environment, in the belief that this could form the basis for

a new model of computing and information processing. By contrast with man-made systems which require complex software to achieve even simple tasks, biological organisms perform complex activities with very simple software. The new discipline of "informatics", therefore, combines computer science, artificial intelligence (AI) and cognitive science.

At Edinburgh University, a research team has developed tiny robots which mimic the behaviour of crickets: they respond to recordings of real crickets, but not to other sounds. Other teams have developed "intelligent agents" which help Unilever and IBM manage workflow, and an intelligent labelling explorer (Ilex) which provides a virtual tour of an exhibition tailored to the interests of the user.

At BT's research laboratories, biologists and entomologists have been recruited to explore how "ants"—intelligent agents—could be used to determine alternative routes through a telecommunications network when a blockage occurs. Based on the reports from the "ants", the network could be re-configured in less than one second, compared with the several minutes normally required.

At the Massachusetts Institute of Technology (MIT), research teams have developed Cog, a machine which "learns" from experience rather than being pre-programmed. The exact opposite of this approach is represented by Cyc: about $40 million has been spent on organizing its "reasoning engines" and storing 500,000 rules (derived from two million common sense facts) in its knowledge base. (Source: *Computing*, 31 July 1997)

"Push" technology

Push technology on the Web has three components: the client software; the channel server; and the content that appears on the channels. Push takes place when the user agent delivers a continuously updated and personalized stream of information from various content providers at pre-set intervals. About 40 companies are now competing in the push market, including Microsoft and Netscape, who have begun incorporating push clients into their browsers.

Corporate intranets can benefit from push technology which can facilitate making company information easily and immediately available to employees. Private corporate channels can be set up to push business content such as current announcements, company manuals, and press releases. A ticker could notify employees of fast breaking important events. Distribution of updated software can be electronically pushed to employees' desktops. Customers and suppliers can have access to pertinent information and data through the company's extranet. The company could broadcast on its standard Web server on its private channel and the technology allows company control over the content and advertising that employees would see coming from the Internet.

The Internet is based on standards and consensus, yet the latest bandwagon is now rolling along without either being much in evidence. Dozens of companies are currently developing client and server software which supports "push", yet no two suppliers' products are compatible.

Companies such as PointCast, Freeloader (now part of Individual) and IFusion are promoting the metaphor of a broadcast channel which supplies customized information to the user's hard disc. The layout and formatting of the information, however, is controlled by the broadcaster.

Other startup companies—such as Marimba, BackWeb, Intermind and inCommon—have taken a more open approach. They are geared towards the provision of tools for use by the content providers themselves, enabling them to customize their offerings to the public. Each company takes a slightly different approach. Intermind's *Communicator*, for example, is essentially a Web server running on the user's PC. BackWeb originally adopted a similar stance to that of Intermind, but has recently shifted direction, offering a PointCast-style system, albeit one working alongside other applications and with more of a multimedia "feel" about it. The data can be presented in specific formats, such as those offered by *Shockwave* and *RealAudio*.

Lotus will be embedding Marimba's *Castanet* into its *Domino* intranet Web server, while Netscape and Microsoft will be using *Castanet* and BackWeb's product, respectively, to add "push" functionality to their browsers. Developments such as these will extend the use of "push" technology to the vast majority of Net users, rather than a minority as at present.

Ironically, the proponents of "push" technology on the Internet include the very companies once threatened by the Net. The software, by delivering content to the user, completes the transformation of the Web into a broadcast medium, to the satisfaction of both content providers and advertisers. When the customer is offered a range of news services, the more familiar players from the worlds of print and broadcasting stand a better chance of being selected.

This may result in the creation of two distinct Internets—one resembling the current one (an eclectic and free-wheeling mix) and another which resembles other broadcast media, with tight control over content and limited choice. It is not difficult to see which will receive more investment, but it seems likely that the outcome will be more inward-looking Net customers. (Source: *Nfais Newsletter*, 39 (9) September 1997, *Personal Computer World*, June 1997 and *Internet Magazine*, May 1997)

Safe payments

International Business Machines Corporation says it has developed a secure system for payments by credit card on the Internet, and major banks and credit-card companies including Visa, MasterCard, American Express, JCB, Discover and Diners Club are backing the standard.

Under the plan, purchases made under the Secure Electronic Transaction standard, or SET, will be guaranteed by major credit-card issuers just as if the purchase had been made in a store or over the phone.

SET uses an Internet browser like those made by Netscape Corporation or Microsoft Corporation. The consumer places an order with a merchant; the order is encrypted so that the merchant sees only the products ordered and the amount of the purchase, while the bank sees only the payment information—not the items ordered. To use SET, companies will need to establish merchant servers, for which IBM makes the software and hardware. The merchant server acts as an intermediary among the buyer, the merchant and the credit-card company. Everyone that uses SET must be registered, allowing the retailer to feel confident that customers are who they say they are.

SET was launched in Denmark in early 1997, and its use has spread across Europe.

"SET has picked up a lot of steam in the last six months", said Cliff Condon, analyst with Forrester Research, which tracks information technology.

Microsoft and Hewlett Packard Corporation, which recently acquired VeriFone Inc., a leader in the technology allowing payments on the Internet, also have said they are working to develop merchant servers for SET transactions.

IBM estimates that $1.2 trillion will be spent in the information-technology sector by 2000, with about $250 billion of that spent on electronic business.

But for all the enthusiasm surrounding SET, there are some fundamental problems. Banks, for example, have not figured out how much to charge per transaction. There also is no logotype or symbol identifying Internet sites as SET-secure, and SET is not the only electronic payment method under development.

DigiCash NV, a Dutch company operating in the Silicon Valley in California, also is developing an electronic payments system, but one based on cash rather than credit. Consumers can purchase "electronic cash" from a bank, downloading it to a computer hard drive much like withdrawing cash from a cash machine. The consumer can then make purchases on line until the "electronic wallet" is depleted. (Extracted from *International Herald Tribune*, 21 July 1997)

Restructuring the Internet

A conference, hosted by ITU and aimed at restructuring the way domain names are registered on the Internet, took place in Geneva from 29 April to 1 May 1997 and ended with the signing, by over 80 countries, of a new Memorandum of Understanding (MoU) covering the way generic Top Level Domains (gTLD) are allocated and managed.

The gTLD names are the file extensions which denote the "address" of an Internet site on the network. There are at present only three international gTLDs generally accessible to all Internet users—.com, .org and .net—and the exclusive right to allocate gTLD addresses is held by a United States-based company, Network Solutions Inc. (NSI) through a contract with the United States government's National Science Foundation (NSF), which is due to expire in 1998. The NSF announced recently that the agreement would not be renewed.

In order to cope with the growing demand for Internet addresses in the gTLD, the gTLD MoU calls for the establishment of seven new generic Top Level Domains in addition to the existing three. These will be .firm (for businesses), .store (for shops), .web (for organizations concentrating on World Wide Web activities), .arts (for cultural and entertainment-based activities), .rec (for organizations involved in recreational activities), .nom (for individual Web sites) and .info (for information services). Furthermore, the MoU provides for the setting up of an initial 28 new registrars around the world—four from each of the world's seven regions. More registrars will be added as operational and administrative issues are worked out. Registrars will compete on a global basis, and users will be able to shop around for the registrar which offers them the best arrangement and price. Users will also be able to change registrar at any time while retaining the same domain address, thus ensuring global portability.

At the close of the Conference, 57 entities took part in the signing ceremony and put their names on the MoU. The ITU will have an important role to play as the depository of the gTLD MoU and the ITU's involvement in the Conference signals closer links between the telecommunication community and the Internet. (Source: *ITU News*, June 1997)

Smart card companies form consortium

Eight of the world's leading silicon manufacturers and smart card companies from the United States, Europe, Japan and Australasia, led by Mondex International, are joining together to introduce MULTOS—a new "open" high-security operating system for smart cards. Products will be commercially available in 1998.

Dai Nippon Printing, Gemplus, Hitachi, Keycorp, MasterCard International, Mondex International, Motorola and Siemens announced that they have agreed to form a consortium—called MAOSCO—to drive the adoption of MULTOS as an industry standard and to manage its ongoing development.

MULTOS will be available on a non-proprietary "open systems" basis to ensure that it becomes standard for smart card issuers in all sectors including finance, retail, travel, media and telecommunications.

In a parallel move, MasterCard International—representing more than 23,000 members and more than 400 million cardholders—has endorsed MULTOS as its chosen chip card platform. Together, MULTOS and the MasterCard migration plan support a wide range of implementation schemes ensuring that member banks can bring smart cards to market in a way that is useful for the cardholder and profitable for the bank. For the first time, MULTOS technology enables a number of different products or services to be held securely and independently on a single smart card. MULTOS is compatible with all of the existing international standards, permitting products from different industries to co-exist on the same card; for example, a GSM mobile phone with EMV credit/debit products and a retailer loyalty scheme.

MULTOS's unique high-security architecture allows consumers to download new products or services onto the smart card via telephone, ATM or Internet. The same feature allows card issuers to update, add or change applications while the card is still in the hands of the customer. This allows application and security upgrades to be introduced without reissuing cards and enables cardholders to "customize" their card with the applications of their choice.

Another first for MULTOS is that applications on the card are kept totally separate by highly secure "firewalls" guaranteeing the security and integrity of each individual application and the overall card.

MULTOS provides developers with an application programming language called MEL (MULTOS Executable Language) and an Application Programming Interface—or API—allowing developers to develop high-security, high-integrity applications. Alternatively, applications can be developed in the "C" programming language—operating to the same API. Once written, MULTOS applications will be compatible with any MULTOS card enabling card issuers to source application programs, cards and the underlying silicon (hardware) from the widest possible range of suppliers—something which, until now, has restricted the widespread use of smart cards. (Reprinted with permission from *Semiconductor International Magazine*, July 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

APCN: a new milestone for the Asia-Pacific region

The Singapore leg of the Asia Pacific Cable Network, the largest single optical-fibre submarine cable network in the region, was inaugurated on 7 March 1997. This is but one of the many achievements of this fast-growing region where the expansion of international investment and the presence of many multinationals are expected to lead to access to telecommunications for all.

The cost of the whole APCN project (US$ 640 million) was shared between 51 telecommunication entities of which Singapore Telecom made a contribution of US$ 60 million.

The 12,000-km long APCN links the Republic of Korea, Japan, Hong Kong, Taiwan, the Philippines, Thailand, Malaysia, Singapore and Indonesia. Its direct optical link between Australia and the rest of Asia will enable high-speed leased circuits between Australia and Singapore to take a much shorter and more direct route.

Planning for APCN started in 1994 and the network constructed by Alcatel Submarine Network, AT&T Submarine Systems Inc. and KDD Submarine Cable Systems Inc. became operational in January 1997.

In the early 1990s, when Singapore Telecom and its partners first mooted the idea of an additional submarine cable to the existing APC system, the Asia-Pacific region was already one of the fastest growing in the world and observers had proclaimed the next century to be the Pacific century. The need for good communication systems is therefore imperative as the corporate users in the industrial and commercial sectors are an important group of telecommunication customers.

The completion of APCN is therefore timely as it will increase the telecommunication capacity in the region by an additional 800,000 simultaneous telephone channels which should meet the needs of the region until the Year 2000.

APCN with its large bandwidth and high-quality transmission will also provide the high-speed backbone for Internet access and other multimedia services such as dial-up video and interactive television. However, as the region continues to grow and prosper, investments in telecommunication infrastructure such as submarine cable systems will become increasingly important. Singapore Telecom plans to invest a further US$ 50 million in such infrastructure to help economies of the Asia-Pacific region grow and prosper. (Source: *ITU News*, May 1997)

The role of intermediaries in electronic publishing

There are now an estimated sixteen million hosts on the Web, compared with just over a million in 1993. The huge growth in the volume of information available has been accompanied by the development of services intended to make access easier and more focused.

These intermediaries come in various guises. First, there are the search engines, such as *Alta Vista*, which offers access to thirty-one million pages on 476,000 servers and four million items from 14,000 Usenet news groups. Attempting to be more specific in the items they retrieve are intelligent agents and personalized information services. Another approach is represented by information "communities" providing a specialized forum for those with particular interests, such as Healthworks Online, aimed at the UK medical profession.

Scholarly and professional publishing, of course, is concerned with value added information. Value is added by means of evaluation, selection, editing, structuring and organization. In addition, publishers guarantee the authenticity, originality and integrity of their materials, confer protection on its content, and publicize its availability. Many publishers are now offering electronic versions of their printed titles: it has been estimated that there are currently about 3,000 peer reviewed electronic journals.

Various problems, however, remain to be solved before electronic journals can become more widely accepted. These include the variety of interfaces which must be mastered by the user, and the multiple, different Ids and passwords which must be employed. Uniform interfaces and the aggregation of electronic titles from a range of publishers are both highly desirable.

Publisher collaboration—via such projects as Elsevier's *ScienceDirect, Urania (Universal Research Archive of Networked Information in Astronomy) and BioMedNet*—offers one means of achieving this goal. Another route is provided by secondary publishers and information providers. Ovid Technologies, Silver Platter and UMI have for a number of years marketed (CD-ROM-based collections of indexes, abstracts and full-text articles. A further approach is demonstrated by aggregated journals services operated by universities, such as Stanford University's *HighWire Press* and BIDS (Bath Information and Data Services). Yet another development has been the creation of services offered by library cooperatives, such as PICA's experimental *WebDOC* service or OCLC's *FirstSearch Electronic Collections Online*. Finally, subscription agents have also launched their own journal services, aiming to provide "one stop shopping". Examples include Blackwell's *Electronic Journal Navigator*, Dawson's *Information Quest* and *SwetsNet* from Swets.

Although subscriptions remain the more common method of payment, other models are emerging, including transactional charging and consortium-based licences. Subscription agents are expected to play an important role in the administration of such consortium-based licensing schemes. One of the recommendations of a joint JISC/Publishers Association working party was that a central agency be established to act on behalf of publishers, granting licences for the digitization of copyright material. The candidates for such a role would logically include existing copyright clearance agencies and subscription agents. (Source: *Learned Publishing*, 10 (4) October 1997)

Millennium compliance

Although most firms are aware of the Year 2000 problem, few appear to have made progress in dealing with it. According to one source, 80 per cent of UK firms have yet to complete the first phase—the inventory—in their programmes designed to ensure millennium compliance. It may now be too late to implement a comprehensive solution, but at least the critical areas could and should be addressed.

The inventory is essential if the scope and likely cost of the conversion project is to be determined with any degree of accuracy. The next stage is to establish an order of priorities, starting by identifying the areas which are business-critical and customer-related. Significant resources will have to be allocated to the project, perhaps a large part of the IT budget. Certainly, the best project manager available—not necessarily one from the IT department—will have to be made responsible for it.

The conversion will prove both labour- and time-consuming. Software tools, however, may go some way towards relieving the burden on programmers. Most of these provide ways of maintaining software in the longer term as well as dealing with the immediate problem.

It is necessary to ensure that trading partners—companies in the supply chain—are also addressing the problem. Above all else, companies must start now. Apart from other considerations, programmers will be much in demand during 1999, and demand may outstrip supply. (Source: *Information Week*, 17-30 September 1997)

Beyond the Year 2000

Millions of computers are incapable of handling a simple date change from 1999 to the Year 2000. In many pieces of software the year in the date field has been identified as only the last two digits. In the Year 2000 some computers will assume we have started the 20th century all

over again, while others will just stop. This could have disastrous consequences with widespread computer failures from desktop PCs to air traffic control systems which could put many of the world's businesses and even human lives in danger. The problem may also hit embedded systems in other technological tools in the workplace, on the streets and in the home.

A fifth of the 1997 IT budget will be swallowed by Year 2000 costs according to some US reports. Over the following two years the proportion is predicted to rise to 30 per cent of total IT spending. The problem will still be consuming about 20 per cent of technology spending by the first year of the new millennium. The money for Year 2000 fixes will be pulled from profits as well as corporate funds. Tactical developments in new technologies are likely to be the first to be hit, with companies slowing down redeployment projects such as wiring staff to the Internet with Web browsers at their desks.

There may be a silver lining for some companies in the midst of meltdown. Many companies that have just got round to fixing the Year 2000 problem are also using the opportunity to achieve business process re-engineering which failed to materialize in the 1980s. (Source: *Information Strategy*, October 1997)

Problems associated with the millennium

Considerable publicity has been afforded to the "Year 2000 problem". Actually, there are three problems associated with the Year 2000, not one, although one is illusory.

It has been pointed out that the Windows 95 calendar includes a 29 February 2000, in apparent defiance of the rule that years ending in 00 are not treated as leap years. In fact, years which can be divided by 400 (such as 1600 and 2000) are leap years.

The second problem is that 2001 is actually the first year of the new millennium, not 2000. Perhaps this is an opportunity for business, rather than a problem, since it means it will be possible to sell two lots of souvenirs. (Source: *Personal Computer World*, September 1997)

Informetric analyses on the World Wide Web

Quantitative ("informetric") measures normally applied to citation databases can equally be used to evaluate network-based material. The Web may be regarded as a citation network in which traditional information entities and associated citations are replaced by Web pages and hyperlinks respectively. The term "webometrics" has been coined to describe analyses of such sources.

To illustrate how these may be undertaken, a study was made of how the Danish proportion of the Web compared with that mounted in other Nordic countries. The methodological approach was comparable with that employed in standard bibliometric analyses of the ISI citation databases. Various problems, however, were encountered as regards data collection. One such area of difficulty arose out of the fact that some Web pages—those not cited and not containing citations—could not be found using the standard search tools. It also proved difficult to identify all the references to one specific page or group of pages.

It was found that Denmark compared poorly with Sweden and Norway as regards its presence on the Net, certainly less well than it did in on-line scientific databases. The average Web page contained nine hyperlinks—fewer than the number of citations in traditional academic texts— and 40 per cent had none at all.

More generally, citation analysis was not attempted due to the difficulty in locating a collection of Web pages linked sufficiently tightly to admit such procedures. Informetric methods, however, can be used for a range of other tasks, including issue management, research evaluation and the gathering of business intelligence. (Source: *Journal of Documentation*, 53 (4) September 1997.

Esprit and I300I launch 300 mm joint projects

The European Union's Semiconductor Equipment Assessment (SEA) initiative—a project funded by the Esprit Programme—has teamed up with the International 300 mm Initiative (I300I), based in Austin, Texas, to carry out a series of joint projects to demonstrate 300 mm equipment from European suppliers. Three such projects have been launched, covering equipment for cleaning, handling and metrology. The equipment will be installed at I300I's process support and metrology centre in Austin, where it will be characterized and used in demonstrations for other equipment.

The cleaning equipment is an open cassette centrifugal force cleaner being supplied by DMS, the handling equipment is a 300 mm front opening pod and cassette sorter supplied by RECIF and the metrology equipment is a fully automated ellipsometer developed by PLASMOS.

SEA, based at the Rutherford Appleton Laboratory in the UK, was launched by the Esprit Programme in early 1996 with the objective of ensuring that new, state-of-the-art, manufacturing equipment meets all the requirements and standards of mainstream users. I300I and SEA agreed in 1996 to use equipment performance metrics and demonstration methods defined by the members of I300I for 300 mm equipment evaluations. (Reprinted with permission from *Semiconductor International Magazine*, September 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Internet2

"Internet2" is a collaborative effort among research universities, the National Science Foundation and several technology companies to get around the traffic jams and speed limits on today's commercial Internet by creating an ultra-fast, members-only network.

In service experimentally at 12 universities, it allows users to send and receive data as much as 100 times more quickly than on the normal Internet. In many ways, the project represents a sneak preview of the Internet's future. Just as today's Internet started in the 1960s and 1970s for university researchers, the technologies that make Internet2 work could migrate into the broader, commercial Internet over the next year or two.

The most significant development, researchers say, will be the ability to send very large files over the Internet at near real-time speeds. For businesses, that could mean having high-quality video conference calls or transmitting voluminous data files. For ordinary people at home, it could make possible the transmission of clear television images and CD-quality sound.

Started in 1996 with 34 member universities, the project has blossomed to include 112 educational institutions that collectively have invested more than $50 million in the network. (Extracted from *International Herald Tribune*, 10 October 1997)

Computer telephony

MediaPath, the result of a three-year development programme undertaken by Mitel and Digital, links PC

networks with touch-tone telephone resources. It seamlessly integrates e-mail, voice-mail and fax, as well as providing remote access to voice and data services, text to speech and other capabilities.

Essentially, the product represents a combination of Digital's AlphaServer and messaging system with Mitel's *MediaPath* platform, running under *Windows NT*. The AlphaServer has 128 Mb of RAM and a minimum of 2 Gb of hard disc space. This can grow from a 30-channel EuroISDN facility with twelve phones to a 60-channel EuroISDN system with ninety-six.

The utilities and health care industries, in particular, manage client information by consulting on-screen caller details and employing dial from screen facilities. This package is intended to offer the same capabilities to smaller businesses or workgroups.

Applications for *MediaPath* include telemarking, order entry, running a service centre, finance and sales. (Source: *Business Equipment Digest*, September 1997)

Internet telephony

In recent years, there has been considerable interest in the concept of Internet telephony, or Voice over IP (VoIP). This is achieved by encoding voice messages as bits and transmitting them over the Internet using TCP/IP and UDP. The cost of such calls is lower than that of the conventional type, although the sound quality is inferior and connections are less reliable.

Companies such as Vienna Systems, Brooktrout Technology and IDT offer complete VoIP packages for corporate use. Vienna Systems' product, Vienna.way, includes a server, PC client software and a serial "phone adapter", which is installed between the user's handset, their PC and the PBX. The limitation is that a similar arrangement must exist at the other end. IDT's service, Net2Phone, allows calls to be made from a PC to a POTS (plain old telephone system), but users can only make calls by this method, not receive them. Brooktrout's Boston system allows systems developers to build applications based on Brooktrout hardware, such as the TR114 Series Universal Port fax and voice processing board.

VoIP could also be exploited by subscribing to one of the new Internet Telephony Service Providers (ITSPs), such as Global Link or Delta Three. Longer-established carriers are also entering the market. Deutsche Telecom's T-NetCall is a 1,000-user pilot project. Such services require no special equipment: the customer uses the existing, conventional handset to dial an access point or gateway.

At the individual private user level, packages such as *DigiPhone* and *VocalTec* are readily available for use on a multimedia PC with an Internet connection (Source: *Communications International*, September 1997)

Information gap

For every person who logs onto the Internet in developing countries, there are 149 people logging on in the industrialized world. About 50 million people are using the Internet worldwide; the number of subscribers doubles each year.

In Australia, about one in five people owns a personal computer; in India and Suriname, only one in 1,000. The Swiss average four hours of international phone calls each year, compared with averages of 90 seconds for the Russians, 60 seconds for the Chinese and 12 seconds for Ethiopians.

There is an average of one fax machine for every 30 people in industrialized countries. In developing countries, one fax machine serves an average of more than 1,000 people.

About 1.2 billion television set beam information into homes and businesses worldwide. In the United States there are four television sets for every five people, compared to one for every 50 people in least-developed countries. The United States exports 120,000 hours of TV programming to Europe alone a year.

Iceland publishes 537 new books for every 100,000 people each year, the most per capita in the world. (Information is drawn from the *Human Development Report 1997*, commissioned by the United Nations Development Programme. The report is published in English by Oxford University Press (paperback ISBN 9-511997-5; hardback 0-19-511996-7), and in eight other language editions by a variety of publishers.)

C. New Developments

IBM enhances wireless networks

Computer users in small offices and homes will benefit from wireless network developments at IBM Corporation's Thomas J. Watson Research Center, Yorktown Heights, New York. Company scientists are developing low-cost, high-speed wireless technology that transmits virtually error-free data at speeds up to 10 megabits per second—thus exceeding the 2 Mbps limit of conventional wireless LANs. In addition, for the first time anywhere, speeds of up to 38 Mbps have been achieved for data transmissions under laboratory conditions, IBM claims. Keys to the performance and affordability of the new radio frequency (RF) technology are advanced algorithms and coding based on digital signal-processing techniques that solve the multi-path transmission problems that afflict indoor wireless LANs, the company adds. Its algorithms and codes are said to be "strong" enough to effectively eliminate the effect of multipath at data rates up to 10 Mbps and substantially reduce the problem on a diminishing scale up to 38 Mbps. (Source: *Industry Week*, 23 June 1997)

High-throughput X-ray inspection

New equipment from Hewlett-Packard Co. (HP) repositions X-ray inspection of printed-circuit-board assemblies (PCBAs) as a high-output on-line procedure. The company says the 5DX Series II can inspect densely populated, double-sided PCBAs for solder-joint defects at a rate as high as one board every 60 to 90 seconds. For manufacturers of complex consumer electronics such as laptop computers, an improved PCBA manufacturing process means faster time to market with better-quality, more reliable products. HP will offer three models with systems starting at $349,000. (Source: *Industry Week*, 23 June 1997)

Conductive concrete

Canadian scientists have developed a new recipe for concrete that could enhance the safety of bridges, airport runways, and other surfaces that need to be kept free of snow and ice.

Since the 1920s, scientists have been trying to make concrete that conducts electricity so as to be able to heat concrete surfaces by running current through them. Past attempts have included laminating carbon-fibre paper impregnated with cement, which created a conductive but structurally weak material; and coating concrete with conductive materials, which resulted in a strong but not very conductive material. So at present, the only way to heat concrete is with buried electrical cables or tubes carrying heated antifreeze, which are costly to install and maintain.

Now, materials scientists at the National Research Council's Institute for Research in Construction in Ottawa have mixed various sizes of conductive materials—like carbon fibres, graphite, and coke breeze, a steel-industry waste that looks like black sand—into cement paste. These create a continuous network for electricity to penetrate, allowing for conductance while maintaining concrete's strength. An outdoor test slab 6 by 24 metres stayed ice-and snow-free during Ottawa's severe winter. Production costs are modest, and heating costs are "encouragingly cheap".

The team has so far received about 300 queries, mostly from people who want to use the stuff to heat basement floors and walls. At least one airport, the Metropolitan Airport in Detroit is interested in installing a test section of runway made of conductive concrete. Allan Tomlinson of Superior Graphite Co. in Chicago, whose company would do the engineering, says heated runways would not only be safer, but cheaper to operate because costs from delays and snow removal would be eliminated. (Source: *Science*, Vol. 276, 23 May 1997)

Californians develop methanol fuel cell

Researchers from the California Institute of Technology's Jet Propulsion Laboratory (JPL), Pasadena, and the University of Southern California (USC), Los Angeles, have developed what they call a direct methanol, liquid-feed fuel cell, which converts a methanol-water mixture directly into electricity with no preliminary chemical reforming. The unit runs at a fairly low temperature—below the boiling point of water—and creates no toxic by-products, turning all the methanol into carbon dioxide and water.

According to the team, the cell converts over 34 per cent of the theoretical energy content of the fuel into electricity. Better yet, they believe improvements now on the drawing board will push efficiency to better than 45 per cent.

At the core of the new cell is a polymer membrane coated with a platinum-ruthenium catalyst developed by JPL. The membrane divides the cell in half, with an aqueous methanol solution on one side and gas—either oxygen or air—on the other. On the liquid, or anode, side of the cell, a series of reactions initiated at the catalyst takes a molecule of methanol—CH_3OH—and a molecule of water, and sorts them into a molecule of carbon dioxide, six electrons, and six hydrogen ions—or protons. The protons then migrate across the membrane to the gas, or cathode, side. There they combine with oxygen ions to produce water.

The reaction occurs when the electrons given up on the anode side, having flowed through an external circuit to the cathode side, combine with oxygen on the cathode's

catalytic surface. The electron flow through the external circuit, of course, constitutes the cell's electrical output.

According to Gerald Halpert, the fuel-cell project manager at JPL, the significance of the new technology is not just its ability to react methanol directly, but also the engineering implications of that capability. "The payoff", he said, "comes at the system level", when a stack of cells is combined with all the peripheral components (valves, pumps, tanks, and so on) needed for a practical source of electricity. Because it keeps its proton exchange membranes in constant contact with an aqueous solution, the cell requires no special measures to keep the membranes humidified. Also, because the liquid is always flowing, thermal management is greatly simplified, and no cooling fins are required, which helps minimize the overall size of the system.

Thus far, a 50-W system, built from stacks similar to some that have run for more than 200 hours continuously and more than 3,000 hours intermittently without loss of performance, have been demonstrated by Halpert's team. The next goal of the JPL/USC team will be a 150-W system. If successful, it hopes to build multi-kilowatt systems large enough to power electric vehicles.

A flaw in the device as it stands is that its membrane is made of Dupont Nafion, a perfluorinated polymer, that lets not just protons through to the cathode side, but also some methanol, to the detriment of cell output and efficiency, but that problem is being addressed by a high-powered team of researchers, including G. K. Surya Prakash of the USC's Loker Hydrocarbon Institute, under the supervision of George Olah, director of the Institute and winner of the 1994 Nobel Prize in Chemistry.

Besides improving the membrane's performance (halving methanol crossover to less than 10 per cent) the research team hopes to slash its very high cost—by one or more orders of magnitude. (Source: *IEEE Spectrum*, June 1997)

A one-lattice-fits-all substrate on the way

Scientists at Cornell University, in Ithaca, NY, have developed a method of producing a "universal substrate" on which any semiconductor can be grown without such defects as threading dislocations. The approach is a major breakthrough for such applications as lasers, detectors, sensors, integrated circuits, and data storage, because it allows devices made from widely different materials to be integrated onto the same substrate. The work at Cornell was done in conjunction with scientists from Sandia National Laboratory, Albuquerque, NM, and Wright Laboratories, Wright Patterson Air Force Base, Ohio.

Up until now, single crystals of a material had to be grown on a substrate of the same material or one with the same lattice constants—the numbers that specify the lattice spacings. Otherwise, a lattice mismatch of even 1 per cent might induce defects that could destroy the operation of any device built on the substrate.

What Professor Yu-Hwa Lo and his colleagues found worked was to bond an ultrathin layer of gallium arsenide to a substrate of the same material but with the crystal lattices of the two layers misaligned by more than 10 degrees. The result was a compliant, flexible substrate on which a crystal of any material could be grown. They demonstrated the technique by growing thick high-quality crystals of indium gallium phosphide and indium antimonide (InSb) on the GaAs substrate, whose lattice mismatch with either can go as high as 15 per cent.

The researchers employed wafer-bonding techniques to produce the substrates. "Basically we bond together two wafers of GaAs at an angle to one another. Then we grind away all but a few atomic layers of one of the wafers", explained Lo. To be effective, the layer must be between 1 and 10 nm thick.

Theoretical studies convinced Lo that the ideal compliant substrate would have to be ultrathin—and free standing—a dream structure that was not practical at all, he observed. It was another three or four years before he and his co-workers could devise a way to create a practical substrate with dream-like properties. In the end they settled on the "twist-bonding" technique in which the atomic registration at the interface is completely scrambled. Although the two materials are joined together to form one entity, the top layer is somewhat detached. The hope was that this would give it flexibility.

The tryouts so far have been with GaAs, but the scientists are now in the process of repeating their triumph with silicon.

For applications that use the GaAs substrates—sensors and infrared detectors made from compound semiconductors, for example—the technology is available now for product development.

For the universal silicon substrate, much more needs to be done. (Source: *IEEE Spectrum*, June 1997)

Classy glass twists light

A new type of glass that can bend light in two ways is simplifying the design of optical equipment and improving the performance of optical systems. In conventional optical materials, the refractive index is constant throughout, and incoming light is bent in the desired direction by the shape of the lens surface. But in Gradium glass, developed and manufactured by LightPath Technologies Inc., Albuquerque, NM, the index of refraction varies along the optical axis as well as at the surface.

Gradium glass is therefore better able to correct for aberrations that plague conventional lenses. Usually, either extra lenses are added to reduce the spot size or lenses having a curved but non-spherical surface are used. Moulding or grinding these surfaces into the desired shape is difficult and expensive, however. But spherical lenses made of Gradium virtually do away with spherical aberrations, and can often reduce spot sizes by a factor of 10 or 20.

To produce Gradium, glass layers of different material compositions are placed in a mould and heated in a furnace at predetermined temperatures. When cooled, the mix forms a single "boule" of glass with a smooth variation of refractive index across its thickness. Lens blanks drilled from the boule can then be ground and polished by means of standard tools.

An essential aspect of producing Gradium is determining the right values and variations of the refractive index. To this end, LightPath researchers developed computer models to design and test the gradient profiles. The modelling software and the manufacturing processes that give predictable and repeatable results stem from more than a decade of development.

As Gradium itself bends light, it is ideal for optical communication systems. In certain cases, lenses can be built with flat surfaces, eliminating losses from the air spaces that are inevitable with spherical lenses. With plane surfaces, the assembly, alignment, and ruggedness of the system also improve. Collimation, wavelength-division multiplexing, and switching are being actively developed using the plane-

surfaced devices. LightPath is collaborating with various universities, companies and government labs to develop Gradium lenses for optoelectronic applications. LightPath chairman and chief executive officer Leslie Danziger expects that products will be commercially available during 1998.

Gradium lenses available today are made from lead-based (or flint) glasses, which are useful for working with monochromatic light or in optoelectronic systems where each wavelength is treated separately. But for purposes of focusing light of many wavelengths onto the same spot, so-called crown glasses, which are barium- or lanthanum-based, are needed in addition to the flints. Accordingly, LightPath is developing crown glasses for polychromatic systems but Danziger does not expect them to be commercially available before 1998. (Source: *IEEE Spectrum*, June 1997)

An added dimension in display technology

While we see in 3-D, most pictures exist only in 2-D. Even clever attempts to make convincing three-dimensional representations of objects, all strain to create the illusion of three dimensions on a two-dimensional surface.

Now Elizabeth Downing, a former Stanford University graduate engineering student turned entrepreneur, has taken a completely different approach by building a true 3-D display. Though small and rudimentary, her proof-of-principle invention—a sugar-cube-sized block of special glass—can come alive with dancing colours that exhibit height, width, and, most importantly, depth.

The new technology "doesn't create an image that appears to be three-dimensional", Downing says, "it actually produces an image that is drawn in three dimensions". As a result, it places few restrictions on the viewing angle or the number of people who can observe the images at the same time. Moreover, the images are emissive—they glow rather than reflect—so viewers can easily see them under ordinary room light without special glasses or headgear.

The display's unique characteristics seem to make it a natural for potential use in, for example, medical diagnostic-imaging systems, arcade games, computer-aided-design tools, and air-traffic-control monitors. The display could also be employed as a scientific-visualization aid for analysing weather patterns, air flows around an aircraft, and other complex multidimensional sets of data.

The patented device, now being commercialized by Downing's new company, 3D Technology Laboratories of Mountain View, CA, uses a pair of infrared lasers to selectively excite fluorescent metallic particles suspended in a clear glass cube, measuring 1.5 centimetres on a side. When these special rare-earth metal additives (also called dopants) are mixed into the molten glass during manufacturing, they "distribute themselves evenly throughout the glass like chocolate chips in a cookie", Downing says. When a spot inside the solidified glass is illuminated with invisible infrared light, the tiny impurities glow brightly. (Extracted from *Technology Review*, May/June 1997)

Shrinking sensor technology

Scientists at IBM's Research Laboratory in Zurich, Switzerland have devised an elegant method for immobilizing several ligands onto a surface simultaneously, with potential use in a wide variety of miniaturized applications, ranging from biosensors and immunoassays to combinatorial screening assays. The method, described by Hans Biebuyck and colleagues, uses a premoulded poly-dimethylsiloxane (PDS) mask imprinted with a network of channels. The PDS mask is first placed onto the "sensor"

surface (gold, glass, polystyrene, or silicon) to create a network of microchannels (3 mm long by 3 μm wide) into which nanolitre quantities of reagent are drawn by capillary action. Once proteins in the reagent have bound to the chemically activated surface, the PDS mask is removed, and the resulting exposed areas are blocked to prevent non-specific protein binding. Using ellipsometry and scanning electron microscopy, the scientists demonstrated that IgGs taken into the channels cross-link homogeneously to the sensor surface. Fluorescence microscopy studies also revealed that attached IgGs remain structurally intact and that different IgGs can be added to respective channels simultaneously. The format was amenable to enzyme-linked immunosorbent assay (ELISA)-type tests and, according to the scientists, is "simple, inexpensive and economic of reagents ... [and] applicable to miniaturization of many assay formats in current use". (Source: *Nature Biotechnology*, vol. 15, June 1997)

Intel supercomputer achieves 1.34 Tflops

Intel's parallel supercomputer has achieved record levels of processing performance. The machine, destined for delivery to its owner, Sandia National Laboratories in New Mexico, achieved 1.34Tflops. This exceeds the previous record by a quarter.

The supercomputer, a joint development of the Department of Energy, Sandia and Intel, will be used to ensure the safety, reliability and effectiveness of the US nuclear stockpile through simulation rather than nuclear testing.

The supercomputer comprises an 86 cabinet machine which houses 9,200 200 MHz Pentium Pro processors, 573 Gbyte of system memory and 2.25 Tbytes of disk storage.

Its peak power consumption is 850 kW, it weighs about 44 tons and occupies 160 m² of floor space. Three hundred tons of air conditioning plant is needed to maintain its environment. (Source: *Electronics Weekly*, 18 June 1997)

Polymer diode can switch on any colour

Computer screens, television monitors, fluorescent lighting and even traffic lights made out of low-cost LEDs could be just around the corner following announcement of the first plastic device able to emit light of multiple colours. Unlike conventional LEDs, the new devices—made out of polyphenylenevinylene and polyquinoline—emit colours ranging from red to yellow to green and even blue, depending on the voltage applied to them.

Normal LEDs, made of materials such as gallium nitride or gallium arsenide, are limited to single colours, making them impracticable for the biggest application of all in flat-panel computer and television screens.

Samson Jenekhe, a professor of chemical engineering, chemistry, and materials science at Rochester, has developed multi-colour polymers that raise the prospect of replacing today's bulky screens with much thinner and more efficient arrays of LEDs, and which are said to outshine the performance of traditional materials in several ways. Most importantly, just one layer of the devices can create full-colour images and, unlike normal LEDs, Jenekhe's devices can produce efficient greens and blues.

Other advantages include the fact that the plastic LED requires just three volts for start-up and is at least as bright as a current television screen. Since these plastics can be made at room temperature, the LEDs should also be far cheaper to produce than conventional LEDs, which must be made at high temperatures.

Key to the work has been the team's efficiency in bringing together the electrons and electron holes that combine to produce the light. Jenekhe's group has been able to construct layers of polymers tens of nanometres thick and position them so that they supply a steady stream of electrons and holes.

Researchers have tried to make such LEDs before—and some have even succeeded in producing a device capable of emitting light. But this has only been of a single colour. The new LEDs emit the full range of colours, depending on the voltage applied to them. By combining the light from several plastic LEDs, Jenekhe has even produced white light that could form the basis for LED-based fluorescent lighting.

Another attractive application being targeted by researchers is in traffic lights. A large, lightweight polymer LED could replace the heavy, inefficient 120 V white bulbs that glow behind the coloured glass covers of traffic lights everywhere. Because the LEDs consume so little electricity, this could result in substantial power savings. (Source: *Electronics World*, July 1997)

Forces that could blow nanochips apart

As the tiny electric wires in computer chips grow ever smaller and the current they carry proportionately greater, the wires' atomic structure becomes increasingly prone to breakdown, causing gaps that could disable a chip or even an entire computer.

Now a team of materials scientists from Columbia University and IBM has measured the forces created as electric currents dislodge atoms from microwires—and found them to be massive.

The phenomenon, called electromigration, is not expected to cause failure in existing computers, but will undoubtedly present a mounting problem to chip designers and manufacturers, say the researchers.

To measure changes in the atomic structure of a wire as current flows through it, the researchers focused a fine beam of X-rays. They showed that one end of the wire, to about 15 per cent of its length, was stripped of metal, and that a build-up of atoms at the other end caused large stresses—of as much as 340 Mpa—that eventually damaged the wire and its insulation.

The electrons travel along the wire as current and also dislodge atoms of metal from their positions in the wire, carrying them along and depositing them further downstream. Rearranging atoms in this fashion can create gaps where atoms are removed and can also create local pressures where atoms pile up, squeezing metal out of the wire much like toothpaste from a leaking tube.

At the moment, moving a few thousand atoms will not affect wires millions of atoms in diameter. But in microelectronics, many wires are now less than 1μm in diameter, and moving thousands of atoms around can have far more dramatic effects.

Computer failures because of electromigration actually occurred in the 1960s, before hardware engineers were fully aware of the problem. They solved it by using new combinations of metals, by limiting current and the wires' length, and by encapsulating circuits in rigid insulating materials.

But during the last 30 years, the size of microelectronic circuits has decreased by almost 40 times, while current in those circuits has decreased less rapidly, from the range of 10 to 50 mA to about a tenth of that level now. As a result, current density has increased by a factor of ten.

Once microwires shrink to 0.25 μm in diameter and smaller, chip designers will have to discover ways to limit current sent through such wires, or find other ways to counter electromigration. (Source: *Electronics World*, July 1997)

Room temperature quantum material is bathed in gold

Gold-cluster molecules, possessing a set of extraordinary quantum properties, could form the building blocks for testing ultra-miniaturized architectures envisioned by some for 21st-century nanoelectronics, according to researchers at Georgia Tech in Atlanta. Their main fascination is that their conduction electrons are quantized both in their number and in the states they can occupy. Normally, such effects can only be observed and used at very low temperatures—such as that of liquid helium, near absolute zero. But the Georgia Tech team reports that the new series of nanocrystals are both sufficiently small that these effects are prominent even at ordinary temperatures, and yet are large enough to have the robust crystalline properties of the bulk metal.

In structure, each molecule in the new series has a compact, crystalline gold core—just 1-2 nm across—encapsulated within a shell of tightly packed hydrocarbon chains linked to the core via sulphur atoms.

"The surrounding chains can be of any length, and can be modified to confer particular chemical properties, so that they can be incorporated into various solid-state and solution structures", says professor Robert Whetten, head of Physics and Chemistry at Georgia Tech. "Most importantly, each member of the series behaves as a substance composed of infinitely replicated molecules, which can be separated from other members of the series to yield pure substances with precisely defined properties".

The gold cluster molecules emerge spontaneously during the decomposition of certain gold-thiolate polymers of the type commonly used in decorative gold paints and in gold anti-arthritis drugs. With sufficient control of the decomposition process, this series can be isolated without concurrent production of larger gold crystals. It is then relatively easy to separate the principal members of the series from each other to obtain the necessary homogeneity. Once purified, the molecules spontaneously assemble into crystalline thin films, powders, or macrocrystals, while preserving the discrete properties of the individual gold nanocrystal cores.

Gold is important technically not only for its inertness—once made, the clusters are immune to corrosion—but also for its highly stable surfaces that find application as junctions in critical microelectronic applications. The electromagnetic and conduction properties of the clusters are extremely sensitive to charging, and somewhat less so to energy level. According to Whetten, this could allow them to be used in proposed electronic circuitry known as "single-electronics".

The new gold cluster materials are the first to exhibit charge-quantization in a macroscopically obtained material, for which every cluster behaves identically. First measurements were conducted at Georgia Tech by observing the step-like changes in the current passing from a scanning tunnelling microscope tip to a gold plate through a single gold cluster molecule as the voltage was increased.

The highly regular spacing between these steps, known as the "Coulomb staircase", showed that the molecules' gold core is charging like a small metal sphere in a series of discrete steps by adding or removing single electrons.

Whetten and collaborators at the University of North Carolina-Chapel Hill have reported developing an electrode

based on the most massive of the new series and have started investigating electrochemistry.

Quantization of the energy levels of the conduction electrons has also been observed separately in optical spectroscopy experiments that reveal the discrete level structure—even at room temperature.

For more information contact: Robert Whetten, 223 Centennial Research Building, Georgia Institute of Technology, Atlanta, Georgia 30332-0828, USA. E-mail: robert.whetten@physics.gatech.edu (Source: *Electronics World*, July 1997)

Sitting on fuel cell technology

Fuel cell technology, able to generate energy from hydrogen and oxygen, offers several advantages as the drive system of the future in terms of cleaner vehicles and reduced reliance on fossil fuels.

Unfortunately, up to now, systems have been bulky and only useable in substantially modified vehicles. But Daimler-Benz has announced that its latest experimental vehicle manages to pack all the extra hardware required under the seat of a standard model.

Necar I, Daimler-Benz first experimental vehicle, demonstrated back in 1994 that fuel cell technology is a viable proposition, but it was hardly practical then, as the system had such high space requirements that it was more closely related to a mobile laboratory than a vehicle.

However, in Necar II, the scientists have reduced the size of the fuel system to such an extent that it can now be easily accommodated under the rear seat bench of a Mercedes V-class vehicle.

The compaction has been achieved largely by means of a drastic reduction in the thickness, through optimization of their surface characteristics, of the bipolar plates that ensure an even distribution of the reactant gases to the electrodes. This has allowed the individual cells in Necar II to be grouped much more densely into stacks.

Furthermore, a new stack compression strategy has reduced the number of tie rods needed, making for considerable space savings. In Necar I the electrical and liquid supply connections were located separately. But in Necar II, the researchers have been able to unite them on the end plates thanks to a special compression technique and the use of new materials.

The moisturizing units formerly required on each fuel cell stack have also been replaced by a single compact unit, separately located within the cell system.

All these individual measures combine to reduce the size of the system to such an extent that the laboratory on wheels of Necar I has now been transformed into the spacious passenger car Necar II, in which all six seats are available for passengers.

At present, the gaseous hydrogen required for energy production is still stored in tanks under the roof. Daimler-Benz research work is now concentrating on development of a system capable of deriving hydrogen from liquid methanol. This could make it possible to refuel a fuel-cell car by using simple filling procedures not that different to those found in a petrol station of today. (Source: *Electronics World*, July 1997)

Observation of electric fields of ferroelectric substances by electron beam holography

Fujitsu Ltd. has established a new technology to evaluate the characteristics of ferroelectric thin films for non-volatile ferroelectric memory devices such as FRAMs

by applying the electron holography technique using a transmission electron microscope.

The greatest influence on the characteristics of non-volatile ferroelectric memory devices is the ferroelectric thin film used for retaining the memory data. The most generic method to investigate the electrical characteristics of this ferroelectric thin film is to fabricate an evaluation specimen (flat parallel-type capacitor) in which the thin film is sandwiched between a pair of top and bottom metal electrodes, impress a voltage on the electrodes and measure the magnitude of the electric field generated inside the ferroelectric substance (degree of polarization).

However, this method uses an evaluation capacitor that is fabricated with a comparatively simple process different from that for the actual manufacture of the device, so the measurement results cannot be applied intact to the miniature capacitor of the device that has an area of a few square μm and thickness less than one μm. In addition, even if the ferroelectric characteristics of a device are investigated in the process of manufacture for utilization in process control, the conventional evaluation technique does not involve any electrode, so it will be impossible to investigate the ferroelectric characteristics. Further, a ferroelectric substance is much more unstable compared with a silicon oxide film, so depending on the manufacturing process or electrode material, the elements inside the film will be dissociated and, in extreme cases, the film will lose its ferroelectric properties. Due to these conditions, it had been quite difficult to investigate the ferroelectric characteristics of ferroelectric thin films.

To cope with these problems, it will be necessary to devise a means to evaluate the ferroelectric characteristics of capacitors of actual devices consisting of any type of electrode material and regardless of whether they have or do not have any electrode. A bright outlook to resolve these problems has been acquired through the establishment of the new evaluation technique based on the application of electron holography using a transmission electron beam microscope.

In the electron holograph, visualizing the phase change of electron waves affected by a local scalar and/or a vector potential makes it possible to directly image the distribution of the electro or magnetic field at high resolution.

Ferroelectric substances possess an electric field generated by the shifting of positions of atoms comprising the ferroelectric substance (spontaneous polarization) even when no voltage is impressed from the outside. The direction of this electric field differs with the specific position and creates a domain structure. At the same time, an electric field is formed outside the specimen, both of which undergo a phase change with electron transmission.

Fujitsu succeeded in visualizing the potential distribution across the ferroelectric capacitor by electron holography.

Further details from: Fujitsu Limited, Public Relations Dept., 1-6-1, Marunouchi, Chiyoda-ku, Tokyo 100; Tel.: +81-3-3213-4160; Fax: +81-3-3216-9365. (Source: *JETRO*, June 1997)

World's first rewritable optical head for DVD-RAMs

Matsushita Electric Industrial Co. Ltd., has developed the world's first rewritable optical head mechanism for use with DVD-RAMs. It features an 8.5 mm mechanism to facilitate the slim configuration of DVD-RAM units.

The company had formerly developed read-write technologies to allow compatibility with optical disks of varying substrate thickness: DVD-RAM, DVD-ROM, PD,

CD-R and other CDs. The new product was achieved through development of compressed lateral beam optical prism using a beam shaping prism.

Conventional PD and CD-R drives use a 780 nm wavelength infrared laser; DVD-RAM standards require the use of a 650 nm red laser. Matsushita enabled read-compatibility of the two systems with a single red laser and a lens-switching mechanism instead of two separate lasers, thus reducing overall size. CD-R disks can be read by adding an optional integrated unit for reading 780nm CD signals.

The new head realizes rewritable DVD-RAM drives with thin drive-height. It is capable of reading speeds of 2 times or more for DVD and 20 times for CD-ROMs.

Further details from: Matsushita Electric Industrial Co. Ltd., Tokyo International PR Group, 1-1-2, Shiba-Koen, Minato-ku, Tokyo 105, Tel.: +81-3-3578-1237; Fax: +81-3-3437-2776. (Source: *JETRO*, June 1997)

Compressed digital output CMOS image sensor with analog 2-D DCT processor and ADC/quantizer

Prof. Y. Tadokoro and Assoc. Prof. S. Kawahito of the Department of Information and Computer Sciences, Toyohashi University of Technology, and Matsushita Electric Industrial Co. Ltd., have jointly developed an LSI chip that performs all functions from image sensing to image compression with a single chip and which is ideal for use in digital video cameras.

This LSI chip enables direct image sensing without using a charge-coupled device (CCD). The power consumption is 30 mW, one thirtieth that of conventional counterparts, and is also usable as a convenient portable information-processing terminal for the transceiving of animated images.

The prototype image sensor LSI uses a complementary metal oxide film semiconductor (CMOS) technology that is in wide use in memory and logic devices as its image pickup device. The photosensitive unit consists of a PN junction photo diode and a MOS-type switching array, and has 128 x 128 horizontal and vertical pixels. The chip is 5.4 mm long and 4.3 mm wide, and the image-processing unit contains an image-compression circuit and an analog/digital converter. The system compresses analog signals and converts into digital signals for data output. Compared with conventional types of CCDs and digital compression methods, the power consumption has been reduced to one thirtieth, and the image deterioration that is normally generated through analog signal compression has been suppressed to a range compatible with compact portable terminals.

Integrating all components into a single chip enables the chip to be used conveniently in compact portable terminals. By additionally mounting a flash memory, the chip will be usable for fabricating a one-chip digital still camera. The chip is available at a price that is about one half that of its conventional counterparts. It is expected to be used in the manufacture of portable terminals capable of both transmission and receiving, monitoring cameras and for imaging with personal computers. The research team plans to commercialize the chip in 1998.

Further details from: Toyohashi University of Technology, 1-1, Hibarigaoka, Tenpaku-cho, Toyohashi City, Aichi Pref. 441, Tel.: +81-532-47-0111; Fax: +81-532-44-6757. (Source: *JETRO*, June 1997)

Tripping the light at fantastic speeds

In today's world of high-speed telecommunications, researchers are always on the lookout for faster ways to send information. The speediest schemes today encode data as pulses of laser light fired through glass optical fibres. But the comparatively slow electronic switches that pulse the light on and off limit the overall speed of these systems. Now researchers at the University of Utah in Salt Lake City and Osaka University in Japan have come up with a new polymer-based optical switch that has the potential to dramatically boost the data rate.

Beams of laser light trip and reset this speedy switch. One laser fills the polymer with evanescent charge pairs called excitons, which block an information-carrying infrared beam; a second laser can collapse the pairs and open the switch again in just a trillionth of a second. However, a series of technical hurdles—such as the polymer's tendency to break down when hit repeatedly with laser light—must be overcome before the new switches are ready for the market.

Because of the hair-trigger response of excitons, the new polymer switch has the potential to switch at 1 terahertz, or a trillion times a second.

The new switch relies on polymers that can conduct electricity and emit light, derivatives of a compound known as poly (p-phenylene vinylene), or PPV. Several research teams recently used these materials to make the first polymer-based laser, which absorbs laser light of one colour and remits it as a beam of a different colour. In their new work, Utah physicists Sergey Frolov and Valy Z. Vardeny and their colleagues exploit these light-handling talents to create their switch. Other high-speed exciton-based switches have been reported in the past, but they rely on different optical effects for their switching.

To make the conducting polymer opaque and turn the switch "off", the researchers hit it with a pulse of green laser light. The pulse excites electrons in the material to a higher energy state, leaving behind positively charged electron vacancies, or "holes". These newly created energetic electrons and holes stick close together to form excitons, which themselves absorb light at an infrared wavelength. The absorption essentially blocks the infrared data beam.

To turn the switch back "on" again, the researchers hit the polymer with a pulse from a red laser that is precisely tuned to stimulate the exciton's electrons and holes into recombining. That makes the polymer transparent again to the infrared data beam. In their initial demonstration, Vardeny and company only created 80 million pulses per second. Raising this to a trillion would of course also require the control lasers triggering the switches to be pulsing at the same speed. Conventional setups can accomplish that by splicing together separate, rapid-fire laser pulse trains, although such systems are difficult to set up.

For this and other reasons, even Vardeny admits that the scheme has a long way to go before it could become a real-world technology. (Source: *Science*, Vol. 276, 27 June 1997)

"World's smallest" serial EEPROM introduced

Microchip Technology (Chandler, AZ) has introduced a 16-byte, 128-bit serial EEPROM in a five-lead SOT-23 package. The 24C00, in the SOT-23 package, provides a 10 times reduction in board area requirements over a traditional 8-lead PDIP package and a 3 times reduction over an 8-lead SOIC 150 mil package.

The 24C00 is targeted for reduced board size and memory applications, such as keyless entry systems, PCM-CIA cards, dimmers, thermostats and calibration data storage. It uses the 12C protocol and has the following specifications: 500 nA typical standby current, 500 μA active current, 1.8 V supply, 200-year data retention and 1,000,000 erase/write cycles. (Reprinted with permission from *Semiconductor International Magazine*, June 1997.

A new solution for heat management

As the transistor density per chip in today's electronics multiplies, heat dissipation becomes an ever greater design concern. Typically solved with metallic heat dissipaters, the problem has a new solution, suggests Advanced Ceramics Corp., Cleveland. It offers a boron nitride filler that can be used with an epoxy moulding compound where very high thermal conductivity and good flow characteristics are desired, says the company. Called PolarTherm, the filler is intended as an efficient way of drawing heat away from the chip, thereby providing more flexibility in the design of smaller and/or higher-performance packages. The greatest benefits are seen in applications where small size is at a premium, as in laptop computers and hand-held devices. (Source: *Industry Week*, 9 June 1997)

Electro-optic terahertz sensing

Look for new imaging technology to extend our vision into the unseeable—things such as diseased tissue, electric fields, or plastic explosives hidden in a suitcase. That's the promise of research into real-time electro-optic terahertz sensing, says Xi-Cheng Zhang, associate professor of physics at Rensselaer Polytechnic Institute, Rensselaer, NY. With a frequency of more than a trillion cycles per second, terahertz signals occupy a large portion of the spectrum between the infrared and microwave bands, explains Zhang. "Until now no technology existed that could use this radiation to rapidly create images". The device is said to create an instantaneous image of 250,000 pixels. The detector uses a zinc telluride crystal onto which the terahertz radiation is focused after flowing through the target material. At the same time, a laser "readout" beam is directed into the system and used to convert the spatial and temporal (spectral) distributions into visible images that can be captured by a video camera linked to a computer. Molecular OptoElectronics Corp., Watervliet, NY, has licensed the technology. (Source: *Industry Week*, 9 June 1997)

ABB's new power semiconductor

ABB has unveiled a marriage of transistor and thyristor technology with significant implications for electrical power systems. The company says the new semiconductor enables power-system engineers to shrink the size and cost, while boosting to unprecedented levels the efficiency and reliability of medium-voltage equipment they design to control the flow of megawatts. ABB says the integrated gate commutated thyristor (IGCT) offers high-frequency operation at high currents and voltages while compact inverter designs can feature 50 per cent fewer components—and provide cost savings of 30 per cent or more. As examples, the company cites applications in traction power control, industrial motor drives, train and ship propulsion, transmission lines, utility interties and power flow controllers, industrial VAR compensators, and locomotive drives. The IGCT will be manufactured at ABB Semiconductors AG, Lenzburg, Switzerland. (Source: *Industry Week*, 9June 19.97)

TI 0.18 μm CMOS process packs in 250 m transistors

Texas Instruments (TI) has detailed a 0.18 μm CMOS process at a recent technology symposium in Japan, a follow-on technology to its 0.21 μm TImeline process announced in 1996.

With 25 picosecond delays and 2.4 GHz analog speeds, the company is targeting the 0.18 μm process at wireless and optical communications. RF and IF circuits along with DSP baseband processing could be placed on the same device. The 2.4 Gbit/s data rate is aimed at the new STM16 fibre optics communications standard.

For the process TI has switched to a shallow trench isolation. This, coupled with the reduced process dimensions doubles the available transistors.

While few, if any, designs will need 250 m transistors, halving the die size for a given design could bring significant cost reductions.

The as yet experimental process is to move to a production standard in the near future. Commercial use for the process is not expected for two years, design starts are expected by the end of 1998.

Most manufacturers, TI included, have yet to move to full production on 0.25 μm geometries.

TI's own TImeline process, actually 0.21 μm drawn, is only now ramping to production on microprocessors. ASICs will follow shortly. (Source: *Electronics Weekly*, 25 June 1997)

BT 40 Gbit/s LAN

BT Laboratories has a prototype local area network (LAN) operating at 40 Gbit/s, thought to be the fastest LAN yet reported.

Called SynchroLan, it is based on optical time division multiple access (TDMA), and provides 16 simultaneous 2.5 Gbit/s channels.

The system is timed by a clock generator which feeds a polarized clock signal of 4 ps pulses separated by 400 ps gaps into one end of a polarization-maintaining fibre. This runs through the write-side of all the nodes in the system and these add their data bits onto the fibre, one bit per node per 400 ps slot. The data is sent polarized at a different angle to the clock thereby avoiding interaction.

The fibre returns through the read-sides of all the nodes where the data is extracted at each node. This is also timed by the polarization-separated clock. Control is through an Ethernet bus, but could be done over the main bus.

Currently, the prototype is communicating over 50 m in total. The development team belives that 1 km will be achievable without significant modification, and further still with dispersion compensation. (Source: *Electronics Weekly*, 27 May 1997)

Vertical-cavity surface-emitting laser (VCSEL) for parallel, large-capacity optical communications

ATR Adaptive Communications Research Laboratories and Precision & Intelligence Laboratory, Tokyo Institute of Technology, have jointly succeeded in producing a vertical-cavity surface-emitting laser (VCSEL) of high performance that is one of the key devices for futuristic optical interconnects and parallel, large-capacity optical communications.

The special planar azimuth of a compound semiconductor wafer is utilized to enable considerable stabilization of the unstable polarization mode, the main factor obstructing the commercialization of VCSEL of simple structure, and to simultaneously enable the laser oscillation threshold current density to be lowered to about 1/4th that of conventional types of planar emission lasers.

With the generic type of striped semiconductor laser used in the production of compact disks, the laser beam is radiated from the crystal terminal plane. In the VCSEL, the light beam is radiated perpendicular to the crystal plane, so

that it enables two-dimensional arrays as well as integration with other devices with much greater ease. However, with the conventional type of VCSEL, the direction of oscillation of the electric field of the radiated laser beam is not well aligned (unstable polarization mode), so this conventional VCSEL is unsuitable for polarization-sensitive applications such as coherent detection systems. In addition, polarization mode control will be required for application to futuristic, high-speed, large-capacity transmission systems which demand low noise, because polarization fluctuations cause excess intensity noise. This polarization mode control VCSEL is further important for two-dimensional (2-D) arrays applications. Several countermeasures have been proposed to resolve this matter, but since complicated machining processes are required, it had been quite difficult to produce high-performance VCSEL. Further decrease of the power consumption that is vital in the production of large-scale two-dimensional arrays was also necessary, so laser oscillation with a smaller drive current was also required.

In general, semiconductor optical devices such as VCSEL are fabricated by applying the epitaxial crystal growth technique and vapour-depositing several layers of thin semiconductor films consisting of different materials on thinly sliced semiconductor crystals (wafers) made of semiconductor crystals such as gallium arsenide (GaAs). With the conventional type of VCSEL wafer, GaAs cut out from the crystal surface of excellent symmetry called the (100) surface are generally used due to the ease of crystal growth and machining process.

The VCSEL developed this time changes the crystal planar cutout azimuth of the GaAs crystal planar for use as the wafer, utilizes the crystal plane characteristics (excellent optical anisotropy and large optical gain), and resolves the aforementioned problems without requiring any complicated machining process.

Further details from: ATR Adaptive Communications Research Laboratories, 2-2, Hikaridai, Seika-cho, Soraku-gun, Kyoto 619-02, Tel.: +81-774-95-1501; Fax: +81-774-95-1508. (Source: *JETRO*, May 1997)

Charge modulation device image sensor of 4 million pixels

Olympus Optical Co. Ltd. has developed a charge modulation device (CMD) image sensor featuring an extremely high degree of image resolution, which integrates image sensors of as many as 4 million pixels, 10 times the number in typical charge-coupled device (CCD) image sensors. The sensors operate with a small amount of power.

This sensor is called the CMD type solid-state image sensor and is a silicon sensor with a diameter of 7.5 μm, with 2,048 pixels horizontally and vertically, and converts visible light into electric signals. Compared with CCD sensors with 300,000 to 400,000 pixels which are used for inspections, the new sensor features a large-scale integration of over ten times. The sensor incorporates various imaging functions. For example, when applied for a superhigh-resolution camera, if imaging speed rather than image quality is required, only one out of four pixels in the horizontal and vertical directions are activated to capture the overall image in real time. A part of the image can be read out as an animation, and the part can be switched to full screen freely for instantaneous readout.

The power consumption is increased when the readout speed is raised for CCD sensors with a large number of pixels. In contrast, the CMD solid-state image sensor is usable as a sensor for superhigh-resolution cameras, in which

its power consumption will be less than one fifth compared with that of the CCD counterpart. Even though it is a sensor with large-scale integration, it enabled the high-speed operation with low power consumption. Enhanced resolution, and random accessing functions are realized through the X-Y address format, and the newly developed scanning circuit and controller. The company plans a prototype precision camera incorporating the new sensor, and observes that the system is applicable to the automation of inspection for LCD panels, semiconductors and IC chips, and other applications.

Further details from: Olympus Optical Co. Ltd., Public Relations Dept., 2-3-1, Nishi-Shinjuku, Shinjuku-ku, Tokyo 163, Tel.: +81-3-3340-2174; Fax: +81-3-3340-2130. (Source: *JETRO*, May 1997)

GeneChip fabrication

The fusing of genetic engineering and microelectronics disciplines at the micro level seems likely to yield further benefits.

At present, researchers at universities and biotechnology companies alike are exploiting semiconductor fabrication technology to create DNA chips, which are being used to speed up the arduous task of genetic sequencing.

Sequencing is used by geneticists to create matrices of DNA strands that are then used to help solve genetic problems. But this has traditionally involved tedious lab work which is time-consuming and expensive. One solution is to have a laboratory on a chip.

Affymetrix is a biotechnology company based in California which has developed just such a chip—the GeneChip. The company, which is 30 per cent owned by Glaxo Wellcome, has been using semiconductor technology a decade old to produce the device. This enables the GeneChip to use glass as its substrate. "The feature sizes that we're dealing with are so large, 10 to 50 μm, compared to those used by the semiconductor industry that we can use glass rather than silicon, which is a considerable cost factor", says the company chairman.

The company produces "combinatorial DNA arrays" on the surface of the glass. "Instead of building circuits, we're building strands of DNA", says Diekman.

This is done by etching a pattern on a protecting layer, before depositing onto the surface a DNA nucleotide. A nucleotide is one of the four base elements of DNA—guanine (G), cytosine (C), adenine (A) and thymine (T). In the DNA double helix, G only attaches to C, and A only to T. This results in the two, complementary halves of the helix.

It is the existence of these two halves which is exploited when testing for genetic mutations. For example, if the structure of the gene for a particular disease is known then one half of the double helix is produced on the GeneChip, so that when specially treated sample of a patient's blood is introduced onto the chip's surface it will recombine with the static G and C, or A and T, strands to re-form the gene. A fluorescent chemical is included on the surface of the chip that only becomes activated when this recombination occurs, so that a scanner—developed by Hewlett-Packard and Affymetrix jointly—can identify whether the patient has the problem gene or not.

So far, the company has developed a GeneChip that tests for mutations in the HIV virus. This can be used to help doctors treat HIV carriers, enabling them to select quickly the most suitable drugs for treatment, since some drugs used for HIV therapy are known to have adverse effects on carriers of different types of the HIV virus. Diekman says

that while the usual tests carried out to determine the best HIV treatment for a patient can take two months, and cost $1,000, Affymetrix's HIV GeneChip takes ten minutes, at a cost of $90, to do the same tests.

This is one practical example of how to use the GeneChip technology to benefit the medical world. But of far greater interest, according to Diekman, is how the GeneChip can benefit the Human Genome Project, where geneticists from around the world are working to identify all the genes in the human body by the year 2006 and then map how those genes interact with each other.

Affymetrix's GeneChip can, at present, carry 10,000 genes. This is because, although a gene typically consists of between 1,000 and 10,000 nucleotides, it only takes 800 of them to represent a gene on the chip. "That's where [Affymetrix's] software helps", says Diekman.

In theory, once all 100,000 human genes have been identified, they could be represented using ten GeneChips, although Dieman expects a GeneChip to carry far more genetic information by 2006.

The chips would then aid the next phase in the Genome project, by allowing genetic engineers to quickly see how the genes interact.

At the moment, the GeneChip has to be read by a charged coupled device (CCD) camera to pick up the fluorescent images brought about by recombination. Whether the technology can be developed in such a way that a microelectronic circuit can interact with the DNA strands to produce even quicker results is another matter.

Leroy Hood has developed a machine that can make DNA to order—the Model 394 DNA Synthesizer.

Hood is the William Gates III Professor of Molecular Biotechnology at the University of Washington at Seattle. Gates is quoted as saying: "The gene is by far the most sophisticated program around", so it is hardly surprising that he wants to muscle in on the world of genetics by providing the university with $12 m of funding for Hood's research.

His machine, manufactured by Hood-founded company Applied Biosystems in California, has a simple keyboard that is used by the operator to program in a chain of nucleotides. It then goes on to manufacture the required strand of DNA. But Hood is also developing a genetic chip, that will have 65,000 fragments of DNA. These fragments will react individually with unknown samples of DNA, so that geneticists can have a sequence of the unknown DNA generated for them immediately. This would then be compared with a database of DNA arrays, for identification purposes. (Source: *Electronics Weekly*, 28 May 1997)

Successful production of thin wire by arranging indium atoms

The National Research Institute for Metals (NRIM) of the Science and Technology Agency (STA) successfully formed an atomic chain by arranging about 200 indium atoms one after another on silicon substrate in an ultrahigh vacuum thereby producing the world's narrowest electronic conduit.

To examine the conditions when electrons are passed through the thin wire, which is only as wide as an atom, NRIM plans to connect external electrodes to both ends of the wire and measure conduction characteristics of the electrons. This success is expected to lead to the development of a new device in the future in which only one electron may carry information.

This thin wire is produced as follows: the silicon surface on which the atoms are arranged is shaved in the crystalline direction at a certain angle so that the stages

called "terraces", different in height by only two silicon atoms, may appear on the surface; by evaporating indium atoms on this surface, atoms are arranged in lines along the edge of the terraces.

The length of the atoms extends to 70 nm (1 nm=1/1,000,000 mm). In the future, electrodes will be connected to the linearly-extended thin wire to pass electrons through it and electron conduction characteristics and other conditions will be measured.

The thin wire was produced by a group under Unit Leader Hitoshi Nejiro et al. of the Extremely High Vacuum Field Station Single Atom Operation Unit of NRIM.

For further information, contact the Extremely High Vacuum Field Station Single Atom Operation Unit, NRIM, STA; Tel.: 0298-59-2837. (Source: *STA Today*, April 1997)

Computer can respond to thought

Research at Imperial College could open up the world for severely disabled people by allowing them to communicate through computer—simply by thinking.

Will Penny and colleagues, researching into biosignals as part of the Brian Computer Interface project, are attempting to use information from the motor cortex region of the brain, recorded using electrodes attached to the scalp, to interface directly with a computer.

The basis for the work is that movements of limbs, for example, are preceded by desynchronizations and synchronizations within the electroencephalogram (EEG). But these event-related desynchronizations and synchronizations (ERD and ERS), appear to be present when volition to move a limb occurs, even when actual movement of the limb does not in fact take place.

Clearly, the accurate real-time determination and classification of the ERD/S offers many exciting possibilities for the control of peripheral devices via computer analysis.

This project aims to research this protocol. The primary application is expected to be computer interfacing and control by severely disabled people. But the methodology is general and has numerous other application areas.

Key areas of technical research to be solved include better preprocessing techniques for the spontaneous (non-averaged) EEG and development of suitable pattern recognition algorithms. This will also include investigation of dynamic "neural" network architectures.

Will Penny, Department of Electrical Engineering, Imperial College, London SW7 2BT, UK. E-mail: w.penny@ic.ac.uk. (Source: *Electronics World*, June 1997)

Solar-powered aircraft

Aeronautical engineers in Southern California are developing an aircraft—called Centurion—that they believe will push solar-powered aircraft concepts to new heights, and provide a vehicle for scientific experiments.

Engineers for AeroVironment are designing the aircraft to fly at over 30,000 m altitude as part of NASA's Environmental Research Aircraft and Sensor Technology (ERAST) programme. Like its predecessor, the AeroVironment-developed Pathfinder, the Centurion will be an ultralight flying wing with multiple electric motors along its wingspan, powered by solar cells spread across the wing's upper surface. But Centurion's wingspan will be more than twice that of Pathfinder.

The final solar-powered Centurion will be designed to reach the ultra-high 30,000 m altitude for a relatively short duration—about two hours—while carrying a small 90 kg

payload of scientific sensors. The full-scale Centurion will span between 70 and 80 m.

The Centurion is one of several unpiloted aircraft being developed by an alliance between NASA and several small aeronautical development companies and universities under the ERAST programme. The goal of the programme is to develop aeronautical technologies that will lead to development of a new family of high-flying remotely piloted aircraft for scientific missions. (Source: *Electronics World*, June 1997)

Millimetre-sized machines could provide jet thrust

Could an array of hundreds of tiny jet turbines, each a fraction of a centimetre wide, one day replace a single jet engine to power an aircraft? That is what researchers at Stanford University's rapid Prototyping Laboratory hope, and is among the blue-sky possibilities suggested by a new approach to mechanical design called massively parallel mechanical systems.

Although replacing a jet engine is well beyond the current state of the art, the scientists propose demonstrating the value of this approach by building several simpler but still useful devices.

One such device is a system to keep aircraft wings from stalling, a condition that causes the wing to lose the upward force that keeps it in the air another is a tactile interface for virtual reality and tele-operation systems.

The aircraft device would work by covering critical parts of a wing with thousands of tiny holes each about 1 mm in diameter and separated by 5 mm. In front of each hole would be a small pressure sensor. When a sensor detects the conditions that precede a stall, it instructs a tiny valve to open, allowing a jet of pressurized air to blow out through the hole behind it. If properly triggered, such jets could prevent a stall from developing.

The tactile interface for virtual reality systems would be next step on from force feed-back mechanisms that are currently used and give tele-operators a better feel for what they are manipulating. The new device would be something like a flat pin cushion, consisting of a dense array of millimetre-square pins attached to actuators that would position and push them up and down with a controllable amount of force. The millimetre spacing between individual pins would make the interface feel almost like a solid surface when all the pins are positioned at the same level. Under computer control, however, the surface could be programmed to imitate the shape and hardness of different surfaces.

The difficulty with such engineering is that it falls between normal manufacturing methods that can create objects a centimetre or larger, and micro-mechanical devices that measure a few microns made using semiconductor manufacturing techniques.

The Standford team is currently developing methods to make large numbers of mesoscale-sized mechanical devices, by combining two different types of techniques—miniaturizing traditional manufacturing methods while scaling up techniques used in the semiconductor industry.

So far the researchers have fabricated an array of nine nickel wheels, each one 0.3 mm thick and 5 mm in diameter, mounted on nickel axles to demonstrate they can make entire mechanical devices in place, without any assembly. Similarly, they have made a four-bladed propeller, 5 mm in diameter. (Source: *Electronics World*, June 1997)

Physics sets engineering challenge

Two of the world's largest superconducting magnets, for use in an international particle physics experiment, are to be designed and built by a team under the guidance of a scientist from the UK. Elwyn Baynham, the project leader from the CLRC Rutherford Appleton Laboratory and one of the world's experts on superconducting magnets, is to lead a team of engineers and scientists to design, construct and test a pair of massive toroidal magnets. These magnets will form a key part of the end cap detectors of the Atlas experiment on the large Hadron collider (LHC) currently being constructed at the European particle accelerator laboratory at CERN in Geneva.

Over 30 km of cable will be used to form the coils of the magnet. The coils will operate at 4.5 K—just above absolute zero—and the conductors will carry a current of 20,000 A with zero power loss. The magnets will have a stored magnetic energy of over 400 Mj—equivalent to the kinetic energy of an inter-city train at 125 miles per hour.

The huge scale and complexity of the finished product means that it will not be possible to build a prototype of the end caps, so special modelling techniques involving finite element analysis and virtual reality simulations are being used to ensure that the design is feasible. When the design stage has been completed the components will be fabricated in industry to the defined specifications of the design team and finally assembled, integrated and commissioned into the detector at CERN.

When the Atlas detector has been completed it will be used by particle physicists worldwide to search for evidence of the Higgs Boson. The LHC is due to be switched on in July 2005. (Source: *Electronics World*, June 1997)

Miniaturization using molecular circuits

The idea of employing organic molecules as electronic components was first suggested in 1974. Circuits made from such components would be hundreds of times smaller than conventional ones, allowing more processing power to be built into chips. It is only in the last few years, however, that chemists have developed techniques enabling them to work with single molecules.

In order to carry a signal, a molecule must permit the passage of electrons along its length. Some molecules contain double or triple bonds between their atoms. If it is arranged so that multiple bonds alternate with single bonds, a channel is created along which electrons can flow. As well as simple chains of alternating double bonds found in ethene groups, or triple bonds encountered in ethyne groups, chemists have created conducting materials from benzene rings and thiophenes (ring-shaped, sulphur-containing molecules).

Work undertaken at the university of South Carolina and Pennsylvania State University has resulted in a series of molecular "wires" mounted on a gold surface. The problem of insulating wires has been addressed at the University of Oxford by encasing molecular wires in tubes made from stacks of hoop-like molecules.

The next stage is to develop logic boxes which form the basis of computation. Earlier in 1997, teams at the University of Birmingham and the University of Bologna announced the creation of an XOR gate, with two inputs and one output. Work is proceeding on other types of gate, such as AND and OR.

The first application of molecular wires is likely to be as interconnects between conventional microelectronic devices. Full-blown molecular computing is seen as being at

least five years away. (Source: *New Scientist*, 2 August 1997)

Chip power boost

A breakthrough in the way chips consume power, reported by the University of California's Information Sciences Institute (ISI), could dramatically cut power consumption by 80 per cent and make possible new types of highly integrated chip designs.

Researchers within the ACMOS group at ISI have patented a prototype microprocessor called the AC-1, which consumes just one fifth of the power of a similar CMOS processor. The design uses pulsed power and adiabatic charging techniques which recycle some of the power used in the chip's clock cycle.

Researchers are unsure if the same techniques can be applied to commercial microprocessors and other chips, but chip companies will be able to buy licences for the technology.

Low power consumption is critical to building large, high-performance microprocessors where problems of heat dissipation are limiting designs. More exotic types of chips built as a cube could be made possible with low power technologies. (Source: *Electronics Weekly*, 13 August 1997)

DRAM firms show interest in IRAM

Several DRAM manufacturers have offered to fabricate samples of a novel processor being developed at the University of California, Berkeley.

Dubbed Intelligent RAM (IRAM), the IC architecture tackles the increasing discrepancy between processing performance and memory bandwidth by combining a vector processing style of computing with multiple blocks of on-chip store.

According to Professor David Patterson, head of the Berkeley project, "most" of the DRAM firms approached—Mitsubishi, Hyundai, LG Semicon, Samsung, IBM and Micron—are interested in manufacturing the IRAM samples.

Patterson expects to work with one or two of the companies, resulting in the first samples by early 1998. Envisaged applications for the ICs include PDAs, game consoles, servers and disk drives. (Source: *Electronics Weekly*, 13 August 1997)

Stickier circuits

Scientists at the University of Illinois (Urbana-Champaign) report developing a process to improve the adhesion of polymer films used in integrated circuits. The researchers say the technique can be used to increase the adhesion of copper or other non-reactive metals, such as gold and silver, to a variety of polymer substrates. By precisely controlling deposition rates and temperatures, the scientists embed copper clusters on the polymer surface. The researchers say the clusters "act as nanonails" anchoring the metal layer that is subsequently deposited. (Source: *Chemical Week*, 23 July 1997)

Supercomputer to push the speed envelope

Scientists with Lawrence Livermore National Laboratory will explore cutting-edge modelling methods with a series of new supercomputers. IBM will provide machines delivering speeds in the 3-teraflop range in 1998 and up to 10 teraflops in 1999. Beyond 2000, the Energy Dept. would like systems in the 30- to 100-teraflop range, but has not selected specific computer vendors. Most current

supercomputers work at rates measured in hundreds of gigaflops.

The size of models simulated on the machines will also be well beyond what is now considered large. For example, problems on the order of 10,000 to 1 million cells or elements are considered large today. But the new machines will handle models with 1 billion cells. The systems will also hold about 2.5 terabytes of main memory, or about 140,000 times that found in a modern desktop computer. The analysis schedule includes medical simulations, global climate modelling, aerospace and automotive design, and nuclear fuel degradation.

The first machine in the project, a massively parallel 1.8-teraflop computer, uses Intel processors. Computers coming from IBM will use the company's RS/6000 SP (scalable parallel) technology. High performance will come from using clusters of shared memory processors. The architecture can grow to accommodate as many as 512 processors. (Source: *Machine Design*, 19 June 1997)

Ion implantation could cut SiGe device costs

An Italian research group is attempting to reduce the cost of silicon germanium (SiGe) devices by using ion implantation for their fabrication.

SiGe heterojunction bipolar transistors (HBTs) are faster than silicon-based ones, letting devices operate at 5 GHz without resorting to GaAs technology.

The group, called IMETEM, comprises 15 people from the University of Catania. It resides at SGS-Thomson Microelectronics' wafer fab and research centre in Catania.

The group claims that existing techniques for producing SiGe structures, like molecular beam epitaxy (MBE) and chemical vapour deposition (CVD), although successful, are difficult to incorporate into current ULSI technology. This, it says, is delaying the adoption of SiGe commercially.

Its proposed approach for fabricating SiGe heterojunctions is a technique based on high dose germanium ion implantation into silicon. Ion implantation offers a high wafer throughput and can be confined to particular regions of the wafer.

Other IMETEM devices under development include an infra-red silicon LED. Silicon is not normally suitable for LEDs but, by including erbium-oxygen complexes in the material lattice near the PN junction, IMETEM has created an emitter that operates at 1.54 μm, the fibre-optic communication wavelength. The group is also starting to look at silicon carbide-based semiconductors for high voltage use. (Source: *Electronics Weekly*, 16 July 1997)

Fast links

Siemens has developed from scratch, what is claimed to be the first generation of high-speed, high-density surface mount backplane connectors, capable of handling data rates of up to 2.5 Gbit/s and with signal rise times down to 50 ps. Called SpeedPac, the connector will be available from January 1998.

To date, the method of improving the performance of a backplane interconnect system has often remained flawed. Performance has been tweaked by adding more contact pins to the connector. But not all the pins can be used for signal transmission. Excessive pin count also means unnecessary insertion and extraction force on the board, offering a potential source of damage to boards and accessories.

Users typically have to reinforce the card extraction levers and add stiffeners to the backplane.

The SpeedPac connector is a zero-insertion force design. It closes around the edge of the daughter board like a crocodile jaw. To close the two connector halves, the user pushes a button on the front panel that in turn actuates an elbow-lever mechanism on the connector. This mechanism loads all the conductors' contact springs and grounding strips and is self-locking.

Unlike the conventional connector arrangement, there are no pins or sockets. Neither are there through-hole connections. The conductors are one piece, being pushed onto pads on the surface of the motherboard at one end and the daughter at the other. Plastic spacers support the conductors within the connector. The spring loaded contact has an end of life force of 0.75 N.

To overcome the problem of crosstalk, the SpeedPac's conductors are suspended in pairs or twin-ax lines within conductive metallized transmission channels, hence the need for plastic supports. The impedance of the two conductors in their metal passages is balanced precisely from daughter card pad to backplane pad.

In order to meet perceived customer requirements, the conductors have been arranged as single-end lines as well as differential pairs. The 2.5 mm spacing per twin-ax spaced version provides 140 differential pairs per 100 mm, and the 1.75 mm spacing per coax spaced version can go as high as 196 singled-ended lines per 100 mm.

Differential pairs and single-ended lines may be combined on one connector. The high density is achieved through the symmetrical layout of the two rows of conductors on each side of the daughter card. Grounding is taken care of independently via numerous contacts on the metal housing, which connects directly to the grounded top layers of the backplane and of the daughter card. (Source: *Electronics Weekly*, 30 July 1997)

Light steps for tiny computers

A single molecule that acts as a binary switch has brought nanoscale computers a step closer. Scientists in Japan have created molecules that alternate between two different shapes when exposed to pulses of light. In a computer, one shape would correspond to a 1 and the other to a 0, allowing binary information to be stored in grids of molecules.

Naotoshi Nakashima and his colleagues developed the molecules at Nagasaki University. Each looks like a piece of string (an azobenzene molecule) threaded through a bead (a cylindrical cyclodextrin molecule). The bead moves between two positions on the string depending on whether the molecule is exposed to ultraviolet or visible light.

The beads are held on the string by molecular stoppers—bulky chemical groups at each end. The whole assembly is known as a rotaxane. The researchers say that the energy of ultraviolet light converts the straight azobenzene molecule into another stable form which has a kink in the centre. This forces the bead to slide to a new position. Visible light returns the azobenzene to its straight state, allowing the bead to return to its original place.

Nakashima and his colleagues say the two forms of the rotaxane absorb light in a different way, which would allow information encoded in the molecules to be "read".

Rotaxanes that perform a similar trick have already been made, but temperature dictates the position of the "bead". Nakashima's group is the first to make a rotaxane switch operated by light, a feature that could make it more convenient for computing applications. (Source: *New Scientist*, 13 September 1997)

Technology for plating ferrite film onto ultrafine plastic spheres

Prof. M. Abe and his research team of the Faculty of Engineering, Tokyo Institute of Technology, have applied the sonochemical technique (application of power ultrasound waves to stimulate chemical reaction) to ferrite ulating and succeeded in uniformly depositing ferrite films onto ultrafine plastic spheres with diameters of 0.25 µm. By the conventional process, when sphere diameters become smaller than 0.3 µm, only islands are generated and it becomes impossible to plate the entire surface of the ferrite films.

The ultrasonic waves are conceived to reform the surfaces of the ultrafine spheres and to permit the formation of films continuously. This technology is attracting attention as the first example of application of the power ultrasound waves to the formation of inorganic thin films.

Ferrite plating enables plating to be accomplished in an aqueous solution of less than 100° C regardless of the type and shape of the substrate material. Magnetic ultrafine spheres produced by plating ferrite onto plastic spheres have been commercialized for use as a cancer diagnosis reagent by utilizing the immunity reaction.

Ultrasonic irradiation chemical process was therefore used in the ultrasonic enhanced ferrite plating process. Ultrasonic waves were directed on a ferrite plating reaction, and plating performed for 90 mins. on polyacryl spheres with a diameter of 0.25 µm. It was possible to coat the surface uniformly with a ferrite film to a thickness of 0.1 µm. The film consisted only of a ferromagnetic component, and the magnetic property was improved threefold compared to when no ultrasonic wave was irradiated. As a result, the immunity reagent property was considerably improved. In addition, the range of applications of magnetic ultrafine spheres will be extended to, for example, copying machine toners as well as tape back-coating material.

Further details from: Tokyo Institute of Technology, Department of Physical Electronics, Ookayama, Meguro-ku, Tokyo 152, Tel.: +81-3-5734-3039; Fax: +81-3-5734-2906. (Source: *JETRO*, October 1997)

Stack cell technology for futuristic DRAMs

Toshiba Corp. has established a stack cell technology that enables the mass production of futuristic DRAMs with capacities of over 1 Gbit and line widths of about 0.15µm. The technology was established by producing the master pattern in a simple rectilinear shape for ease of mask pattern transfer onto wafers and by introducing a fully self-aligning technique for arranging the bit wires and capacitors in direct wiring (contact) with the active region. For capacitors, the method of forming a ferroelectric type of film in the concave part of the interlayer insulating film is adopted, and an excellent surface flatness has been attained that is required in particular with stack cells.

The new stack cell technology is characterized by the self-aligned polyplug, cross-point contact and concave capacitor. The self-aligned polyplug is a self-alignment technology using the gate as the standard. The space between the gate covered with silicon nitride film is filled with a boron-phosphorus-silicate glass (BPSG), the BPSG is removed by selectively etching the nitride film, after which the plug is formed by doped polycrystalline silicon.

For the cross-point contact, the interlayer film covering the polyplug is patterned in groove shape and a nitride film adhered on the side wall, the groove filled with tungsten to form the bit wire, and a nitride film formed on the upper part

of the tungsten. Another doped polycrystalline silicon is formed by the self-aligned technique after the bit wiring. This connects to the polyplug to form the contact between the capacitor and the active region.

For the concave capacitor, a silicon oxide film formed on the bit wire is etched in concave structure to successively form the electrode ruthenium film, barium-strontium-titanate (BST) film and another ruthenium film. A uniform flatness is obtained with ease since there is little level difference with respect to the oxide film surface. Further details from: Toshiba Corporation, Corporate Communication Office, 1-1-1, Shibaura, Minato-ku, Tokyo 105. Tel.: +81-3-3457-2105; Fax: +81-3-3456-4776. (Source: *JETRO*, October 1997)

Reduced potential rise-up time of Gbit class DRAMs

NEC Corp. has established a technology to sharply reduce the potential rise-up time of 4-16 Gbit class DRAMs, of which commercialization is anticipated in the 21st century, to only a fraction compared to those of DRAMS manufactured by other technologies. The new technology is based on changing the electrode material of the capacitor (memory element) from the usual polysilicon to a metal, by which large-scale integration and acceleration of memory storage are achieved at the same time.

The capacitor electric charge is proportional to the area of the counterfacing electrode and inversely proportional to the distance between the two electrodes, so this distance is made as small as possible according to the technical limit. However, with large-scale integration, the capacitor area must be as small as possible, and improvements have also been made in the electrode materials.

With polycrystalline silicon used previously, surplus electric charges are accumulated inside, so an oxide film is generated between the capacitor electrodes in the process of manufacture, so that the distance is larger by that extent. The company shortened the distance between electrodes by using a metal (tungsten) in place of polycrystalline silicon, and increased the area by processing the metal into a cylindrical form. This allowed adequate capacitance even with DRAMs of over 4 Gbit class.

A metal with lower electrical resistance was used at the contact between the capacitor and the power unit, which shortened the time for electric charge input and output. Therefore, with 4-16 Gbit DRAMs, the potential rise-up time has been shortened to 2.0-2.5 ns, only a fraction compared with DRAMs manufactured by conventional processes. Further details from: NEC Corporation, Public Relations Div., 5-7-1, Shiba, Minato-ku, Tokyo 108-01, Tel.: +81-3-3798-6511; Fax: +81-3-3457-7249. (Source: *JETRO*, October 1997)

Parallel processing computer for advanced science and technology computations

Autostrade Co. Ltd., a computer-related technology company, has developed a parallel processing computer system enabling advanced science and technology computations for molecular design and quantum dynamics calculations.

In contrast to conventional types of high-speed, special-purpose processing systems, the new parallel processing system incorporates multiple central processing units (CPUs) to permit the computer to be used in parallel as a computer group. The user can select the processing capacity and processing speed according to specific needs. For example, the type incorporating 14 CPUs can be switched to process

up to 14 programs or for a processing speed of up to 14 times.

In parallel processing, when the computer is given a processing instruction, the other computers in the system serve to assist the computer's operations. The characteristics are therefore not so different to those of a high-speed special purpose computer, but there is a distinct advantage that the processing time and cost can be substantially decreased.

Further details from: Autostrade Co., Ltd., 13-54, Ueno-machi, Oita City, Oita Prf. 870, Tel.: +81-975-43-1491; Fax: +81-975-45-3910. (Source: *JETRO*, October 1997)

Largest energy storage capacity at liquefied nitrogen temperature

Sumitomo Electric Industries, Ltd. and Kansai Electric Power Co., Inc. have jointly succeeded in building a prototype high-temperature superconducting coil for superconducting magnetic energy storage that has attained the world's largest energy storage capacity of 100 J (joule).

The two companies built a prototype 100-J high-temperature superconducting coil for SMES that uses silver-coated bismuth-based conductors, and conducted performance tests. As a result, it was confirmed through D.C. 34.2-A electric conduction tests that the superconducting coil in a liquefied nitrogen environment (-196° C), can store the world's maximum energy of 100 J (equivalent to electricity to illuminate a 100-W lamp for one second).

Up to now, the maximum storage capacity had been about 10 J, so this coil can store ten times more energy. It was also possible to conduct AC 2-Hz electric conduction tests by simulating the operational mode of SMES. The newly developed coil can be operated with inexpensive liquefied nitrogen, so it is anticipated to decrease system running costs substantially.

Further details from: Sumitomo Electric Industries Ltd., Tokyo Administrative Dept., 1-3-12, Motoakasaka, Minato-ku, Tokyo 107, Tel.: +81-3-3423-5221; Fax: +81-3-3423-5009 (Source: *JETRO*, October 1997)

Technology for producing extrabright, high-efficiency electroluminescence devices

IMES Co. Ltd. has established a technology to produce extrabright, high-performance organic electroluminescence devices which are usable in place of emitting diodes (LEDs) for computer liquid crystal displays (LCDs). Highly reactive metals such as lithium and strontium are incorporated in the organic molecules at the cathode interface by which the electron-injection characteristic is improved considerably.

The new technology was co-developed with Assoc. Prof. J. Kido and his research team of the Postgraduate School of Engineering, Yamagata University. Attention was directed to the fact that electron injection from the cathode undergoes an organic molecule reduction at the cathode interface (cathode boundary), so metals of excellent reducing property, such as lithium and strontium, were doped in the organic layer at the cathode interface.

Whereas electron injection from the cathode is difficult due to the high energy barrier with conventional types of devices and requires a high drive voltage, the new technology minimizes the barrier height for electron injection from the cathode, which decreases the device drive voltage substantially. Compared with conventional types of electrodes made of magnesium or lithium alloys, low-voltage drive at less than 10 V is possible, which doubles the device efficiencies, and a brightness of over 30,000 cd/m^2 from Alq^f has already been attained. Upon the commercialization of the

high-brightness EL device, the cost of the liquid crystal display is expected to be reduced to about one half compared with TFT-LCD.

Further details from: IMES Co. Ltd., 3, Kirihara-cho, Fujisawa City, Kanagawa, Pref. 252, Tel: +81-466-45-5922; Fax: +81-466-45-6060 (Source: *JETRO*, November 1997)

AND now, molecular logic gates

UK chemists have built the first workable logic AND gate for the molecular computers of the future. The device, based on a single molecule, could make computer chips a million times smaller.

AND gates emit a signal representing a binary "1" only when they receive two independent inputs. They are crucial for carrying out computer calculations, acting as the "carry digit" during binary additions.

Chemists dream of building molecule-sized AND gates, but it has proved difficult. The two inputs have to act independently and the output signal has to be strong enough to produce a distinction between "on" and "off". Previous attempts to make AND gates only produced very weak signals, says research team leader Prasanna de Silva of Queen's University, Belfast. But now his team has managed to make a molecule that produces a good signal.

The team built their logical molecule from a crown ether—a ring of alternating oxygen and carbon atoms—and a fluorescent anthracene unit. The crown ether binds sodium ions and the anthracene binds hydrogen ions. When both ions are present the anthracene fluoresces strongly, so they can act as independent input signals. De Silva's team is now working on integrating the gates into logic circuits. (Source: *Chemistry & Industry*, 15 September 1997)

Cool chips clock at faster speeds

Tiny cooling pumps buried within silicon chips could significantly increase the speed at which the ICs are clocked.

Called cryocoolers, the miniature heat exchangers will cool semiconductor devices to temperatures as low as 60 Kelvin, said co-inventor, Lyn Bowman of Sunpower, a US R&D company working on the project with Ohio University.

Cryocoolers work by moving heat from the silicon substrate to the chip's surface. The heat is then removed by conventional heatsinks and fans. But unlike existing ICs the transistor junction will be the coolest part of the device, rather than the hottest.

The cryocooler is made from a Stirling engine and cooler. Heating one side of the cooler causes the other side to get cold. The silicon circuit would be fabricated at the cold end of the pump. When one end of the Stirling device is heated, the thermal gradient causes a piston to move. The piston starts to oscillate at 10 kHz for the miniature designs.

The cooler is the same design as the engine, operating in reverse: the piston movement extracting heat from the cooler's surface.

Unlike today's exotic IC cooling systems, a cryocooler does not require an external liquid gas supply.

Existing Stirling engines and coolers are the size of a PC power supply and made of steel. To transfer the technology to silicon, extensive development in micromachined structures is being undertaken, but it could be many years before commercial devices use cryocoolers. (Source: *Electronics Weekly*, 1 October 1997)

Intel packs more on multi-level cell

Intel has started sampling the world's first stand-alone multi-level cell flash memory chips. The devices store two bits—using four voltage levels—per transistor.

The first multi-level cell device from Intel is a 64 Mbit memory made on the well-established 0.4 μm process. It sells for $29.90, having the current $7 to $9-per-megabyte cost of flash.

Volume chip production of its StrataFlash is scheduled for the first quarter of 1998 and, one year on from there, the price is expected to be only $20.

During 1998, Intel expects to migrate the part onto a 0.25 μm process to give a 128 Mbyte density at which point the power requirement will drop to 3 V from the 64 Mbit's 5 V.

To read multi-voltages per transistor, Intel uses three sense amps per I/O instead of one per I/O. (Extracted from: *Electronics Weekly*, 24 September 1997)

Self-replicating silicon

Daniel Mange and his colleagues at the Swiss Federal Institute of Technology in Lausanne report that they have made a self-repairing, self-replicating version of a specialized computer. It is able to perform only one specific task, but they hope to do the same soon with a "universal" computer—a necessary step towards creating computers that truly mimic life by reproducing and evolving.

The Swiss system is based on cells of identical processors, which they call "biodules". Each cell contains a random-access memory and a single field programmable gate array, which is a collection of circuits that can be rewired by software, allowing it to assume new functions. The biodules are laid out in a two-dimensional array, with a "mother cell" at one corner. Each one is programmed with an artificial chromosome—a string of bits that encodes all the information necessary for all the cells to function together as a computer.

Mange explains that each cell uses the mother cell as a reference point to calculate its position in the array, extracts from the bit string the information that a cell at that position needs to carry out its particular functions, and wires itself accordingly. The resulting computer can perform just one task: checking a string of parentheses to see if every left parenthesis belongs to a closed pair.

The system is able to repair itself by enlisting spare cells that sit off to one side of the working array. When a cell is identified as faulty, its entire column is deactivated. Then the functions of each column are shifted one column over, so that a spare column takes over the function of what used to be the last working column of the computer. Mange suggests that such a system might have applications in avionics, for instance, for computers that require extraordinary fault tolerance, but he admits that there is a "rather high" price to pay in efficiency: the need to store the complete "genome" in every cell. "It's the same price biology agrees to pay with every living being to have a very safe architecture", he says.

Self-replication is an extension of the same idea. Mange and his colleagues have shown that with enough spare cells in the array, all of the working cells of the computer can simply copy themselves into a new set of cells. Moving on to a self-replicating universal machine should be relatively easy, says Mange. "We should be able to realize the original dream of Von Neumann in the very near future", he says. (Source: *Science*, Vol 277, 26 September 1997)

IBM puts copper into ASIC process

Two ASIC processes, one using copper interconnect technology, have been announced by IBM Microelectronics.

IBM has split its ASIC lines in two, one aimed at high performance and the other aimed at lower power, higher volume chips.

The copper process will take ASICs to a considerably smaller process than any other thus far announced. Called SA27, the process has design rules of 0.16 μm drawn (0.12 μm effective length). By using the lower resistivity copper as tracks, gate delay is reduced to just 33 ps. In real-world terms a phase lock loop can run at 800 MHz. Production of ASICs could happen by early 1999.

SA12e is a larger geometry ASIC process designed for products looking for low power at a more reasonable price rather than outright performance and small die size. The 0.25 μm process can integrate ten million transistors and has a power dissipation of 0.05 μ W/MHZ/gate, the company claims. Initially designed to run at 2.5 V, the company aims to qualify the process for 1.8 V operation. (Source: *Electronics Weekly*, 15 October 1997)

Epic-explicitly parallel instruction computer

Intel and Hewlett-Packard (HP) have officially announced a new processor architecture they are calling Epic—explicitly parallel instruction computer.

Epic is the technology that enables IA-64, the 64-bit microprocessor architecture that is Intel's first marked departure from the x86 instruction set.

The first product using the IA-64 and the Epic architecture is to be Merced. This will be able to execute its own 64-bit instruction set, and both the x86 and PA-RISC instruction sets from Intel and HP.

Merced will be manufactured using a 0.18 μm process sometime during 1999. By then Microsoft expects to have Windows NT running on the processor. It also expects a compiler to be available for software development. (Extracted from *Electronics Weekly*, 22 October 1997)

Blue laser battle looms

Blue laser diodes promise to quadruple optical storage densities as their shorter wavelength allow smaller dots to be read. However, few organizations have made one, let alone produce devices with an operational lifetime greater than several seconds.

Fujitsu recently announced five hour continuous operation, but Nichia has responded by going public on a 300-hour device.

Shuji Nakamura, Nichia's chief researcher, is open about the difficulties involved: "The reproducibility of these characteristics is poor at the moment, we have to clarify the reasons for the device's good lifetime."

Outside Japan, no one has had a blue laser diode last more than a minute in continuous operation, but longer periods of pulsed operation have been demonstrated. (Source: *Electronics Weekly*, 22 October 1997)

"Two million gates by 2000" says Altera

Altera has come up with a new mixed CPLD and FPGA programmable logic architecture which gives customers a programmable system-on-a-chip. The architecture, called Raphael, will deliver two million gate chips within three years.

On a quarter micron, five level metal process, the Raphael architecture delivers 500,000 gates of programmable logic. That will be incorporated in a chip "early" in 1999, says Altera.

On a 0.18 μm, six level metal process the architecture delivers a million gates. Such a process is expected to be available at the end of 1999, says the company. On a 0.15 μm, seven level metal process, Raphael delivers two million gates.

Altera says that the architecture delivers system performance of 100 MHz. Embeddable RAM blocks include dual-port RAM which allows simultaneous read/write functions.

The move to a mixed SRAM/E^2 architecture is because of what Altera calls the "architectural limitations inherent in FPGAs". FPGAs, based on SRAMs, are less efficient than E^2-based structures at using multiple metal levels so requiring increasing die size to add functionality.

The Raphael architecture uses an extra hierarchical interconnect layer—making four in all—to improve functionality and performance. (Source: *Electronics Weekly*, 22 October 1997)

Small torque

IBM's Zurich Research Laboratory and the University of Zurich claim to have developed the most sensitive device ever for measuring magnetic moments. Called a torque magnetometer, it is 140 μm wide and measures the torque exerted on magnetic samples exposed to a magnetic field. The instrument is a silicon microcantilever with integrated piezo-electric elements to measure deflection. Its sensitivity is said to be 1,000 times better than commercial alternatives. The magnetization of a 650 nm-wide sample of magnetite weighing 400 pg—equivalent to the amount of magnetic material in a pigeon's internal compass—can be measured. San Diego-based Quantum Design plans to produce a commercial instrument based on the sensor soon. (Source: *Electronics Weekly*, 29 October 1997)

Evolutionary chip design

Researchers at the University of Sussex in the UK are using evolutionary techniques to determine the optimum design for integrated circuits (ICs). Developed by Adrian Thompson and colleagues at the Centre for Computational Neuroscience, the system has designed ICs that use 1 per cent of the silicon used by comparable human-designed circuits.

The system uses field-programmable gate array (FPGA) ICs that can be continuously reconfigured to perform different tasks. An evolutionary algorithm randomly configures the FPGA and physical performance of the configuration is evaluated using evolutionary fitness criteria. The next step is the "cross-breeding" of successful designs to produce even more efficient ICs.

Thompson speculates that the technique could also be used in chips in which the configuration changes during use, always being the most efficient configuration for the current task. (Source: *Scientific Computing World*, September 1997)

Researchers create quasi-periodic superlattice

A research group from the Institute of Physical and Chemical Research and the University of Electrocommunications of Japan, has succeeded in fabricating a semiconductor superlattice in which the alternating layers of two thin film materials stack to form a quasi-periodic structure. The arrangement of the thin films, as well as the electron states determining the materials' characteristics, exhibit fractal properties. According to the

Japanese group, this can lead to the creation of "fractal superlattices", with potential applications as new types of electronic materials. The material was developed using ALE to alternately stack a layer of GaAs thin film with gallium phosphorus. The two films arrange themselves in quasi-periodic order, following the rules of a Fibonacci series. The researchers confirmed the superlattice's fractal nature through X-ray analysis. (Reprinted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahner's Publishing Co., Des Plaines, IL, USA)

High-brightness LEDs

Light emitting diodes (LEDs) are becoming a viable alternative to the incandescent light bulb. In the past five years, the luminous performance of high-brightness LEDs has surpassed red-filtered incandescent sources. Today, efforts are being made to further improve efficiency and productivity. A compound semiconductor wafer bonding technique that improves efficiencies by a factor of two over current LED technologies has been developed by researchers at Hewlett Packard's optoelectronics division (San Jose, CA).

A1GaInP double heterostructure (DH) LEDs have been fabricated using a proprietary wafer-to-wafer bonding technique where the GaAs absorbing substrate (AS) is removed and replaced by a "transparent" n-type GaP substrate (TS). Luminous efficiencies exceed unfiltered 60 W tungsten sources (>15 lumen/W) in the yellow-green to red (570 to 640 nm) spectral range (see figure below). This has opened the way to high-power appplications, such as traffic signal installations where a 15-20 W LED bulb could replace a 60 W filtered incandescent bulb. In 1996, an actual installation in St. Paul, MN, demonstrated a 38 per cent savings in energy costs and a 1.7 million kilowatt hour annual reduction in energy.

The LEDs were grown by metal organic vapour phase epitaxy (MOCVD) on GaAs substrates for lattice-matched growth. An ~50 μm p-type GaP window layer was grown on top of the structure by hydride vapour phase epitaxy (VPE) to improve current spreading in the top contact and to facilitate handling of the epitaxial layers during wafer bonding. This technique has been demonstrated on 50 mm diameter wafers.

Conventional chemical etching techniques are used to remove the GaAs substrate. The exposed n-type layers are then placed adjacent to an ~8-10 mil thick n-type GaP substrates at elevated temperatures, 400-1,000° C, under uniaxial pressures. The two surfaces are bonded into a single wafer. Low-resistance ohmic conduction across the wafer-bonded interface is enhanced by matching the crystallographic orientations of the surfaces and effectively increases high-power LED conversion efficiencies. Efficiencies are further improved when the LED is packaged in a reflector cup with partially reflective silver epoxy. Light is emitted from the transparent substrate and reflected out to the five remaining surfaces.

The mechanical strength of the wafer-to-wafer bonds exceeds that required to withstand scribing, dicing and packaging, noted Fred Kish, R&D project manager at HP. When a die sheering test using ~10 kg/cm² was applied to the edge of the die, no failures were observed at the bonding interface, but \rather at areas within the GaP substrate itself.

There may be some fundamental advantages of LEDs over conventional lighting where lifetimes are on the order of 1,000 hours. Unlike the burning of an incandescent filament, the light generating electron-hole recombination event in an LED is not an inherently destructive process and may thus provide higher reliabilities. High-brightness LEDs have demonstrated projected lifetimes in excess of 100,000 hours under accelerated lifetest, according to Kish. (Reprinted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahner's Publishing Co., Des Plaines, IL, USA)

Versatile chemical sensors

Two separate groups report that they have created new chemical detection schemes that promise to be compact, cheap and versatile.

The new systems detect compounds when they bind to recognition molecules embedded in the sensor material, changing the way it interacts with light. One scheme exploits the optical properties of a silicon chip that has a surface etched into a forest of pillars and pits; the other relies on an assemblage of tiny plastic spheres trapped in a polymer-and water-based gel.

The new sensors are based on cheap starting materials, yet they can detect a wide range of compounds with high sensitivity—the silicon-chip sensor, for example, can detect DNA strands at concentrations of one part in a quadrillion, a sensitivity 100 times better than conventional sensors can achieve. As a result, they could pave the way to low-cost detectors for medical diagnosis, industrial monitoring and environmental testing. (Extracted from *Science*, Vol. 278, 31 October 1997)

From pure light, particles of matter

Scientists have long been able to convert matter into energy. Now by using the Stanford Linear Accelerator Center (SLAC), they have been able to reverse the process.

A research team has created particles from photons. The creation was observed when electrons near the speed of light collided with photons from a tabletop terawatt glass laser, developed at the University of Rochester. The photons collided with other densely packed photons to create an electron and a positron. Over several months, the team studied thousands of collisions, leading to the production of more than 100 positrons. Participants included scientists from the University of Rochester, Princeton University, the University of Tennessee and Stanford University. (Source: *Industry Week*, 20 October 1997)

D. MARKET TRENDS AND COMPANY NEWS

Market Trends

Bright future for LCD monitors

The LCD monitor market is expected to grow at a 120 per cent compound annual growth rate from 1997 to 2001, from 480,000 to 11.3 million units, according to DisplaySearch, a market research firm based in Austin, TX. The majority of the growth is expected to occur in the larger panel sizes, equivalent to 17-inch and 20-inch CRT monitors. DisplaySearch also expects growth to accelerate when fourth-generation lines, which were determined to be most cost-effective in the production of the larger panel sizes, begin operation. (Reprinted with permission from *Semiconductor International Magazine*, June 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Cheaper LCD manufacturing design

Manufacturing cost savings from 20 to 80 per cent are cited for a new integrated liquid-crystal-display (LCD) design jointly developed by Paris-based Thomson Multimedia and Sarnoff Corp., Princeton, NJ. The cost of implementing the active-matrix technology for an average production line is estimated to be well under $5 million and is expected to provide a return on investment in less than one year. Based on new self-scanned amorphous silicon integrated display circuitry, the approach integrates the electronics into the display itself, eliminating the cost of perimeter circuitry and freeing space for a larger viewing area. The companies are licensing the technology. (Source: *Industry Week*, 23 June 1997)

Worldwide DBS market to hit $3.2 billion

In-Stat (Scottsdale, AZ) expects dramatic growth for digital Direct Broadcast Satellite (DBS) set top boxes because of burgeoning global demand. In 1996, the United States and Canada were the primary markets for digital DBS set top boxes. However, in 1997 many new satellite transmission systems were being launched into space, opening up new DBS markets for Europe, Japan, Asia/Pacific, Latin America and the Middle East.

In-Stat expects the worldwide market for DBS set top boxes to grow from $3.2 billion in 1997 to more than $4 billion in 1999 through 2000. During 2001, price reductions will reduce revenues to around $3.5 billion. (Extracted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Computer shipment growth strengthens, production and capacity gains continue strong

Growth in the dollar value of shipments from manufacturers of computer and office equipment (SIC 357) bounced back during the second quarter of 1997 following an uncharacteristically weak first quarter.

Further evidence of the continued extraordinary strength of the computer/office equipment manufacturing sector is contained in the Federal Reserve Board's report on industry capacity. The Fed's latest survey shows that the industry's productive capacity expanded by 38.5 per cent between July 1996 and July 1997. Overall capacity growth in the manufacturing sector of the US economy has expanded by a solid rate of 4.2 per cent during the past year. Since the current economic expansion began in earnest in 1992, industrial productive capacity across the whole range of manufacturing industries has grown by about 48 per cent; for the computer/office equipment sector, capacity has grown by more than 350 per cent. (Extracted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Global prospects for PLC market

Capital spending for plant capacity in the US and Asia will boost the global programmable-logic-controller (PLC) market at an average annual rate of nearly 5 per cent through 2001, says Automation Research Corp. (ARC), Dedham, MA. Its new study, "PLC Worldwide Outlook", predicts the market will increase from slightly more than $5.5 billion to more than $7 billion in the next five years as the PLC business continues to migrate towards nano- and micro-distributed systems and open architectures. Major new emerging technologies impacting the PLC market include Windows NT, device networks, more powerful microprocessors, networking and the Internet and intranets. ARC says its new controller segment, "PC Compatible & PC Plug-in Controllers", will experience the largest growth— nearly 160 per cent—of any PLC type during the next five years. The dominance of PCs with Microsoft Corp. operating systems on both the business and control ends of a manufacturing plant will further compress the automation hierarchy well into the twenty-first century, making data

more accessible to operators, managers, and remote sites. (Source: *Industry Week*, 15 September 1997)

Manufacturers go for annual DRAM

DRAM manufacturers are set to break with the tradition of introducing a new generation every three years, which quadruples density, and instead bring out a new generation every year, doubling density. First examples of intermediate generation DRAMs will be 128 Mbit and 512 Mbit DRAMs.

Manufacturers such as IBM intend to slip a couple of 64 Mbit dies in the industry standard 400 mil package; others, like Fujitsu, will go straight to a monolithic, single die 128 Mbit device. LG Semicon will start with a double die and move in a couple of months to a single die.

The DRAM manufacturers are planning a new generation of DRAM every year: the 256 Mbit is pencilled in for 1999, the 512 Mbit is slated for 2000, and the 1 Gbit for 2001.

A number of reasons are being given for the break with normal practice. One is that Intel has demanded it for its PCI 100 bus—a proposition which Intel declined to confirm or deny. Another is that PC manufacturers are demanding 128 Mbits because the current x16 width generation of DRAMs means that 64-bit microprocessors require four DRAMs, while four 256 Mbits is too much memory for the PC makers.

A further reason is because 128 Mbits fit into the standard 400 mil package whereas 256 Mbits, made with current process technology, cannot fit.

The last reason cited for the break is that DRAM manufacturers may not recover their investment in the 16 Mbit and 64 Mbit DRAM generations and need a new product to add value to their wafers. (Source: *Electronics Weekly*, 1 October 1997)

Electronics output growth moderates

The best available measure of the dynamics and momentum of any industry—total product output—is the set of industrial production indices compiled by the Federal Reserve Board. Unlike measures of industry shipments (which are expressed in current sales dollar terms), price changes do not distort the underlying trends in end-market output that is captured by the industrial production data.

For the broadly defined electrical/electronic machinery and equipment industry, output has grown at a double-digit annual rate for five consecutive years now.

Here are highlights of the trends in some of the important subsectors of the overall electronics/electrical end-market:

- Production gains in the components sector have been exceptional for several consecutive years. Even with the plunge in semiconductor prices last year, the total components sector recorded unit output growth of more than 20 per cent. Momentum should begin to build again as we move into 1998.

- Despite large gains in the dollar value of communications equipment shipped during the past several years, unit output gains have generally lagged behind those of other electronics industries.

- US-based output of consumer electronics products declined in 1996 after solid increases had been recorded the previous several years, despite the strong demand for consumer electronics (both US- and foreign-manufactured). A modest bounce back during 1998 may be anticipated.

(Extracted with permission from *Semiconductor International Magazine*, September 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Audio chip market prediction

In-Stat (Scottsdale, AZ) announced that it expects the audio subsystem market to undergo substantial changes this year, as it moves to the PCI bus. This move will set off an explosion of innovation in the PC audio market that will attract new players and open up new opportunities in the audio chipset market. As a result, In-Stat anticipates the audio chip market to experience increased unit growth, exceeding $1.6 billion by 2001, up from $634 million in 1996.

In-Stat's 34-page report, "PC Audio: A Market in Transition", provides a comprehensive market analysis of the PC audio markets, technologies and strategies, along with forecasts and segmentations for PC audio chips and a competitive analysis of the manufacturers involved. (Extracted with permission from *Semiconductor International Magazine*, September 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

The impact of the Internet on telecommunication companies

If there is one thing on which both telecommunication and Internet communities seem to agree, it is that the Internet must move to bandwidth pricing and a settlement mechanism if it is to continue to service the increasingly demanding applications that are running across it. Telcos are going to have to learn to live with such a model, although this should not prove to be that difficult.

The Internet boom will also stimulate other parts of the telecommunications business. Telcos are beginning to understand the dynamics of intranet/extranet style services and suddenly it seems that Internet technologies are not necessarily an elaborate bypass threat after all. In fact they are increasingly seen by business customers as the basis of their own network development plans and these customers are demanding services which can run the resulting business applications with the necessary security and reliability they expect. Telcos are well placed to provide intranet services and while there might be structural difficulties, these again are not impossible to resolve.

In every sector, companies have spent the past decade developing communications technologies which have stalled at the public network for want of an open and cost-effective way of connecting them. Now that Internet technologies seem capable of fulfilling the gap, old favorites such as desktop video conferencing are being dusted off for business use over the Internet. Electronic commerce is also resurgent as a Web application, with no less a company than IBM as its champion. (Source: *Communications International*, August 1997)

Extranet

According to Price Waterhouse, goods and services valued at $500 million were sold via the Web in 1995. Forrester Research predicts that there will be 14 million business users on the Web by the year 2000.

The most recent manifestation of Web-based business activity is the creation by some companies of *extranets*. Essentially, these are intranets extended to embrace customers and suppliers, as well as employees based off-site. Early applications include (as might be expected) external

e-mail, information access and advertising. A very small proportion of companies, however, are also using such systems for invoicing and payments. Concerns about security are probably inhibiting adoption in this area.

Although the technology is well-suited to information retrieval, it is less than ideal for standard data-processing tasks such as updating a database or processing a financial transaction. Again, this will constrain the use of extranets until improvements in the underlying software infrastructure (and organizations' development of the necessary design skills) makes them more practicable.

An illustration of the limitations of current extranets is provided by the parcel-tracking facility offered by the US company, Federal Express. Customers can log on to determine where their parcel is in the delivery chain. Although customers can view the data, however, they cannot change it. A full extranet would allow customers to re-schedule deliveries.

This would entail support for more complex transactions than simple data access, and necessitate a more robust infrastructure than current Internet or intranet systems. Creating such an infrastructure, with the necessary security systems, represents the next challenge for businesses. (Source: *RGB: the IT Network Magazine*, August/September 1997)

Mass storage products

Despite the falling costs of electronic storage, there is still a problem as regards meeting the demand for storage economically. Many companies are still increasing the size of their paper mountains by 20 per cent a year. An effective strategy demands that a cost-effective mix of storage products be employed.

Magnetic disk storage, often in the form of RAID arrays, offers access times one quarter those of optical disks, but is rewritable. This latter characteristic makes it un-suitable for applications where audit trails and permanent recording are required. In these circumstances, optical disks offer high-capacity storage (a 2.6 Gb 5.25-inch optical disk can accommodate up to 60,000 document images) at a cost per megabyte as little as one-tenth of that for magnetic disks.

Magneto-optical (M-O) disks offer the options of either rewritable or WORM (write once, read many) modes. The current generation of M-O drives and media conforms to the 4X standard (2.6 Gb), but 8X (5.2 Gb) will be available early in 1998. The data transfer rate has also been improved, approaching speeds matching those offered by conventional magnetic disks. A new generation of ASMO (advanced storage magneto-optical) devices is also currently under development: these will be able to store 6-7 Gb.

Tape systems are also exhibiting new features, including "intelligence" built into a chip in the cassette, which reduces the average search time from 45 to 7 seconds. Capacity has also increased: Sony's AIT tape has a capacity of 25 Gb, the equivalent of a small jukebox.

It is also noticeable that standards are beginning to be more aggressively supported via trade groups such as OTSA (Optical Trade Suppliers Association) and the Document Management Suppliers Forum. (Source: *Document Manager*, 5 (4) July/August 1997)

How the Web is changing the business of business information

Explosive growth of the Internet and Web in recent years has challenged and changed many aspects of the business information business. These changes will accelerate for the years ahead. On the positive side, the Web has enabled a rapid shift from proprietary applications and software to standard communications and browser interface. This should make it easier and faster to provide direct access to more compelling business information sources and applications for more users. The Web dynamic also raises awareness, expectations and demand for better access to information.

The Web has also stimulated tremendous creativity in formulating new tools for implementing business applications quickly and creatively: many of these, like Java, have only recently been applied to serious business applications. The Web and related intranet initiatives encourage seamless integration of external and internal sources of information in the same business applications. On the other hand, the Web creates numerous challenges. The history of the Internet and the Web encourages the mistaken view that information and access can and should be nearly free. Substantial uncertainty surrounds the business model for many providers of services and content associated with the Web.

Broad access to general business information via the Web, the Internet and corporate intranets can dramatically accelerate the creation and delivery of higher value business applications. These services must be developed and deployed thoughtfully and must be tightly integrated into real business applications in order to achieve their potential impact. Inevitably, business information services and applications must meet the users' need for topic-centric rather than publication centred access to information. Beyond a core set of titles, business decision makers seek useful information from a wide range of sources, accessed conveniently and consistently, to deliver the right answers. (Source: *The Electronic Library*, 15(4) August 1997)

The for and against for embedded DRAM

To embed or not to embed, that is the question. Whether the sub-$2 cost of a discrete 4 Mbit DRAM makes it ridiculous to incur the costs of embedding it, or whether the extra performance of embedded DRAM can be worth the extra cost.

Why the fuss about embedding DRAM when other memories such as SRAM, EPROM, EEPROM or flash are routinely embedded? Because of the capacitors used in DRAM manufacture whereas the other memories are made up of transistors.

Logic processes are all-transistor. Marrying up an all-transistor logic process with an all-transistor memory process is an easier business than tacking on a process which contains capacitors.

Capacitors—either entrenched in the silicon substrate or stacked on top of it—add steps to the manufacturing process which add cost.

That is why DRAM is the last kind of memory to be used in embedded applications. Its value has been much hyped.

But will embedded DRAM follow other technologies like bubble memories, multi-chip modules, anti-fuse and BiCMOS to become a technological byway after promising to be a highway?

It is a straightforward issue—extra performance versus extra cost. Better performance derives from the extra width you can put in embedded DRAM. Whereas a discrete DRAM is organized x1, x4, x8, x16, or x32 bits, embedded DRAM can be as wide as 1,024 bits.

That allows for very much higher data exchange rates than the fastest conventional DRAM buses between discrete chips such as Rambus.

Whereas the next generation of Rambus—Rambus 2 expected in 1999—is expected to transfer data at up to 12.6 Gbits-per-second at 800 MHz using a 16 bit wide memory, a 1024-bit wide embedded block of DRAM can deliver data rates of 160 Gbits-per-second at 166 MHz.

The other benefits of embedding are obviously reduced capacitance by eliminating external connections, a reduced footprint, reduced pin-count and reduced EMI. But there is also another benefit—reduced power consumption by up to five times.

The downside is the extra cost of embedded DRAM. That comes from the extra masking layers involved in adding the capacitors needed for the DRAM process.

Embedded DRAM needs six extra masking layers than embedded SRAM. That adds some 20 per cent to the eventual unit cost of an ASIC incorporating embedded DRAM.

Additionally, non-recurring engineering charges (NREs) for embedded DRAM are 50 per cent higher than those for conventional ASIC, so unit volumes have to be above 10,000 units to make it a cost-effective exercise.

The costs suggest that embedded DRAM is not yet a substitute for cheap, discrete DRAM but it may be a substitute for wide (32-bit), high-performance (100 MHz+), expensive (£15), SRAM.

Despite the current cost disadvantages in embedding DRAM, there are varying estimates that the market for ASICs containing embedded DRAM could range from $4-7.5 billion by 2000, which is why the world's top DRAM companies such as NEC, IBM, Texas Instruments, Toshiba, Hitachi, Samsung, Fujitsu, Siemens, Mitsubishi et al. as well as the world's top silicon foundries such as TSMC of Taiwan and Chartered Semiconductor of Singapore are all offering, or about to offer the technology.

According to Toshiba, the cut-off point where embedded DRAM becomes cost-effective is in systems requiring 5 Gbits-per-second data transfer rates and faster.

This might be normal in graphics processing and is becoming a requirement in some telecommunications areas such as ATM and Ethernet switching, but it is needed in few other areas—yet.

But processors are getting faster exponentially—capable of Gbit-per-second processing around the year 2000—and faster memories, especially in areas requiring high integration like portable equipment, could take embedded DRAM technology into the mainstream.

The largest application developing to fill that $4.75 billion market in 2000 is 3-D graphics —with 35 per cent of the market; followed by hard disk drive control with 22 per cent; networking at 11 per cent and cache at 7 per cent. After that comes a collection of small market areas: printers and wireline communications at 4 per cent of the market each; DVD control at 3 per cent; PDAs, set-top boxes and games machines with 2 per cent each, and wireless communications with 1 per cent.

That is 93 per cent. The rest is for "others". So even "others" could command a $70 million market, suggesting that there is a lot of value-added which a good DRAM-on-ASIC process can bring to the equipment industry, and a lot for the semiconductor industry to play for in reducing the cost of embedding DRAM. (Source: *Electronics Weekly*, 27 August 1997)

More older users

Almost one in three adults age 55 and older now owns a computer, a 43 per cent jump from one and one half years ago, according to SeniorNet, a non-profit US organization that promotes computer literacy for older adults. The number of older people using online services is also climbing. Of the estimated 50 million users, more than 7 million are older than 50, many with above-average incomes and education. Most current research shows that people in their teens and 20s, and those over 55, are more likely to use computers outside the office than are baby boomers. Some reasons for the increase in senior computer use: Computers have become easier to use and are more readily available at community sites such as libraries and senior centres. (Source: *Communications of the ACM*, vol. 40, No. 11, November 1997)

Taiwan's chipmakers to invest $67 billion in next 10 years

Taiwan's chipmakers have collectively announced plans to invest more than $67 billion over the next 10 years. From 1994 to 1998, Taiwan chip producers invested about $16.7 billion in 8-inch fabs. The new $67 billion in investment includes plans for some of the world's first 300 mm fabs.

In terms of sales volumes, Taiwan's fab business has grown at a compound annual growth rate of close to 50 per cent from 1991 to 1996.

IC manufacturers in the Taiwan market collectively invested more than their combined output for the first six months of 1997, spending the equivalent of 100 per cent of sales during the period on new capital equipment. By comparison, the Republic of Korea spent just less than 60 per cent of sales on equipment, with Europe at about 25 per cent, Japan near 22 per cent and the United States at 21 per cent. The data, compiled by SEMI, show worldwide spending for wafer fabrication equipment during the first half of the year totaling $9,618 million, of which Taiwan accounted for 14 per cent. Assembly equipment spending reached $820 million, with Taiwan capturing 13 per cent, and test equipment amounted to $2138 million, with Taiwan responsible for 12 per cent of that. (Extracted with permission from *Semiconductor International Magazine*, November 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Semiconductor market to reach $300 billion in 2001

The worldwide semiconductor market is on pace to bounce back from declining revenue in 1996 and grow 5.6 per cent in 1997 with revenue reaching $149.7 billion, according to Dataquest (San Jose, CA). In 1996, the semiconductor market posted a 6.3 per cent drop with revenue totaling $141.7 billion, and low DRAM pricing in 1997 will limit the worldwide semiconductor market to single-digit growth this year, according to Dataquest analysts.

Dataquest analysts predict the worldwide semiconductor market will show double-digit growth in 1998. They believe the market will sustain double-digit growth through the year 2001, with worldwide revenue surpassing $300 billion (see table 1).

Table 1

Worldwide semiconductor revenue forecast

1996	*1997*	*1998*	*2001*
Total market ($ billion)			
141.7	149.7	174.7	300.1
Annual growth (%)			
-6.3	5.6	16.7	10.2

Source: *Dataquest.*

While microprocessors and DRAM are expected to be the key market drivers for semiconductor growth, other semiconductor products should experience the fastest growth. (Extracted with permission from *Semiconductor International Magazine*, November 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Technology recognition signals Euro revolution

A revolution is happening in Europe's approach to microelectronics with a new-found recognition of the importance of getting technology out of laboratories and into factories, says professor Roger van Overstraeten, president of IMEC, the International Microelectronic Centre at the University of Leuven, and a director of the EU research programme MEDEA.

"The problem of Europe is not the research but turning the research result into a product and bringing it to market. That is changing," van Overstraeten said.

The time is ripe for Europe to back microelectronics entrepreneurship. "It is only recently that we have had critical mass in this field," said van Overstraeten. "In Flanders—and all over Europe—IT is seen as an extremely important driver of wealth for the people". Van Overstraeten has come up with a BF 2 billion ($50 million) venture fund (expected to be increased to BF 3 billion) to fund IT start-up companies, backed by seven banks to be invested by a committee chaired by van Overstraeten.

The Belgian Government is one of only five Governments in Europe—the others being Germany, France, Italy and Holland—significantly backing MEDEA. (Extracted from *Electronics Weekly*, 26 November 1997)

Satellite-based services

At least three operators will be offering satellite-based global data communications services like the Internet in the year 2001. This follows a ruling by the International Telecommunications Union (ITU) that frequencies designated for broadband services must be shared. Previously ITU had indicated that only one operator—Teledesic—would have access to the frequency bands. At least two other operators, Alcatel's Skybridge and Motorola's Celestri, are expected to compete with Teledesic when they become operational in 2001. The basis of the deal is that geostationary, or fixed-orbit satellites already in space must share bandwidths with proposed, non-geostationary systems. (Source: *Electronics Weekly*, 26 November 1997)

GSM keeps on top in cellular race

GSM will continue to dominate the digital cellular phone market until the establishment of the third generation of cellular systems, according to a report published by Forward Concepts. The study, *Wireless98*, forecasts that the market for GSM cellular phones will peak at $7.7 billion with sales of just over 32 million units in 2000. Its main rival, CDMA, is forecast to grow its market share to almost $4 billion with sales of roughly 16 million units in 2002. (Source: *Electronics Weekly*, 26 November 1997)

Company News

Free Web devices possible by 2000

Internet devices will be offered to consumers for free by the year 2000. So claims Martyn Gilbert, managing director of DOT Matrix, the Cambridge-based company developing network-oriented computers.

Gilbert said that just as some mobile phones are now available for free, products like Internet appliances will pay for themselves through subscriptions to various services available over the Internet.

The company has developed the digital on-line terminal, called DOT. This is a general hardware platform that can be tailored to applications such as home banking, Web-enabled phones and set-top boxes.

DOT also contains a smart-card reader which enables shopping over the Internet.

Electronic purse company Mondex, whose technology is about to be deployed over the Internet, is one company that Gilbert is in discussion with.

DOT Matrix has just signed a deal with Diba, the US-based company which has developed a software platform for Internet-based consumer electronics products. The two companies will jointly develop Internet-based consumer applications based on DOT Matrix's hardware design.

Diba will also support DOT's smartcard reader which, according to both companies, provides the key to volume take-up of the product. (Source: *Electronics Weekly*, 21 May 1997)

Microsoft puts down roots in Cambridge

Cambridge University and the software giant Microsoft will site Microsoft's first foreign research centre at the University. Over the next five years, Microsoft will spend $80 million on the new centre, which will employ about 40 leading researchers and accommodate other short-term academic staff and graduate students. The researchers will be employees of Microsoft, but will be encouraged to give lectures at the University and interact with academic staff. The University is helping to provide land and buildings for the centre.

Following the success of its first research centre at Redmond, WA, Microsoft decided in 1996 to triple its research effort.

Roger Needham, former head of the University's computing department, will head the new centre, and other staff will be recruited from across Europe and beyond. Needham said the goal of the centre is to develop the next generation of computing technologies that will enable machines to interact with their users in a more intelligent way. The company has set up a technology advisory board of top European researchers to help it recruit key staff and highlight research areas.

Microsoft also unveiled plans to invest $16 million in venture capital for local high-technology industries in Cambridge. (Extracted from *Science*, vol. 276, 20 June 1997)

Hitachi links into Cambridge R&D

Hitachi Europe and Cambridge University are to collaborate in communications systems research. The company's R&D division will work with the University to develop software technology for computer networks.

Hitachi joins Alcatel, Nortel and the US Department of Defense's Naval Research Laboratories in funding network technology research at the University's Centre for Communications Systems Research (CCSR).

Professor Stewart Lee, director of CCSR, is in negotiation with a further nine potential industrial partners.

Hitachi researchers will be working alongside 24 full-time academics to develop technologies in such areas as copy protection, network security and network systems architecture.

Digital "watermarking" for copy protection is one technology CCSR hopes to develop with Hitachi.

Other research being carried out by CCSR concerns future hardware technology, building on ATM and Ethernet networking technologies.

Funding for CCSR research programme will amount to over £1 million a year of the nine companies sign up. (Source: *Electronics Weekly*, 25 June 1997)

Fujitsu, NEC plan PLD push

Programmable logic, a semiconductor product area which Japanese companies have yet to penetrate, is being targeted by Fujitsu and NEC.

With the programmable logic market now approaching the $2 billion mark, it is a difficult product sector to ignore, but a handful of US companies—Altera, Actel, Xilinx, Cypress, Lucent, Vantis and Lattice—dominate the market and the patent position.

Fujitsu is looking to acquire the technology more as a capability to boost its leading position in ASICs than as a route to becoming a supplier of discrete PLD chips. (Source: *Electronics Weekly*, 11 June 1997)

Japanese set target for 12-inch wafers

Leaders of the semiconductor industry in Japan do not anticipate moving to 12-inch wafers before 2001—which will come as a relief to the rest of the world—and do not expect 12-inch fabs to be unduly expensive.

SEMI, the semiconductor equipment trade body, expects there to be as many as nine pilot 12-inch lines in the world next year.

The move to 12-inch wafers could coincide with the move to 0.18 μm process technology. The semiconductor industry does not expect lithography tools capable of volume production on 0.18 μm to be available until 1999. (Extracted from *Electronics Weekly*, 11 June 1997)

AMD signs loan agreement for Dresden megafab

AMD (Sunnyvale, CA) signed a loan agreement that will finance Fab 30, a new semiconductor wafer fab factory and research centre to be built by AMD in Dresden, Germany. The loan commitment totals $967 million. Current plans call for a total investment of approximately $1.76 billion through the year 2006. AMD will contribute resources totaling $332 million. German governmental support adds up to $469 million supplemented by an indemnity bond to partially secure the loan.

The loan provides for the construction of an 875,000 sq ft chip fabrication facility and the establishment of a design centre. The wafer fab facility will include approximately 90,000 sq ft of cleanroom space.

The plan is for the Dresden megafab to begin production in 1999 and be capable of producing 6,000 8-inch wafers/week at maximum capacity. (Reprinted with permission from *Semiconductor International Magazine*, May 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Partnership to develop advanced lithography technology

A private industry consortium, led by Intel, Advanced Micro Devices and Motorola, have joined forces with the Virtual National Laboratory (VNL)—consisting of three US Department of Energy labs—to launch an advanced lithography research project targeted at increasing computer chip capabilities for the twenty-first century.

The advanced lithography technology—called Extreme Ultraviolet (EUV)—will allow the industry to etch circuit lines smaller than 0.1 μm widths.

The group, known as the EUV LLC (Extreme Ultraviolet Limited Liability Co.), will invest $250 million in private funding over the next three years to develop extreme UV lithography for commercial manufacturing of computer chips. This project represents the largest investment ever by private industry in a Department of Energy research project. The group hopes to move today's developmental EUV technology into production factories early next decade.

The Virtual National Laboratory represents the combined resources of the Lawrence Livermore National Laboratory, Sandia National Laboratories and E. O. Lawrence Berkeley National Laboratory.

The EUV LLC has received the support of government and industry organizations such as the Defense Advanced Research Projects Agency (DARPA), the US Semiconductor Industry Association (SIA) and SEMATECH; technology suppliers 3M, Integrated Solutions (ISI), Northrop Grumman, Tinsley Laboratories and TRW; and semiconductor equipment manufacturers ASMLK, Nikon, Silicon Valley Group (SVG) and Ultratech Steppers.

TRW (Redondo Beach, CA), for example, reports that it signed an agreement in late July with the EUV LLC, calling for the development, integration and testing of an EUV light source based on TRW's solid-state laser technology.

A well-controlled interaction between the laser and the plasma will generate the required output of EUV radiation. The VNL is currently working with the EUV LLC as part of a cooperative research and development agreement signed in March.

TRW is scheduled to deliver the first EUV LLC laser in January 1999. A demonstration of the integrated light source prototype is expected to occur at one of the VNL member sites during December 1999. Wafer stepper manufacturers are expected to begin integrating the EUV light source in test configurations by the end of 2000. (Extracted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Hitachi and DuPont form joint venture

The DuPont Co. (Wilmington, DE) and Hitachi Chemical Co. Ltd. (Tokyo, Japan) have agreed to establish a new global joint venture in high-performance liquid

polyimide materials for microelectronic applications. Polyimides are used for stress buffer and dielectric layers in the fabrication of semiconductor chips and related components.

The startup date for the new joint venture, HD MicroSystems (Hitachi Chemical DuPont MicroSystems L.L.C.), is subject to the receipt of appropriate regulatory approvals. The venture will combine both Hitachi Chemical and DuPont polyamide coating businesses, including research and development, manufacturing, quality assurance, sales and technical service.

HD MicroSystems will be owned and funded equally by DuPont and Hitachi Chemical Company America Ltd. A wholly owned subsidiary based in Japan will serve Pacific Rim countries. HD MicroSystems management will be located in the United States and Japan, with a global workforce serving Japan, Asia/Pacific, the Americas and Europe.

As a new company catering to the global needs of the microelectronics industry, HD MicroSystems will also have manufacturing capability in North America and Japan. DuPont's Parlin, NJ, production facility and the Hitachi Yamazaki works in Hitachi City, Japan, will provide HD MicroSystems with local manufacturing and distribution points in the Pacific Rim, the Americas and Europe, as well as the ability to cross-manufacture the same products, to maintain flexibility as a global supplier. A new, state-of-the-art manufacturing facility is planned for Parlin, with operations expected to start in late 1998. (Reprinted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Motorola flash bid

Motorola is developing its own architecture for stand-alone flash memory which it will use to produce a 1.8 V simultaneous read/write flash in 1998 and a 0.9 V version in 1999.

Until now Motorola's involvement in discrete flash memory efforts has centred on a joint development with Mitsubishi. This has involved licensing the Japanese company's 3.3 V DINOR single transistor cell flash architecture which the two companies continue to develop in tandem.

However, the low voltage flash effort being pursued exclusively by Motorola is of a two transistor cell NOR flash architecture.

Motorola's flash will have a 1.8 V write as well as read and will be genuinely simultaneous, allowing a read while being written to without latency.

Motorola's plan is to sample the 1.8 V flash on a 0.35μm process and then move to a quarter micron process for production volume quantities in the third quarter of 1998.

The initial densities of the 1.8 V devices will be 8 Mbit and 16 Mbit. They will be made in Motorola's MOS15 wafer fab in Austin, TX, and will be packaged in the microBGA package which has a 0.75 mm ball pitch. (Source: *Electronics Weekly*, 22 October 1997)

Motorola follows IBM down the copper track

Motorola has announced that from 1998 its leading edge semiconductors will use copper tracks instead of aluminium to connect transistors.

The announcement comes on the heels of a similar disclosure from IBM.

Like IBM, Motorola is aiming its first copper process at 0.2μm chips with effective channel lengths of 0.15μm or lower. Up to six layers of metal are available in the process.

One hundred million transistors could be fabricated on a single die with the process, Motorola claims. First samples are expected by the middle of 1998, with production in September of 1998.

Copper has advantages over aluminium as an interconnect material, principally due to lower resistivity—nearly 40 per cent less. However, its tendency to diffuse through the substrate means it needs isolating from the silicon. The technique used to contain the copper is called a damascene process, which completely encloses the tracks except where they contact the interconnection vias. (Source: *Electronics Weekly*, 8 October 1997)

Interface challenge to CDMA

A radio air interface for next-generation mobile phones has been proposed to challenge the Ericsson and Nokia-backed CDMA (code division multiple access) protocol.

The technology, called TD-CDMA (time division code division multiple access), is being promoted by a group of telecoms manufacturers, including Alcatel, Nortel and Siemens. It combines the frequency spreading aspects of CDMA—where data signals are spread out from narrow bandwidths to broader ones—with the time slotting technique of TDMA (time division multiple access) that allows one GSM band to carry up to 8 channels.

The proposed technology was in response to Nokia's and Ericsson's announcement that they are proposing the use of CDMA before the European Telecommunications Standards Institute (ETSI).

ETSI will decide which air interface protocol to use for UMTS (Universal Mobile Telephone System). (Source: *Electronics Weekly*, September 24, 1997)

Siemens 32-bit chip/DSP rated at 120 Dhrystones

Siemens has unveiled its 32-bit microprocessor cum-DSP for real-time embedded applications.

Called TriCore, the core has a 120 Dhrystone Mips rating and features a single cycle (10ns) 16-bit multiply-and-accumulate (MAC) unit for DSP computations. Siemens intends to add up to 16 Mbit of embedded DRAM to the core when used in system-on-a-chip designs for such applications as mobile phones, disc drives and automotive.

Sample silicon is due to be shipped in mid-1998 with full production of a 100 MHz part in early 1999. The target price is $15. (Extracted from *Electronics Weekly*, 24 September 1997)

Sharp gets reflective on LCDs

Sharp is to begin making reflective colour LCDs, which consume one seventh of the power and are one third the thickness of conventional LCDs.

Reflective LCDs save power over existing displays because they do not need a backlight. Several companies are vying to produce colour reflective LCDs. Sharp is to use one of the simpler technologies, developed in conjunction with Professor Uchida of Tohoku University, which adds an opaque reflective coating to the transparent rear cell conductor. When the cell is on (transparent) the reflector is exposed and bounces incident light back out of the cell.

The company is claiming a reflectivity of 30 per cent and a contrast ratio of 10:1. Switching speed is 50 ms, the same as conventional TFT displays.

The initial product, planned for production in January 1998, will be a 75 mm (280 x 220) model with 260,000 colours, followed by 100 mm and 160 mm displays. (Source: *Electronics Weekly*, 24 September 1997)

Business laboratory

Hewlett-Packard Co. has created a real-life laboratory with a small organization in Fort Myers, FL, and will use the site to discover product enhancement and support services that will help businesses adopt a networked environment faster and at less cost. Feedback from the laboratory will be used to show how future technology can be improved, and help managers and employees better understand the setup, operations, and support of sophisticated computer environments. Beginning in June, weekly updates from the laboratory—the Harry Chapin Food Bank of Southwest Florida—were being posted at the Palo Alto, CA-based company's small-business Website—www.hp.com/go/smallbiz. Glidden Electronics, DeLand, FL, designed the office environment for the food bank, which will use it to electronically track outgoing and incoming inventory, increase community awareness, and streamline internal processes. (Source: *Industry Week*, 18 August 1997)

Drug firms back move to link databases

Because the world's major biological databases are constructed differently, it is virtually impossible to devise search programs to tap into them all effectively. A user has to hop from one to the other using each database's search engine to retrieve information that comes in a variety of different formats. That may soon change, however. A group of leading pharmaceutical companies have put their considerable weight behind the development of common standards for the interface between biological databases, based on an approach popular in the computer industry. But bioinformatics specialists who run some key databases used by academic researchers say that they are not enamoured of the interface standards chosen, although they may not be forced to adopt them.

The strategy was agreed to at a meeting in Philadelphia, attended by representatives of pharmaceutical giants such as SmithKline Beecham, Glaxo Wellcome, and Zeneca, together with a number of software companies and representatives of databases, including the European Bioinformatics Institute (EBI) in Cambridge, UK, and the Genome Data Base at Johns Hopkins University. The participants unanimously agreed on a fast-track plan to bring life sciences databases under standards drawn up by the world's largest software consortium, the Object Management Group (OMG).

The OMG was set up eight years ago to tackle the problem of incompatible databases. The OMG's approach, dubbed the Common Object Request Broker Architecture (CORBA), does not impose an external set of rules for the contents of databases to which everyone must adhere. Instead, CORBA defines interfaces that allow different databases to communicate with each other no matter what their format. Software companies then use these interfaces to devise programs that allow researchers to access data in otherwise incompatible locations.

The EBI has already championed the CORBA approach, winning funds from the European Union to study its application to biological databases in collaboration with other European partners. The Philadelphia meeting agreed to work towards getting the OMG to establish a life sciences "task force" by the end of 1997 to hammer out the details of applying CORBA to life sciences databases. Seven task

forces in various business areas already exist. (Source: *Science*, Vol 277, 15 August 1997)

Bell plans 200 GHz devices

Microprocessors running at 200 GHz and memory sizes of 64 Gbit could be made possible by the year 2010 as a result of work by researchers at Bell Laboratories in the US.

Such devices would make use of new lithographic techniques that could generate geometries of 0.01μm compared with today's cutting edge process technologies that use 0.25 μm geometries.

Although the chip industry has looked towards expensive new lithographic techniques based on X-rays and extreme ultraviolet technologies to achieve finer geometries, Bell researchers believe that electron beam-based lithography could prove to be the best and cheapest approach.

Bell has been working on an electron beam lithographic system which uses a special mask to scatter an electron beam across the chip wafer. (Source: *Electronics Weekly*, 13 August 1997)

Republic of Korea and Germany to grow silicon production

LG Chemical Ltd. (Republic of Korea) will form a joint venture with Huls (Germany) to increase their silicon production on a global scale. The venture will run a factory in Germany while constructing an integrated silicon production plant in the Republic of Korea. Under the terms of the agreement, Huls will transfer control of its European silicon business to its joint venture partner. By 2001, LG Chemical expects to open the silicon plant in the Republic of Korea, which promises to be the first one in Asia. (Source: *Semiconductor International*, November 1997)

Xilinx hits ASICs with big FPHAs

Xilinx has announced a programmable logic architecture that will form the basis of the company's high-end products beyond the year 2000.

Called Virtex, the architecture will be capable of implementing FPGAs with over one million gates. The architecture will enable PCI-bus designers to develop chips running at 66 MHz, rather than the 33 MHz only just possible today. Multipliers in the new chips run at over 100 MHz.

Virtex has a simpler structure than Xilinx's existing XC4000 devices. The basic building block is now a four-input look-up table and a flip-flop. This is in line with other companies' architectures, and makes synthesis tool development easier.

With a million gates available, Xilinx aims to wipe out almost the entire ASIC market.

FPGAs offer advantages in terms of time to market and reprogrammability.

At higher volumes, where ASICs are much cheaper, Xilinx can offer its HardWire service. This turns an FPGA design into an ASIC with only a slight price premium. (Source: *Electronics Weekly*, 26 November 1997)

Global Telematics first with GSM/GPS combo

Global Telematics, Racal Electronics' joint venture with European Telecom has combined GSM mobile communications with GPS satellite positioning in its vehicle tracking and navigation service.

Other companies known to have developed similar services are General Motors, which will use its products in certain Vauxhall models in 1998, and Ford.

The company will target the service, initially at fleet vehicle operators in the UK and South Africa. Its initial offerings comprise three products, each based on a GSM hands-free mobile phone and a global positioning system (GPS). The communications will be provided by the Vodafone network.

The driver dials a number and receives detailed spoken navigation information in addition to traffic updates and route planning. The system can also be used for security, giving off signals when the vehicle is stolen, or calling emergency services in case of vehicle failure or accidents. It uses a differential GPS with an accuracy of up to 5 m.

This market is expected to reach $20 billion a year by 2011. (Source: *Electronics Weekly*, 26 November 1997)

Intel price war

Intel will bring out its latest micro-processors in low-cost versions to cover every PC price point. It is also considering making fully integrated chips or chipsets incorporating all the functions of low-end PCs.

Cloners have declared a strategy of moving the PC price point down from $2,000 to sub-$1,000 and then to $500 and lower. Recently IBM announced it would follow PC market leader Compaq into the sub-$1,000 PC market.

Now, Intel intends to be the leader in every sector of the PC market by producing its latest microprocessors in "multi-segmented" versions tailored for every price point. Intel will also bring out integrated PC chipsets containing the microprocessor plus many PC functions such as graphics and DVD control and modems.

Intel's strategy is a departure from its regular practice of bringing out a high-end micro costing around $1,000 and then dropping its price gradually until it reaches the pockets of the manufacturers of low-end PCs.

From autumn 1998, the Pentium II architecture will become the most ubiquitous of all Intel's processor generations by being introduced simultaneously in all price and performance brackets. (Source: *Electronics Weekly*, 19 November 1997)

Motorola launches video system

After 12 years of development, Motorola's Qorus videoconferencing system has finally been launched.

The system, which Motorola developed with BT until the telecommunications company decided to exit in-house product development, is built around the MCQ70 video processor and the DSP56303 digital signal processor.

Qorus is said to address the requirements for a variety of standards. These include the ITU's H.320, which is used with ISDN and switch digital connections; H.323, used over LAN and Internet Protocol connections; and H.324, targeted at videocommunications over standard telephone lines.

The MCQ70 supports H.261 and H.263 video compression standards, designed for use over ISDN and the Internet respectively.

A number of audio compression algorithms are also supported, including G.722, which handles audio frequencies between 50 Hz and 7KHz over ISDN. (Source: *Electronics Weekly*, 5 November 1997)

Cypress advances its 0.25 µm plans

Cypress Semiconductor's plan to have quarter micron CMOS technology in production during 1998 has passed the 0.35 µm point with the launch of the first SRAM—based on the RAM4 process.

The 1 Mbit asynchronous SRAM is Cypress' first 0.35µm product based on the six-transistor cell technology.

The company also recently introduced a claimed market leading 1 Mbit FIFO, and expects to move its programmable logic parts to the six-transistor SRAM technology (instead of current flash technology) by mid-1998.

Cypress has also reorganized its European sales operation in an attempt to achieve its goal of $200 million sales in the region by the year 2000. (Source: *Electronics Weekly*, 12 November 1997)

E. APPLICATIONS

Specialized servers

The increase in the number of small offices installing networks, and the growth of the Internet, are stimulating the sales of servers. These vary enormously in size and specification. At the bottom end of the market, some are simply Pentium II-level desktops with a large amount of system memory and mass storage: at the upper end, servers may feature multiple processors, RAID 5 configurations and UPS systems.

A recent advance in the design of server systems, referred to as I₂O, employs a combination of network and hard drive controllers, a bridge ASIC and a RISC co-processor. Intelligent I/O processors offload I/O tasks from the host CPU, increasing overall system performance. The I₂O special interest group (SIG)—which includes companies such as Compaq, Hewlett-Packard, Intel, Microsoft and Novell—is working on extending the specification to other application areas. The initial focus will be on clustering connectivity, fault tolerance, peer-to-peer communications, server-network management, fibre channel technology, asynchronous transfer mode (ATM), WAN applications, 64-bit addressing, mass storage/RAID, and intelligent real-time operating systems (IRTOS).

Acer servers illustrate some of the concerns of suppliers and users. The units incorporate three 400W power supplies to assure continuous operation. Bundled *Easy Build* software assists with installation, while *Remote Diagnostic Management* software permits the network nodes to be monitored from the server.

An inset box describes some of the alternatives to Intel CPUs. Digital Equipment's Alpha chip— promoted by Samsung and Mitsubishi as well as Digital itself—is now establishing itself as a credible alternative. The new G4 processors for the PowerPC are expected to appear towards the end of 1998. (Source: *Byte*, June 1997)

Hitachi scans faster

Hitachi has introduced its SX3 family of passively scanned colour LCDs whose optical performance is similar to more expensive active matrix displays.

Passively scanned displays are hampered by the need for the liquid crystal to hold its state between scans. By scanning two lines at a time, using what Hitachi describes as differential signals, the scan rate is doubled, allowing the crystal to be tailored for characteristics such as contrast ratio.

Contrast is said to be 50:1, compared with 30:1 for normal passive matrix and 100:1 for active.

Hitachi, and other Japanese display makers Sharp and Sanyo, are calling the technology HPA—high performance addressing.

Faster scanning also results in a quicker response time, making the display more suited to showing moving images. A response time of 150 ms is half that of conventionally scanned passive displays. Active displays respond in 55 ms.

Hitachi expects to reduce the response time to 80 ms by mid-1998 by using a thinner cell gap and a faster crystal.

Diagonal screen lengths of between 12.1 and 15.5 in. (SVGA and XGA), are available and target applications are notebook, "mega-notebook" and desktop monitors. Cost is "60 per cent" of active matrix displays of a similar size and performance. (Source: *Electronics Weekly*, 26 November 1997)

Hands-free computer pointing device

Ferranti Technologies is developing a hands-free computer pointing device that non-invasively measures eye position to initiate action on screen or elsewhere.

Weighing around 100 g, the prototype head-mounted unit uses low intensity infra-red light and an optical system to measure the position of the eye's pupil within its socket and infer the angle at which the user is looking.

Applications include mouse replacement, head up display operation and image streering in virtual reality systems.

For use with a desktop or laptop computer, a simple calibration procedure is required where the user looks at the middle of each of the four edges of the screen in turn. This allows the unit's software to calculate the relative position and orientation of the head relative to the display. Calibration is valid until the head moves a significant amount.

Ferranti is looking for partners in the fields of games and disability research to assist it to develop applications and products.

How it works

A broad beam of infra-red light from an LED is directed onto the user's eye. Some part of it passes through the user's pupil and is reflected back along its original path by the retina, which is a reflective surface at infra-red wavelengths. A beam splitter directs the returning light on to a CMOS imaging array. The position of the reflected spot on the array is dependent on the pupils position within the original broad beam. A DSP processes the image from the array to remove spurious reflections, finds the centre of the reflected spot and damps the oscillations in the signal from the eye's natural tracking motion. (Source: *Electronics Weekly*, 2 July 1997)

A twinkle in the cat's eye

The use of active road studs is a step nearer following the completion of road trials.

Road studs, of which cat's eyes are the most famous example, are passive reflecting devices. The Doncaster-based company, Astucia, is promoting a version which, in addition to a passive reflector, uses leds and a solar charged battery.

The studs are self-contained and can change behaviour in response to varying conditions. A variety of colours and flashing patterns are available and optional in-built sensors are claimed to allow the studs to respond to ice, fog, standing water, standing vehicles and vehicles driving too close together. Vehicle distance is measured based on the frequency of the passing headlights. (Source: *Electronics World*, July 1997)

Help for people with speech disorders

Until now, humans have written down and reproduced speech. In future, this can also be done by computers. German scientists have developed a unit that can create synthetic speech signals, in other words, can convert letters into sounds. One programme on a "VOICE-Card", which is not much larger than a credit card, transforms any given text into phonetic code. A processor generates the acoustic signals, and the computer articulates the text. People with speech disorders can, for example, conduct everyday tasks with the help of the small devices. Text is typed in, and the machine then speaks the desired words at the push of a button. The system can easily be converted for use with other languages. Work is already under way on English, Czech and Chinese versions. (Source: *Deutschland*, March 1997)

Intelligent pen scans words and translates

An electronic pen which scans a word before translating it into another language is being launched in Europe.

Quicktionary, a device measuring 170 x 35 x 35 mm, has been developed by an Israeli company, WisCom Technology. So far it only translates between two languages because of the limited memory in the pen.

"In the tip of the device is a high resolution scanner", said Ronny Gorlicki of WisCom. "All you have to do is go over the word with the tip." The device uses optical character recognition (OCR) software to read printed text, before a search engine looks for a translation of the word in its language databases. The translation is then printed, along with all the idioms associated with it, on its LCD.

The key to the device's workings, claims Gorlicki, are the concise algorithms and the highly compressed language databases. "The algorithms that go into recognizing the characters are based on shapes and sizes", he said. "These allow a device that has very low-power consumption and a low configuration cost." (Source: *Electronics Weekly*, 21 May 1997)

FreeFax

FreeFax is a service that allows you to send faxes to anywhere in the world for free. Using FreeFax, you can send faxes to the UK, US, Canada, South Africa, Greece, Hong Kong, China, India and Croatia. The list of countries and the area codes within them that the service supports is growing.

The FreeFax software is simple to use, and fairly basic. It is little more than a TWAIN-compatible viewer, a text

editor and some facilities for sending the fax off on its way. There are two parts to a fax. The main way of getting your faxes ready is by scanning them in. Once scanned, you would not be able to do much with your fax. You can make some standard image adjustments and it also has built-in optical character recognition (OCR), so you can covert your scan to editable, searchable text.

The other part of your fax is the cover sheet. This is equally fixed: you type in the name, the company, the fax number and the cover page text. The only trick here is the fax number: it must be in the standard international format of country code, area code and number, regardless of where you are sending it from. The service will send you an e-mail telling you of the success or otherwise of your fax.

FreeFax works through an international network of agreements set up by TPC for local ISPs to act as fax servers in different area codes. For example, all faxes sent to the UK will be sent to a Demon server, which will then perform the final, telephone leg of the journey using its national local rate service. Demon foots the bill for this, but gets to advertise on your cover sheet. (Source: *Internet Magazine*, October 1997)

Electronic implants

Pacemakers

The heart's natural pacemaker is the sinoatrial node, a small mass of cells near the top right of the heart. High blood pressure, coronary disease and age can all cause the node to malfunction.

In many cases the solution is an artificial pacemaker. This is a battery-powered control unit connected to the heart via wires through veins. Control units are normally located inside the body, just under the collarbone.

If the heart beats too slow, modern pacemakers will only provide the impulse to the heart when required. These are called demand pacemakers. The pacemaker will only take control when the rate drops below some threshold such as 60 beats/minute.

Over the years, pacemakers have become more sophisticated. If the body requires more oxygen, the heart rate must increase. A modern pacemaker will sense the need for a faster rate, reducing the patient's discomfort. The need for a faster rate can be detected by oxygen sensors in the blood or by an accelerometer—more movement equals more oxygen needed.

Early pacemakers were affected by stray electromagnetic radiation, such as that from microwave ovens and metal detectors. Modern devices have good EMI shielding and backup modes that can take over and provide a constant beat if the intelligent unit fails.

The next step up from a pacemaker is an implantable cardioverter defibrillator (ICD). These do the same job as the "jump start" machines seen in every hospital drama. If the heart has tachyarrhythmias—rapid, uncontrolled beating—the ICD gives the heart an electric shock to restore normal heartbeats.

Retinal implants

There are certain diseases of the eye that cause blindness by damaging just the surface of the retina. Retinitis pigmentosa, for example, destroys the top layer of photosensors leaving the underlying ganglia and optic nerves unaffected.

Eye implants are being developed by various organizations in the US. These consist of a logic circuit covered

with an array of photo-sensitive cells. Data received is converted into a attern of electrical impulses. These are coupled directly through to the nerve ganglia in the retina.

The power supply for the logic, which can be several thousand transistors, is provided by either a separate solar cell or photovoltaic cells on the logic chip.

Both the University of North Carolina and the Massachusetts Institute of Technology (MIT) have developed these devices.

The main problem facing the scientists is the danger of rejection by the body's natural defence mechanisms. At MIT, a biocompatibility study has been carried out, placing five materials in a rabbit's eye for one year. This caused no damage to the eye.

The only organization rumoured to have tried a retinal implant on a human patient is the US National Institutes of Health (NIH). The recipient is said to be able to make out shapes, albeit very shadowy ones.

Cochlea implants

Hearing aids were among the first applications of electronics bringing benefits to people with sensory impairments. One of the greatest steps made in auditory aids was the development of the cochlea implant. Worldwide, over 12,000 people have benefited from a cochlea implant.

An implant has the advantage over a hearing aid in that it can bring sounds to a person who is completely deaf. It does this by bypassing the outer and middle ear. The nerve endings in the snail-shaped cochlea of the inner ear are stimulated directly by electrical impulses.

A number of electrodes are used—up to 16 or 22 in advanced systems. Each electrode connects to nerves which would normally respond to a different part of the audio frequency range.

The down side of a cochlea implant is the dynamic range of the system. The loudest sounds are typically only 20 dB louder than the softest.

Antwerp Bionic Systems (ABS), in which Philips has an interest, is a leading Belgian manufacturer of cochlear implants. The company is currently working on reducing the processing system, today Walkman-sized, to a point where it could fit behind the ear, much like a conventional hearing aid. (Source: *Electronics Weekly*, 28 May 1997)

Neural networks spot oil pollution

UK-based engineers at Conwy Valley Consultants, British Petroleum and the University of Wales have developed a technique that uses self-organizing artificial neural networks (ANNs) to search 3-D fluorescence spectra for evidence of crude oil.

The engineers evaluated two ANNs: the self-organizing feature map (SOFM) and the adaptive resonance theory (ART-2a). Both ANNs were able to identify oil "finger prints" in the fluorescence data. The SOFM network was marginally more accurate than the ART-2a; however, the ART-2a network offered superior execution speed, both fast and slow learning and incremental knowledge-base development.

The spectra are produced by total scanning fluorescence (TSF), a chemical analysis method that is used in oil exploration and pollution detection. Large numbers of spectra are processed and searched manually for peaks associated with aromatic compounds found in crude oil. This is a laborious task and most existing software tools are not suitable for the 3-D data.

According to Conwy's Richard Hatton the advantage given by ANNs is that the data model is built up

incrementally. An archive of oil fingerprints is maintained and the system learns as it goes. The engineers have used both ANN techniques to develop a PC-based fluorescence software tool aimed at geochemists with no special statistical or mathematical knowledge. (Source: *Scientific Computing World*, September 1997)

Parallel processing allows new views of bones

A team of French researchers at the Creatis laboratory at INSA-Lyon and the European Synchrotron Radiation Facility (ESRF) in Grenoble have developed a parallel computing technique for the 3-D analysis of bone X-ray data. The new technique also allows 3-D connectivity measurements to be made on bone samples, something that could not be done using conventional X-ray imaging methods.

The data are obtained by taking a series of images, as the bone samples are rotated through 180° in a beam of synchrotron X-rays, using a special CCD detector designed by the ESRF Detector Group. The detector consists of two 2-D CCD arrays.

A filtered, back-projection algorithm is then implemented to reconstruct a 3-D image of the bone from a series of 2-D projections. The reconstruction is a very time-consuming task: for each bone sample, 2 Gbytes of data must be processed. To increase the speed, the projection algorithm was parallelized to run on nine workstations at the ESRF Networked Interactive Computing Environment (NICE) using the Parallel Virtual Machine (PVM) protocol. (Source: *Scientific Computing World*, July 1997)

System for data networks

A system aimed at data networks operators whose main customers are small to medium-sized enterprises (SMEs) is being developed by Alcatel and US-based Stanford Telecommunications.

Using the ATM (asynchronous transfer mode) data protocol over TDMA (time division multiple access) wireless interfacing technology, Alcatel's 9900WW wideband access system will provide voice and data communications services to customers in densely populated areas, roughly 20 sq km.

Operating in frequency bands between 10 GHz to 41 GHz, the Alcatel 9900WW base station will have a capacity of 600 Mbit/s, supplying each subscriber with data rates of up to 8 Mbit/s. (Source: *Electronic Weekly*, 24 September 1997)

Possibility: biopsies without surgery

Optical coherence tomography (OCT) will replace conventional biopsy for many applications in the future. That is one implication of the new imaging technique developed by researchers at the Massachusetts Institute of Technology and Massachusetts General Hospital. OCT is described as analogous to ultrasound imaging except that infrared light waves, not acoustic waves, are employed. Because of the high resolution—10 times higher than either clinical MRI or high-frequency ultrasound (below right)—early stage abnormalities typical of cancer or atherosclerosis can be detected. (Source: *Industry Week*, 1 September 1997)

Vision system checks fabrics

Artificial-intelligence, high-resolution cameras, and computers are integrated to offer textile inspection speeds of 150 to 200 yards per minute, says Elbit Vision Systems Ltd., Yoqneam, Israel. In contrast, manual inspection is usually capable of only 30 yards per minute, the company adds. The

system is designed to detect such things as yarn defects; weaving faults; holes, oil, water and dyestuff stains; missing threads; starting marks; broken yarn; and dyeing, coating, and finishing irregularities. The company says installations can stand alone or be integrated with production lines. An off-line workstation is provided for review and analysis of defects. (Source: *Industry Week*, 1 September 1997)

How a heat-delivery device can cure

Soon doctors will be able to treat a variety of skin diseases with an electronic instrument that grew out of research at Los Alamos National Laboratory, Los Alamos, NM. The device directs a radio-frequency current to a dual-electrode tip that heats the tissue. Treatment is effective at about 111° F, says Gene Hedin, founder of Thermosurgery Technologies Inc., Phoenix, AZ. A thermocouple device in one of the electrodes monitors temperature and controls the circuitry generating the radio-frequency field. Hedin claims many conditions can be treated with a single application of 30 to 60 seconds' duration. The Pan American Health Organization has adopted the device as the treatment of choice for the tropical skin disease leishmaniasis, adds the company. (Source: *Industry Week*, 18 August 1997)

Web servers

Maintaining a credible presence on the Web requires reliable and well-supported hardware. This review examines seven Web server hardware options, from Apple, Compaq, Fujitsu, Hewlett-Packard, IBM, Sun and WebBox.

Apple's Workgroup Server 9650/233 (£4,720) is based on a 233 Mhz PowerPC 604e, mounted on a card, which makes for easy upgrades. It features 512 kb of Level 2 cache and 64 Mb of RAM as standard.

Compaq's ProLiant 850R (£3,550), like the Fujitsu and Hewlett-Packard offerings, is based on a 200 Mhz Pentium Pro. A low-profile rackmount server, it supports up to two processors and 40 Mb/second Wide/Ultra SCSI drives, which are twice as fast as the Fast SCSI-2 drives commonly found on entry-level servers.

The Fujitsu Internet Webserver G6404 (£6,680) is powerful, scalable and well-supported, although perhaps better suited to bigger company departments rather than small business users.

IBM's PC Server 310 (£1,267), by contrast, is ideal for smaller firms with a minimal Net presence or a small intranet. This is based on a 166 Mhz Pentium, although it can be upgraded to the 200 Mhz version.

Sun's *UNIX*-based Netra i 1/170E (£10,450) employs a 167 Mhz Ultra SPARC processor. The standard 64 Mb of memory can be expanded to 1 Gb. Although fairly easy to configure and set up, the system requires the administrator to develop *UNIX* skills if the best performance is to be obtained.

WebBox (£1,650) adopts a different approach: the entire Web site resides in RAM and Flash memory, and the box itself is hosted by one of a number of ISPs.

Hewlett-Packard's NetServer E40 (£2,120) uses only 20 Mb/second Fast SCSI rather than 40 Mb/second Wide/Ultra SCSI. Despite this, it won the "best buy" award on the basis of excellent support and a remote management capability. (Source: *Internet Magazine*, September 1997)

Colour printers

There are now affordable colour inkjet printers with a claimed capability of producing near photographic quality. Demand has been stimulated by the appearance of relatively

inexpensive digital cameras able to capture images for subsequent storage on a computer's hard disc.

This review examines twelve colour printers (inkjets and dye-sublimation devices) as regards output quality, usability, driver software quality and value for money. The products are: the Alps MD2300 Masterpiece; Canon BJC-4200 and BJC-620 185; Citizen Printiva 700; Epson Stylus Color 200, Stylus Photo and Stylus Color 600; HP DeskJet 670C and DeskJet 870CXi; Lexmark Jetprinter 700 and 2030; and the Olivetti JP790.

Each of the models was tested using files from four applications: Microsoft *Word 95* and *Excel 95*, Adobe *Photoshop 4* and Corel *Draw 7*.

At the budget end of the spectrum (£100-200), there were some products such as the Epson Stylus 200, Canon BJC 4200 and Lexmark 2030 which represented very good value for money. In terms of output quality, however, one (more expensive) model was outstanding: The Alps MD-2300 Masterpiece, which used dye-sublimation technology. Also highly commended was the Epson Stylus Photo, which employed six colours rather than the more usual four, and produced the illusion of continuous tone. The best all-rounder, however, was the Epson Stylus 600 (which replaced the 500). Its 1440 dpi output was excellent for both colour and monochrome work. (Source: *Personal Computer World*, September 1997)

Colour printing technology

The increased power of desktop PCs makes them better able to support colour printing. This power has also stimulated the introduction of digital cameras, which in turn have increased the demand for colour output. Increased demand for colour printers has resulted in manufacturing economies of scale, reflected in more affordable pricing.

A number of companies—notably Canon, with its BJC4200 model—have attempted to improve the output quality of colour inkjet printers by employing multi-pass techniques. The BJC4200 uses lighter colour inks: the print head moves three times over a single line on the page, giving a wider range of colour gradations. Another means of improving quality has been adopted by Epson, which claims that the use of piezo-electric printing heads in its Stylus range (rather than the more common bubble-jet type) permits output resolutions of up to 1,440 dpi.

Key considerations when choosing an inkjet printer are the type of documents to be printed, the output speed required and the cost of consumables. If it is intended to print black text and colour pictures, a model supporting two ink cartridges (one black, one colour) should be selected. Speed is another concern: colour output is much slower than monochrome. With products such as the Epson Stylus 600 or 800, or the Canon BJC4200, better results are achieved on special grades of paper, but these are more expensive.

Until recently, the prices of colour lasers were widely regarded as prohibitive, but some models are now less expensive than they were. IBM has reduced the price of its NetWork ColorPrinter by £3,000 to £4,195. Tektronix has introduced a 5ppm unit priced at £3,995. Prices for the Xerox DocuPrint C55 series start at £3,499. (Source: *Office Equipment News*, August 1997)

E-mail sees blind cause

US researchers have developed a system that uses an electronic camera and e-mail to identify diabetic retinopathy, a common cause of blindness.

Conventionally, a diabetic has to go to a specialist to undergo an eye examination, or a trained photographer uses

a special film camera to take photos which are sent for further investigation.

Using an electronic camera, called the DigiScope, the office staff of general practitioners can generate image files which are then e-mailed to a central diagnosis facility.

The camera-based system is being made under licence and two US health-care organizations are said to be considering offering the service. (Source: *Electronics Weekly*, 3 September 1997)

Paparazzi-proof gizmo

Spurred by worldwide anti-paparazzi sentiment, a company will sell small laser gadgets that celebrities can wear around their necks to render pictures photographers take of them useless, reports the *New York Post*. The device, called the Eagle Eye and manufactured by Alxzka, Bristol, CT, cloaks the wearer in an invisible shield of laser beams, turning a photo into a streaked mess. About the size of a beeper, the lowest-priced model protects against flash photography at night; the more advanced models use military and espionage technology. Three models of the Eagle Eye range in price from $70 to around $400. (Source: *Communications of the ACM*, vol. 40, No. 11, November 1997)

Commercial night vision system (NVS)

Jaguar Cars, the Applied Mathematics and Computing Group (AMAC) at the Cranfield University, Texas Instruments and Pilkington have been designing a commercial night vision system (NVS) for vehicles. The idea for this system has been adapted from a European-funded project named Prometheus that ended two years ago. The idea was to adapt fighter airplane head-up displays (HUDs) and night vision features to the road vehicle. Such features may one day be a standard part of a family saloon.

The NVS system relies heavily on DSP devices in order to cope with high quantity of information in a quickly changing environment, where visible conditions are difficult. A car can reach speeds of up to 150 mph. The visibility may be impaired by night conditions, including dazzle from oncoming traffic, and aggravated by adverse weather such as rain or fog. And yet the images have to be delivered in real-time.

The role of AMAC is to supply advanced digital signal and image processing in order to deliver an optimized, real-time image of the road scene to the driver. The information is received from a Charge-Coupled Device (CCD) and Near Infra-Red (NIR) sensors and a DSP camera mounted on the vehicle. As objects need to be clearly recognized this can be achieved most suitably through the use of DSPs, which in this instance were supplied, along with the camera modules, by Texas Instruments.

The integrated DSP camera, made by the Digital Image Products group at Texas Instruments, incorporates CCD image sensors capable of capturing images not visible to the naked eye. This is then coupled with a programmable DSP and supporting mixed signal conversion circuits. The whole system is linked via a high-speed serial bus, the IEEE 1394, which supports data rates of up to 200 Mbit/s.

The NIR-adapted CCD camera detects the reflected radiation the electrical output is converted to a digital signal before processing. Initially four C40 processors were used, but this was replaced with a single C80 from Texas Instruments. The C80, with its multiple processors on chip, seems to cope with the requirements very nicely.

Once the transformation is done, the enhanced image is displayed on an HUD that was designed especially for the car. The transformed image is superimposed over the real image on the screen, supplied by Pilkington. The image is clear, well-defined even though it is not in colour.

Additional information of the road scene such as lane markings, edges, road signs and so on can be also provided with AMAC's supplementary research.

This work is complemented by the University's long-term work to recognize important features in the scene such as predestrians, animals, road obstacles and other vehicles by using pattern recognition techniques, neural networks and motion detection algorithms. (Source: *Electronics Weekly*, 26 November 1997)

TI floats 1 Gflop

Texas Instruments has extended its flagship C6x range of digital signal processors (DSPs) with a device that can execute a billion floating point operations per second—1 Gflop.

Applications for such a device are in wireless base-stations, virtual reality 3D graphics, voice recognition and image analysis, the company said.

Dubbed the TMS320C67x, the DSP is functionally the same as the previously announced C62x fixed point device. But the arithmetic units have been redesigned to allow for 32-bit floating point operation.

The C67x differs from previous DSPs by having the same architecture and instruction set as its fixed point brother, the C62x. Thus designers can start work designing with the floating point processor before samples are available. (Extracted from *Electronics Weekly*, 15 October 1997)

Intel sets target for Merced

Intel says that it will produce the first of its 64-bit Merced microprocessor line in 1998 using a 0.18-micron process.

Merced will combine features of Intel's X86 architecture with Hewlett-Packard's PA-RISC architecture. It will represent a radical new microprocessor architecture for Intel. Merced will be used to power high-end multiprocessor servers and workstations.

Dell Computer said it is working closely with Intel on the design of Merced systems and plans to be one of the first companies to use the chip in enterprise servers and workstations. However, Merced systems will require a 64-bit version of Microsoft's Windows NT. (Source: *Electronics Weekly*, 15 October 1997)

World's first wavelength locker

Santec Corp. has succeeded in developing the world's first passive desilencing wavelength locker. This is a key component vital for improving the performances of high-density wavelength multiplexed optical communications system.

The new wavelength locker has been made compact by decreasing the number of components to less than one third compared with its existing counterpart. In addition, the optical components feature excellent thermal characteristics and therefore require no temperature regulation. It has a height of 8 mm and can therefore be mounted on a single printed circuit wafer and achieves long-term reliability by airtight sealing.

The standard settable wavelength is the grid wavelength for high-density wavelength multiplexed optical fibre

communications prescribed by the International Telecommunications Union (ITU), but is also capable of coping with the preferred wavelengths of users. Simply inputting a portion of the optical source enables the disparity with the standard wavelength to be output accurately as an electric signal, so users can lock the prescribed wavelength simply by feeding back the electrically processed control signal to the optical source drive circuit.

Due to the widespread use of the Internet and video transmission, demand is being raised for capacity expansion and higher-speed transmission in data communications. In this respect, the wavelength multiplexed optical fibre communications system features many advantages such as large transmission capacity, system flexibility and economy, so the global trend is to commercialize this communications system not only as a trunk communications system but as a system for the commercialization of optical network systems. Further details from: Santec Corporation, Microm Valley Tokadai, Kamisue, Komaki City, Aichi Pref. 485, Japan, Tel.: +81-568-79-3535, Fax: +81-568-79-3538. (Source: *JETRO*, July 1997)

Computers provide insights into tumour growth

Mathematical biologists at the University of Dundee in the UK are using computer simulations to gain insights into the processes that control tumour growth. Dr. Mark Chaplain and colleagues at the Centre for Non-linear Systems in Biology are using the results from biological studies to develop a set of non-linear differential equations that describe angiogenesis. This is a process by which tumour cells stimulate surrounding blood vessels to move towards the tumour. If angiogenesis is successful, the tumour develops a network of blood vessels and grows rapidly.

The angiogenesis process is facilitated by biochemical secretions from the tumour cells that stimulate capillary growth. The Dundee researchers use Sun workstations to solve three coupled equations that describe the interaction of individual cells with the surrounding medium. One equation describes the cell concentration, and the other two describe biochemical concentrations. A collaboration with researchers at the Dundee Dental Hospital provides the cell and chemical diffusion and chemotaxis coefficients along with rates of cell biochemical secretion. The equations are discretized for solution on the workstations and provide cell and chemical densities as a function of time.

An understanding of angiogenesis is crucial to the control of tumours because as the tumour grows it must constantly generate new blood vessels. The next stage in Chaplain's research will be the modelling of blood flow through the capillary network to gain insight into how tumour growth may be controlled by modifying the blood supply. (Source: *Scientific Computing World*, June 1997)

F. SOFTWARE

Simulate risk

Make intelligent decisions that take into account the level of risk associated with various scenarios with @Risk. The risk analysis system from Palisade Corp., Newfield, NY, adds Monte Carlo simulation capabilities to any spreadsheet model, including Microsoft Excel and Lotus 1-2-3. By generating thousands of "what if" scenarios, the software offers users a more complete picture of the risks they face in various business situations. @Risk runs on Windows 95 and NT and earlier versions of Windows, as well as Macintosh version 6 or higher. (Source: *Industry Week*, 8 December 1997)

Fingerprint ICs ease recognition for PCs

Fingerprint identification ICs are enabling a new class of computer security and human identification systems.

Several companies have introduced low-priced fingerprint ID systems that interface to PCs, such as Digital Personal with its $99 U.are.UTM, a mouse-sized fingerprint scanner to be introduced in 1998, and Sony's Fingerprint Identification Unit (FIU) TactileSense fingerprint ID system designed to be integrated into PC keyboards, and Key Tronic showed its secure keyboard finger image scanner.

Many of the fingerprint ID systems use Intel's universal serial bus (USB) for easy connection to a PC.

Fingerprint image capture ICs are a key driver for the applications. Lucent Technologies' spinoff Veridicom has developed a chip that it says will enable low-priced fingerprint ID systems.

The Veridicom chip is about one half inch square and has an array of 300 by 300 capacitive sensors to capture a bit mapped fingerprint image. The chip has a surface 100 times stronger than glass, making it extremely durable. Sony's FIU has developed a durable polymer-based fingerprint recording device. (Source: *Electronics Weekly*, 3 December 1997)

Next-generation middleware

Middleware is a layer positioned between the application and the underlying complexities of the network, the host operating system and any resource servers, such as database servers. The nature of middleware is changing, however.

Whereas applications were once linked together via interprocess communications, now middleware is employed to link the same objects across many different systems. The adoption of Web-based models is also leading to the development of new middleware products. Another change is the adoption of standards such as CORBA and DCOM (Distributed Component Object Model), in place of proprietary approaches which resulted in products incapable of interoperating.

A number of categories can be identified: database-orientated, virtual system, middle-tier, gateways and Web-enabled. JDBC is the most significant new database middleware standard—a set of *Java* classes for specific databases which borrows heavily from the ODBC architecture. DCE provides a good example of virtual system middleware, providing RPC-based access over a variety of systems. The middle-tier sector is represented by such products as ORBs and TP monitors, as well as proprietary solutions, e.g. Borland's MIDAS.

The emerging technologies, however, are Web-based. Indeed, the Internet and intranet appear to have given new life to the middleware market. Web-based products may be divided into server- and client-side categories. Examples include Storm-Cloud Development's *WebDBCE* and the *Internet Database Connector (IDC)*, now part of Microsoft's *Internet Information Server.* (Source: *DBMS*, September 1997)

Cross-platform conversion

Serena Software is offering X:Change 3.1.0, a cross-platform development environment that offloads Year 2000 conversion tasks to your PC. As part of a family of products aimed at the Year 2000 conversion problem, X:Change synchronizes source and data files in a cross-platform environment between the mainframe and workstation so that you can test and convert projects in a workstation environment, freeing up the mainframe CPU. Once the testing and conversion is done, the data can be transferred back to the mainframe.

With X:Change, you can drag and drop data sets, partitioned data sets (PDS), and directories between the mainframe and PC. X:Change can detect any content discrepancies between the files from different platforms. Even if files have been renamed, X:Change can identify which files contain the same data. You can compare files down to the byte level and graphically display the differences between the files. You can access file content in a PC environment without using mainframe editors or library management tools, and you can selectively transfer individual data records to your PC. The records can be chosen based on a key or record range.

For more information, check out Serena's Web site at http://www.serena.com. (Source: *Datamation,* June 1997)

EC supports Emas package

The European Commission is backing the development of a standardized software package to assist companies participating in its voluntary eco-management and audit scheme (Emas).

The software, LMS/U1, is the brainchild of Austrian firm LMS Environment, and has already been tested and implemented at Novartis' waste management centre as well as at car manufacturer BMW and ballbearing firm SKF.

The Commission's support is being given through its Caemis (supranational introduction of computer-aided environment management and information systems) project, part of its Innovation programme.

LMS/U1 uses a relational database to help manufacturers harmonize economic and environmental goals through treatment and management of data. The software is divided into four core areas: management of hazardous and non-hazardous materials; production, in terms of safety and emissions; inventories, of operations as well as products; and organizational issues, such as regulations, permits and ecological audit checklists. (Source: *European Chemical News,* 5-11 May 1997)

Software management

Software constitutes an essential business asset for industries such as banking, airline operation and publishing. It enables companies to reach customers, track their behaviour and service their needs. Even where this is recognized, however, organizations face considerable challenges when deploying software so as to achieve strategic objectives. Managing software effectively becomes of paramount importance.

In collaboration with the European Software Institute and INSEAD, the European Commission has recently conducted a survey of software management practices. *Benchmarking European Software Management Best Practices* is based on the responses from 882 organizations. The questionnaire examined five areas: organizational issues, standards and procedures, metrics, control of the development process, and tools and technology.

The results indicated that the UK and France were in the lead as regards the adoption of best practices. There were significant differences between the situation in those two countries and that prevailing in Spain, Sweden, Belgium and Portugal. It is inappropriate, therefore, to treat all European countries as a uniform bloc when making decisions as to the use of software.

There were some interesting national variations within the categories of practice. Despite its low ranking overall, for instance, Belgium performed well as regards the practices related to software tools and technology. Norway performed less well as regards the organization of software projects. Companies in the Netherlands had a surprisingly low relative rank for the adoption of practices related to the control of the software development process. (Source: *Information Strategy,* 2 (4) May 1997)

How secure are your (e-mail) messages

The security of e-mail messages is becoming of increasing concern to many organizations. "Spoofing" (forging messages) is very straightforward on unprotected systems, and although many "spoofs" are created by pranksters, they can be used in connection with serious fraud.

A number of suppliers are now offering solutions. Qualcomm, for example, which markets *Eudora* messaging software, offers its Authenticated POP service, with *Kerberos* for password protection. Pretty Good Privacy and Deming Software have released plug-ins for *Eudora 3.0.* Another approach is represented by S/MIME, an emerging security standard for all types of e-mail, which increasingly is used instead of Pretty Good Privacy (PGP) and Privacy Enhanced Mail (PEM) security techniques.

One of the more trusted methods of guarding against forgeries is to employ digital signatures, created using one-way hash functions. Another approach would be to encrypt the message itself, although not everyone does so. In part this is due to the unwieldy nature of the encryption software, in part it is a matter of habit. People's attitudes are likely to change, however, as they realize the extent to which e-mail can be intercepted. Their task will be made easier by the release of new versions of PGP which are integrated with the mailing software.

In the meantime, the US Postal Service has announced partnerships with Cylink and Aegis Star, aimed at developing a range of services, including time and date stamping, return receipt, certified and registered mail, verification of sender and recipient, and archiving services. (Source: *Communications International,* June 1997)

Control shipments via Web

Planning and execution of an enterprise-wide transportation management system can now be provided via Internet, intranet, or corporate network access with Metasys Web ETM (Enterprise Transportation Management) JAVA-based software. Controlling the entire life cycle of a shipment from order entry to execution to EDI payment, the system simplifies solution deployment, permits remote access, and allows shipment-status checking by casual users, all within the Internet browser framework. The ETM application itself allows modelling and execution capabilities to optimize transportation-related activities across a multidivision, multilocation supply-chain network, according to Metasys Inc., http://www.metasys.com. (Source: *Industry Week,* 9 June 1997)

Yahoo! Cataloging the Web

The functions of subject guides such as Yahoo! as opposed to search engines such as Lycos, Infoseek, WebCrawler, etc., are often confused. The latter may search entire Web documents for keyword occurrences, while using Yahoo! The search is confined to a finite but growing collection of Web sites that have been manually reviewed and categorized within a browsable hierarchy. Users search for information in Yahoo! in two ways: keyword searching (also used by search engines) and browsing, using the categories as a table of contents approach to the database. Alternatively, a user may select a Yahoo! category and search within that category only for context-sensitive results. Although Yahoo! can perform like a search engine through its Alta Vista searches, its strength lies primarily in its subject hierarchy. Advantages of searching a hierarchical subject index are higher relevancy rates; user does not need to know search-term synonyms; and serendipitous discovery.

Yahoo! does not presume to catalogue everything on the Web; it is a filter and organizer of useful information and is primarily concerned with creating a comprehensive catalogue of quality sites. It does not take a traditional approach to cataloguing as its collection is unlike libraries in that it does not have a pre-existing collection of mixed-media material; information on Web documents is not as

static as print and non-print media; and full description on the Web is not as necessary. In addition, because a Yahoo! subject category is dictated by what is submitted to the database or found through surfing, new subcategories are created as needed. Currently Yahoo! is receiving thousands of site submissions daily and subject lists are organized on a dedicated server and distributed to cataloguers, most of whom work in a specific area. There are fields for title, URL, contact person, geographic location, descriptive comment, and indicators for the presence of Java and VRML. While Yahoo!'s cataloguing system is highly flexible and adaptive, there are guidelines and some standardization, the most important being the use of common sense. Selection criteria are content quality; commercial details; and regional specificity. In summary, Yahoo! is a catalogue of Web sites enhanced by the capabilities of a search engine. It has created its own classification and the end result is a dynamic and flexible set of cataloguing practices linked by the key principles of quality content and overall utility. It is continually evolving and welcomes feedback from users. (Source: *Journal of Internet Cataloging*, 1 (1) 1997)

Information resource centre management (IRCM)

Information resource centres (IRCs), business information centres and corporate libraries are undergoing a fundamental change. Today they function as centres for the distribution of electronic information. Tomorrow, they will become active participants in the creation of enterprise knowledge management systems. In so doing, they will be transformed from a support function incurring overhead costs to strategic components for gaining competitive advantage.

Workgroup and intranet strategies offer possibilities for new ways of accessing and adding value to business information. Unfortunately, exploiting some of these opportunities will be by no means straightforward, and the IRC will be exposed to high levels of uncertainty as it tries to pick its way through the maze of options.

The various components of the strategy must be fitted together so as to present a unified vision of information delivery. Moreover, the strategy must be aligned with that of the parent organization. The IRC will have to make a case for expenditure on new technologies being an investment rather than an overhead expense. It will have to develop new skills as its role expands and as the technology develops. Increasingly, it will have to demonstrate an appreciation of what is required for the organization as a whole, rather than merely the IRC.

This understanding must be implicit in the technologies adopted by and promoted by the IRC. IRCs which adopt solutions not congruent with enterprise office/document strategies will not be positioned so as to participate in essential business processes. (Source: *Bulletin of the American Society for Information Science*, 23 (4) April/May 1997)

Dealing with dodgy characters

One method of dealing with character recognition errors by OCR systems is to store uncorrected output together with image files of the original pages. Use of search software which is tolerant of such errors will produce false hits, but reference can then be made to the image files. The difficulty with this approach, however, is that there is no quick means of identifying where on the page the search term occurs. Two companies are offering solutions to the problem.

The latest upgrade to ZyLAB's *ZyIMAGE* software allows fuzzy searching of uncorrected OCR text. Both correct and incorrect terms would be retrieved and highlighted in the faulty, post-OCR text file, but only the correct word would be highlighted on the TIFF page image. Scanning modules are priced at $1,495 to $5,995. *XyIMAGE Webserver*, which incorporates the new technology, costs $9,995 per server. Although in principle client software is not required, a browser is available for $79 per workstation.

With Iota's Smart Image Technology, documents are scanned or image files are imported, but there is very little OCR and no text files are involved. Content is held in searchable image format (SIF) files. SIF is an extension of TIFF and is fully compatible with it. The retrieval engine identifies geometric text patterns and highlights search terms on the document image itself. The Iota InterSite system applies this approach to storing and retrieving documents on intranets and the Internet. There are several beta installations, including one at Tel Aviv University and another with the Israeli Air Force. InterSite costs $10,000 for ten users, while *SIF CapturePro* costs $5,000. (Source: *Online & CDROM Review*, 21 (2) 1997)

IP finds its voice (IP voice packets)

The idea of converting voice traffic into IP packets and creating real-time voice connections across the Internet or corporate IP network is gaining in popularity—although not with the telephone companies. IP telephony is regarded as inimical to traditional telephony in that it offers the prospect of very low-price international calls whilst at the same time clogging local exchanges with lengthy Internet access calls.

On the face of it, subdividing a stream of pulse code modulation (PCM) data, compressing it, loading it into addressed packets and launching it across a connectionless appears a recipe for creating system delays. To reduce these, network equipment suppliers have devised protocols designed to reserve bandwidth for the exclusive use of constant bit rate applications.

As a result, protocols such as RSVP (reservation protocol) and RTP (realtime transport protocol) are being implemented as "streaming protocols" within IP router networks (including the Internet) to support video and telephony. More radical solutions, such as Cisco's tag switching or Ipsilon's IP switching, have also been developed.

Reserving unused bandwidth for applications to use as and when required might appear a less than optimal solution, but market perceptions are changing. The managers of corporate networks, demanding ever greater amounts of bandwidth for data flows, may come to regard voice as a merely marginal application using a small proportion of the total bandwidth employed. The idea of integrating voice and data across one link to a single access device may be so attractive as to outweigh other considerations. (Source: *Communications International*, April 1997)

Wide area workflow: a new metaphor for handling workflow on the Web

Although many suppliers of workflow systems have been quick to jump on to the intranet bandwagon, and proclaim it the means of finally resolving the issue of cross-platform compatibility, corporate users remain to be convinced. According to a recent Delphi Group survey, only one in five intranet users are employing them for line of business applications. Most businesses continue to rely on a variety of legacy and client/server systems.

The distribution or "push" model underlying traditional workflow systems is at odds with the "pull" philosophy of the intranet, which works on the basis that users will seek out

the information they need. Workflow in the Web, therefore, may be replaced by a new metaphor which supports the distributive nature of transaction-orientated line of business applications. These new applications may be labelled *wide area workflow*.

Sandia Labs, one of the US Department of Energy's laboratories based in Albuquerque, NM and Livermore, CA, has had an intranet running since 1995. In 1996, it began to explore the possible use of the intranet as a work management system, using Metro's *WorkBox*. The first application was a foreign travel request approval process, used by about 600 people in various locations.

Another organization which has moved from workflow on the Web to wide area workflow is Aetna Retirement Services (Hartford, CT). The company has brought legacy systems and secure transaction capabilities into the Web environment. These have been linked to a workflow system. Edify's *Electronic Workforce* was used as the basis of the implementation. (Source: *Inform (AIIM)*, March 1997)

Avoiding hostile applets

Java promises to relieve many of the headaches developers encounter when they migrate code among different machines. Java code's ability to run on diverse platforms also allows unscrupulous applet designers to invade your machine. What potential problems does executable content raise? There are four basic categories: attacks that modify a system, attacks that invade a user's privacy, attacks that deny legitimate use of a machine by hogging resources and attacks that antagonize a user.

A programming language as powerful as Java has the ability to modify data. Java includes predefined classes with methods that can delete and otherwise modify files, modify memory that is in use, and kill processes and threads. System-modification attacks make up the most critical risks. Java's designers have given much thought to disallowing this class of attack. In contract, ActiveX has no limitations on its behaviour once it is invoked.

In the most serious cases, system modification involves intrusion into the system itself. Java misuse can create an avenue of attack. Given that system crackers will use any tool available to compromise security, Java's designers and implementers must ensure that Java does not provide new ports of entry into a machine. To combat all four classes of attack, Java security relies on three prongs of defence: the Byte-Code Verifier, the Applet Class Loader, and the Security Manager. Together, these prongs perform load and runtime checks to restrict access to file system, network, and browser internals. (Source: *Byte*, May 1997)

Java: more than just a programming language?

More than just a programming language, Java is altering the way in which on-line information is being accessed and distributed. What makes Java popular is its integration with the modern Internet. Java has been licensed to just about every key software and hardware vendor in existence, including Microsoft, IBM, and Apple. Java-enabled products are now abundant. Sun's own Java product catalogue lists over 300 for example, and Java development is also on the increase.

Java is successful because it is a completely new product that has been carefully thought through: it is not a hybrid, like C++. In fact, there are no serious limitations to what Java can achieve. Java is also popular for historical, and indeed, political reasons. For the first time in personal computing there is now a technology that is truly universal and which could potentially remove the need for perpetual

software upgrades, as well as the indefinite "tie-in" between the user and software vendor, most notably demonstrated on the personal computer which runs Microsoft's ubiquitous DOS and Windows software.

The model of software distribution is changed when using Java, since Java applications, and indeed data, are transported to the client as and when required. Java programs can also be stored on disk and distributed by conventional means e.g. on floppy disk, although the emphasis is away from "static media" to the dynamic, on-line, alternative. Via the Internet the latest versions of a specific Java application can be delivered in real time to the end user, and the benefits are immediately apparent: the user receives the software immediately and can be sure that it is the most up-to-date version. (Source: *Internet Business*, 3 April 1997)

EIU puts renowned business database on Web

The Economist Intelligence Unit (EIU), a renowned source of global business information, has launched a Web site. It provides access to EIU's database of country and regional publications covering such items as market conditions, economic developments, industry trends and corporate strategies in over 180 countries. Documents can be downloaded using the portable document format (PDF) which as well as text includes associated charts, tables and colour graphics. http://www.eiu.com/ (Source: *Electronics Weekly*, 21 May 1997)

Data warehousing

Data warehousing—the creation of integrated stores of information which can be interrogated using data mining tools—is currently much in vogue with many organizations. Retailers can use such systems to determine which products are most and least profitable, and which outlets perform best and worst, which products perform best and worst in a given area. Other varieties of organization—airlines, oil companies, hospitals and government departments—can also benefit from deploying an integrated information system of this type.

Creating such a storehouse, however, is not always straightforward. A recent survey undertaken by Benchmark Research found that quality of data was a major concern for companies adopting data warehouses. Considerable "cleaning" and verification was required before data could be used. Moreover, often data was held within the organization in varying and mutually incompatible formats, necessitating extensive conversion. A further problem was how to determine who had responsibility for the maintenance of the warehouse. Information managements is a discipline spanning all corporate functions, and IT managers were not necessarily the appropriate people to manage the information store.

Although no one individual might be responsible for information management, everyone believed they needed access to the data store. Increasing numbers of staff were realizing that it represented a useful source of information, according to a study undertaken by Business Objects. Although the intranet might be the means by which information was disseminated throughout the organization, the data warehouse was the prime source of that information. (Source: *Information Management Report*, September 1997)

Creating full-text databases with ISYS

One of the most comprehensive and flexible full text database managers is ISYS for Windows. This application enables users to identify a pool of documents composed of different types and sizes, and existing in different locations including on the Internet, on an intranet, or on an

extranet and create a full-text index of every word in those documents. While the syntax or method of searching may not be the same as in LEXIS or WESTLAW, it is just as powerful. It also gives the ability to produce full-text databases of whatever documents are desired.

The ISYS set-up wizard is like most, prompting users with specific questions and steps that walk them through the process of creating an ISYS database. The wizard can also be a kind of training tool, duplicating the manual process for creating ISYS databases should that approach be chosen in creating subsequent databases. Once ISYS completes the indexing process, it gives the user some statistics regarding the process. This part of the process also produces an error log containing the names of files ISYS was unable to index.

The most important aspect of a full-text database is being able to search for and retrieve information once it has been indexed. Here, ISYS provides its users with a variety of powerful options. With ISYS the full assortment of Boolean search capabilities and proximity operators are available, plus field searching. ISYS's standard search template walks users through the process of performing most of these kinds of searches.(Source: *Information Today*, September 1997)

Windows application server for older machines

Citrix Systems' *WinFrame Enterprise 1.7* is a multi-user *Windows* application server, priced at $5,995. It is likely to be of particular interest to those wishing to run higher-powered applications on older PCs. *WinFrame*, running under *NT*, will support a hundred lower-powered machines running *Windows NT 3.51* (including 286s with 4 Mb of RAM).

Client software requirements are minimal: Citrix's ICA *DOS* client runs on any system with a 286 or higher processor. For *Windows 3.x* and *Windows 95* clients, the minimum is a 386 with 8 Mb of RAM. The server requirements, however, are substantial: one *NT* server is required for every 20-100 clients, depending on the power of the server. A 66 MHZ Pentium with 96 Mb of RAM will support fifteen users, whereas a four-way Pentium Pro 200 is required for one hundred users. Servers must have 16 Mb of RAM plus 4-8 Mb per user. (Source: *Information Week*, (14) 1-14 October 1997)

Application partitioning

Application partitioning is the process of dividing an application among available servers and clients. As such, it is vital to effective client/server design. Issues to consider when designing a scheme include user, processing and network load; application type; costs; maintenance and performance expectations.

User load does not refer to the number of people who have access to the system, but to the number who will access it simultaneously. Somewhere between the 100 and 500 user mark, database servers run out of memory and CPU resources. At this point, a middle tier (or several middle tiers) to multiplex database requests on behalf of the clients must be considered.

The cost of maintenance is rarely considered, even though this may be five times that of development. Costs may be reduced by placing the application logic within a middle or shared tier, giving a single point for maintenance.

The technologies may be grouped under the headings of static and dynamic application partitioning. TP monitors are classic examples of those under the former heading, but distributed objects (such as those defined by CORBA) may have static characteristics as well. Dynamic application programming means that the application may be

repartitioned at any time for any reason, giving maximum flexibility.

Once the logical application partitioning model has been defined, it can be mapped to a physical partitioning implementation. At this point, the architect must commit to specific products and hardware, at the same time specifying the client/server model (two-, three- or *n*-tier). Although the process appears straightforward, there are no easy answers. (Source: *DBMS*, September 1997)

Cross-platform: from headache to big break

The *Remote Services Management (RSM)* package was originally designed by International Software Solutions (ISS) for remote help desk support. Now, however, it finds applications in other areas requiring remote control.

It caters for all the major communications protocols, operates across both LANs and WANs, works with all PC operating systems, and can switch from voice to data on the same line without breaking the connection. It copes with varying file systems—such as FAT, HPFS and NTFS—using Boolean criteria selection. Recovery from interruptions to file transfers is enabled by the use of directory tree comparison and synchronization.

Given these capabilities, network management and control was an obvious area within which it could be deployed. ISS created generic 32-bit *OS/2* and *Windows* versions. The latest release (Version 4) can run one hundred operations simultaneously on one machine, e.g. controlling a hundred clients or managing a hundred ISDN lines. It also contains a programming script language, with tools for GUI design, and nearly 150 functions to automate tasks such as data distribution and asset management, client database manipulation, and local or remote program execution. The package also includes security and auditing features.

Over 450,000 *RSM* licences have been sold worldwide to date. One customer is Iceland: 1,300 stores have had the product installed for front and back office applications. IBM is now building *RSM* into its operating systems software.

RSM offers a solution to the problems caused by cross-platform incompatibilities. This enables the IT manager to focus on more pressing tasks, such as developing an IT infrastructure which imparts competitive advantage. (Source: *Computer Bulletin*, 9 (3) June 1997)

Knocking 'em (macro viruses) dead

Macro viruses, sent as attachments to *Word* documents over the Internet, have created a new worry for those responsible for system security. Conventional anti-virus scanning engines seeking boot sector or program viruses ignore document files and therefore do not detect the macro variety.

Such macros typically enter an organization's system via its mail server, which is frequently isolated from other network servers and outside the scope of any scanning software used elsewhere on the network. Proprietary network scanning software cannot scan attachments as they cannot decrypt them. Internet scanning software is both more expensive and more difficult to install than convention scanning software. Although the virus may be detected by desktop anti-virus software, system managers cannot rely on users to perform checks at regular intervals. Moreover, even when a virus is removed from the desktop, a copy may remain on the server.

Concerted action against the threat, however, is not helped by the welter of claims and counter-claims emanating from the suppliers of scanning software. Proponents of server-based solutions argue that the traditional

approach—comparing viruses with a database of known varieties—is cumbersome and unnecessary. Second Sight's *InVircible*, for example, works by comparing the profile of a healthy PC with its daily activity, looking for unusual events. Suppliers of anti-virus products incorporating databases, however, claim that it is necessary to identify a given virus specifically if it is to be removed without damaging data.

Calluna is offering a hardware-based solution: a £150 Hardwall card mounted in an ISA slot on desktop PCs. The hard disc is partitioned, and all e-mail traffic assigned to a particular area of the disc, surrounded by firewalls at the partition boundaries. (Source: *MicroScope*, 10 September 1997)

New Web interfaces

To date, developments in Net software have proceeded largely independently of those in desktop applications. This duality is about to disappear. The new generation of browsers—currently under development by over a dozen companies—will host all applications via a single, unified interface.

SCO's *Tarantella* server sits between the user and the Web server. Each desktop connected to the *Tarantella* server becomes a *WebTop*, within which *Java* applets redisplay sessions. The sessions can be legacy applications or conventional *Windows* programs.

IBM's long-awaited contribution to the NC interface market, *Workspace on Demand*, offers a choice of four interfaces: the *Navigator* browser, a Lotus *Notes* shell, an object-based shell or a mini-shell resembling a task list.

Faced with products such as these, Netscape has released *Constellation*, an add-on to *Communicator* which allows the browser to take over the entire desktop, embedding links and documents within it. Microsoft is offering a similar option as part of *Internet Explorer (IE) 4.0*. The *Active Desktop* employs *IE 4.0* as a common interface to the desktop, the Net and the LAN.

The way the Web is used in the workplace will change dramatically: commonly visited sites will be cached centrally and distributed internally via push technologies. Intranet messaging will pop up automatically without any need for an open mail client. At home, too, the appearance of the Net will change, as Microsoft and Netscape increasingly emphasize channel technologies. (Source: *Internet Magazine*, October 1997)

HTML + NNTP = groupware

Some US organizations have used BIX, a terminal-based conferencing system, for many years. It has provided a means of exchanging news, contacts, ideas and ASCII text documents. Now NNTP conferencing, combined with HTML-enabled e-mail, has emerged as an alternative route to providing quasi-groupware functions.

This has become possible as a result of two developments. Firstly, the latest news servers from Netscape (*Collabora Server 3.0*) and Microsoft (*Internet News Server*) greatly simplify the process of establishing and using NNTP conferences. Secondly, both Netscape *Navigator* and Microsoft's *Internet Explorer* have acquired new capabilities. In Version 4, both are considerably more HTML-aware. It is now possible to construct a mail message incorporating rich text, tables, images and hyperlinks.

In consequence, NNTP technology can be substituted—to some extent—for proprietary groupware platforms, such as Lotus *Notes*. A newsgroup is merely a directory containing text files. Newsreaders can order the display by the primary headers: subject, date and sender. This facility is of limited use when viewing public newsgrups, but in private newsgroups can enable them to be used as ordered data stores. Postings can be ranked by date or subject to aid retrieval. The new *Collabora* server and client offer full-text searching and direct integration with e-mail. Message threading can be used to create a hierarchy of documents.

It must be admitted that the technology suffers from constraints not evident in the more fully featured, proprietary groupware systems. On the other hand, NNTP servers and the INND server application are becoming easier to learn and apply, and merit consideration as an alternative to those same groupware systems. (Source: *Byte*, September 1997)

Hot assignment for software "agents"

Smart, autonomous computer programs known as "agents" may one day be entrusted with one of the most responsible jobs imaginable: controlling a nuclear power station. Agents are already patrolling unsupervised on the Internet, carrying out useful but tedious tasks such as ferreting out data or filtering incoming messages.

Researchers at the French Atomic Energy Commission are now planning to use similar programs to manage the running of pressurized water reactors.

Nuclear power stations are so complex that it is hard to devise a single computer system to control them.

The control system being developed creates a software agent for each of the four main subsystems in the reactor. The agents manage the water supply, reactor criticality, temperature and pressure. Each agent is given a strict set of rules, and is also able to communicate with the other agents. Because control is distributed, there is no single point where failure would be disastrous, so the system should be more robust than existing control programs. If the agents want to alter the conditions in a reactor they create other software agents to carry out the task. These programs travel to the appropriate subsystem and make the changes needed.

The agent-based system has not yet been let loose on a real reactor but it has been tested on simulations of a malfunctioning reactor, and in all the scenarios tried so far, the agents swiftly brought the reactor back under control. (Source: *New Scientist*, 3 May 1997)

Polymorphing interfaces

In programming, polymorphism usually describes a "one approach, many methods" way of writing code. First, a general procedure for accomplishing a task is described in generalities, then the procedure is implemented in specific ways that are appropriate for each particular situation.

While the practice has been common in the code itself, programmers have been slow to apply this principle to their development tools. Traditionally, each programming language has had its own unique environment, which the software engineer must learn and use.

That custom is changing. Major software companies are now pushing single interfaces to reduce costs and shorten development cycles.

Three quick examples: Microsoft has reworked all of its programming languages so they share Visual Studio 97, a common development tool; Borland has designed Builder, a standard interface, but with no common development tool, so that each language has its own slightly different

implementation of Builder; and IBM has created Visual Age, a loosely defined interface that is implemented in a unique way for each language. (Source: *IEEE Spectrum*, July 1997)

Taking HTML to the next level

Extensible Markup Language (XML) attempts to overcome the limitations of HTML by offering the ability to deploy more sophisticated documents and exchange complex data over the Web. A simplified version of SGML, it has been developed by the World Wide Web Consortium (W3C) and is supported in the latest versions of Netscape Communicator and in Microsoft Internet Explorer 4.0.

XML is an abbreviated version of SGML, designed to make it easier for publishers to define their own document types, and to make it easier for programmers to write programs to handle them. It omits some more complex and some less-used parts in return for being easier to write applications for, easier to understand, and more suited to delivery and interoperability over the Web. But it is still SGML, and SML files can be parsed and validated the same as any other SGML file.

In March 1997 a group of companies that include Microsoft, Sun Microsystems, Hewlett-Packard, SoftQuad and Dow Jones Interactive Publishing endorsed SML as a basic Web technology. Microsoft has placed XML at the heart of its Channel Definition Format for delivering "pushed" documents. Netscape, however, has been slow to put its weight behind XML, preferring instead to push Java. Later, however, it recanted, submitting a proposal for discussion to the W3C which extends XML to describe such elements as website layouts, file systems, or mailboxes, called Meta Content Framework (MCF).

According to the W3C, XML can offer functionality that is beyond current Web technology. Because authors and providers can design their own document types using XML, browser presentation will benefit from greatly improved graphical display and for performance, it argues. Document types can also be explicitly tailored to an audience, so the cumbersome fudging that has to take place with HTML to achieve special effects should become a thing of the past: authors and designers will be free to invent their own markup elements. (Source: *Digital Publishing Strategies*, August 1997)

Web search engines

Guides to the content of the Web fall under two headings: review sites and search engines. The former are compiled by human searchers: the latter, also known as webcrawlers or robots, are programs which "visit" as many pages as possible, automatically generating indexes of their content.

When using a search engine, the more words are entered in the search box, the more likely it is that the items found will be relevant. Most search engines try to find as many of the terms as possible, rather than requiring that every entry should appear in the document for it to qualify for retrieval. A few, such as *Infoseek*, require commas to be inserted between the words. Another tip which helps produce meaningful "hits" is to put inverted commas around key phrases to indicate they should be treated as such rather than as separate words. Most search engines can also be instructed to ignore certain words. *Altavista*, for example, requires the insertion of a minus sign before any words to be excluded.

If the search produces too many "hits", it can be refined by adding new terms and running the enquiry again. If a search does not produce the desired result at all, it may be necessary to resort to lateral thinking, and imaging which words or phrases might appear on the page required.

In addition to the major search engines such as *Altavista* and *Infoseek*, there are a number of specialist engines which might meet specific needs. Examples include engines for searching for films (http://www.imdb.com), newsgroup archives (http://www.dejanews.com), and search engines themselves (http://www.search.com). (Source: *Demon Dispatches*, (8) July/August 1997)

How to remain anonymous on the Internet

There are many ways to keep details private on the Internet. Many service providers permit multiple mail aliases. However, these addresses do not guarantee anonymity as the address can still be traced back. Freemail services also give you a way to protect your identity. Services such as Hotmail will give you a free e-mail address. You can send and receive e-mail from this account and some freemailers also allow you to post messages to Usenet newsgroups.

Another solution is to use an anonymous remailer. Remailers act as an intermediary between you and the person receiving the e-mail. Many anonymous remailers also allow you to post messages to Usenet newsgroups anonymously although some put restrictions on this as the service has been abused in the past. Anonymous remailers work by removing the parts of the message which could be used to identify the person sending it. However, even a remailer might not be completely anonymous. The remailer system will hold your details, including your real e-mail address, and recently several remailers have been forced to give out this information by the courts.

There are also various services that allow you to browse the Web anonymously. If you want to browse a site without leaving any evidence you will need to use an anonymous Web service, such as Anonymizer or the Lucent Personalized Web Assistant. Your requests for pages are passed to the anonymizer service. The anonymizer then gets the page and passes it back to you. (Source: *Internet Magazine*, September 1997)

Direct Network Attached (DNA) storage

As a new model for storage systems, Direct Network Attached (DNA) storage is very much in line with current thinking—offload as many non-core tasks as you can while keeping your system as open as possible. The hear of DNA is its operating system. This consists of a multitasking kernel with multithreaded file systems for each supported network operating system. The DNA OS is able to execute multiple reads and writes simultaneously, even when those reads and writes involve multiple network operating systems. For example, an NT user may request a disc write to a DNA system at the same time as a UNIX user also requests a write. The DNA OS processes both of those requests at the same time, greatly enhancing network response time.

A new draft standard, network data management protocol (NDMP), is designed to make every network attached storage device back-up ready, while enabling plug and play back-up operations. Users will not be required to install additional software on an NDMP compliant network storage device. Several software developers are rallying behind the solution, including Cheyenne Software.

The shift to new storage subsystem and networking products will be helped by the emergence of powerful, flexible interconnection concepts, such as SSA and fibre channel, which can handle the strain of a more robust network connection. Servers, however, will remain limited

in scalability due to a storage to server to client data/program copy problem Other questions still to be answered include how this paradigm fits into other styles of computing and what the expected network access times are. (Source: *The IT Network Magazine*, August/September 1997)

Building communities on the Web: ichat's ROOMS

ROOMS is ichat's flagship product, a client/server solution for adding live communications to any Web site. Claimed to be the industry's best selling chat server, ROOMS functions as the core element of ichat's larger Community System, which includes iPage, a paging application that allows you to locate and contact anyone on the Net who has iPage running, and iThread, which creates electronic discussion-group forums with comments and responses sorted by subject. Although iPage and iThread can operate as stand-alone products, they are designed to integrate with live interactive chat servers running ROOMS.

Over the last six months ichat has announced that three big name publishers have signed up to use its software: Universal Studios On-Line, Time Warner's Pathfinder, and Yahoo! In the case of Universal Studios On-Line it has begun offering a live Hollywood chat program with both moderated and unmoderated discussion. Pathfinder is using ichat to provide discussion over a range of content, while Yahoo! Chat is to be integrated throughout the search service's most popular areas such as sports and entertainment.

There are several innovations in the new ROOMS 3.0 which the firm claims sets ichat's apart from its rivals. First is a Java client which operates seamlessly through firewalls, allowing corporate users to connect to any ROOMS server. It also means that users do not have to download, install, and configure any software. ROOMS also supports timed ad banner rotation. More futurist is the use of avatars embedded within the chat text area. Users can choose from either a pre-selected character or create their own. (Source: *Digital Publishing Strategies*, 1 (11) July 1997)

Hacking through the data jungle

Like an ant laying a pheromone trail to help others find food, Web surfers of the future might leave electronic trails to help other people find the most direct way to the best chunks of information. At least that is the idea behind a new scheme of researchers at Rutgers University in New Jersey.

At the moment, Internet searches rely on keywords typed in by the user. A search engine throws up all the documents containing the keywords. The user chooses one of these as a starting point, and may then follow links to reach the information they are after. Or they may find the document they have chosen is a blind alley and have to start again.

The trouble with this system is that the next person looking for the same information has to go through the process all over again—even if 1,000 people have already been up the same blind alleys.

Using the proposed system, people could look at a page and see information about how other people looking for similar information had rated it. And they would be able to tailor their links according to the value others had given them.

The Web would steadily be transformed into something like a neural network, in which paths between different nodes of information are strengthened or weakened by the activities of millions of users.

The information could be stored in two ways. One would be on a proprietary "shadow network"—a server

maintained by an organization for its own use. The other would be a public version, in which each Web page would store the judgements of people who have been there before.

The extra information might appear as a form of colour coding on potential links, or as an icon in the corner of a page.

For now, the researchers are working on a prototype system for a small number of graduate students at Rutgers. Within five years they hope to have a system that could be scaled up to cover the entire Web. (Source: *New Scientist*, 15 November 1997)

Visual IP preview

Users can now assess intellectual property (IP) logic function blocks before making a commitment thanks to a tool from Summit Design.

Called Visual IP, the tool allows blocks of IP from different companies to be simulated. This helps a potential buyer to gauge the blocks' suitability.

Models are then made available on the Web for anyone to access. Potential IP buyers then download them and Visual IP, the special viewing software, from Summit. Visual IP contains a simple schematic editor, so several blocks of IP from different vendors can be linked together. The tool allows simple simulation of the IP, helping the user to better understand its function.

To improve security, the vendor can choose the amount of data that is available, so the model can be compiled as a black box or with access to internal signals and registers. Any model between the two extremes is possible. (Source: *Electronics Weekly*, 24 September 1997)

Fusion system to benefit astrophysics

A comprehensive software and database system developed by nuclear fusion researchers will soon be available to astrophysicists who study solar plasmas. An international consortium of 12 nuclear fusion and solar plasma physics laboratories in Europe and North America has been formed to modify the Atomic Data and Analysis Structure (ADAS) system to run on Unix workstations. The original ADAS system was only available to researchers using the IBM mainframe computer at the Joint European Torus (JET) research facility at Abingdon, UK.

Originated by Prof. Hugh Summers at the UK's University of Strathclyde, ADAS is an interconnected set of computer codes and data sets for modelling the radiant properties of atoms and ions in plasmas. The system consists of a library of over 240 subroutines and a graphical user interface (GUI) that provides users with the capability to explore thoroughly the results of their simulations. (Source: *Scientific Computing World*, June 1997)

Vegetation simulations will improve models of Earth's atmosphere

Plant scientists at the University of Sheffield in the UK are developing a computer simulation of the interaction between climate and vegetation that will help researchers model the Earth's atmosphere with greater accuracy. A Dynamic Global Vegetation Model (DGVM) is currently being coupled to the General Circulation Model (GCM) of the atmosphere developed by the Hadley Centre for Climate Prediction and Research in Bracknell, UK.

According to Sheffield researcher Prof. Ian Woodward, plants make an important contribution to the climate because they are involved in the exchange of carbon dioxide and water, they strongly influence the absorption of solar energy and they modify wind patterns. When coupled, the

vegetation model will provide this information to the GCM in exchange for climate data which will be used to recalculate the vegetation parameters. Preliminary results obtained by manually exchanging information between the two simulations suggest that if the carbon dioxide content of the atmosphere were to double, an increase in leafy vegetation would have an overall cooling effect on the climate.

Woodward stresses that changes in vegetation will be an important factor in any climate change scenario because they provide feedback mechanisms that can either encourage or discourage climate change. According to Woodward the most important factors in vegetation change are critical disturbances to vegetation such as fires, storms and human intervention. Currently there are no DGVMs that attempt to integrate critical disturbances. (Source: *Scientific Computing World*, June 1997)

Network directory services

Network directory services are now shipped as part of most network operating systems, including Windows NT and Novell, and can tell a network manager instantly how many users are on the network, where they are and which resources they have. The most basic use for small companies is keeping a list of users and attached resources on the network. However, it is in large installations that directory services really come into their own. They enable changes to be made to network configurations and software which can ripple down throughout the network so that change only has to be done once. Similarly, some directory services can also be made to hold telephone number information.

E-mail and group ware are the types of application that directory services can be used for and most network vendors are trying to build them into these sorts of packages. Novell, for example, provides access to its Novell Directory Services through Groupwise, its groupware package. Lotus has its own directory service which it uses as a back end for cc:Mail. Netscape also has its own directory service for its intranet products and the formation of Novonyx, the company's joint venture with Novell, will see Netscape products which integrate directly with NDS.

Because of the way in which directory services have developed, some users may find themselves with different directory services supporting different products. There are two solutions. The first is to use the Lightweight Directory Access Protocol, a standard protocol which enables directories to talk to each other with minimal traffic. The other alterative is to use a meta-directory, a directory of directories. (Source: *Computing*, 17 July 1997)

Java in information services

When Sun Microsystem's Java programming burst onto the Internet scene a couple of years ago it promised to bring unrivalled interactivity to the World Wide Web along with a sophistication simply not possible using normal HTML. Now the first wave of Java-enabled information products with the likes of Ovid, Desktop data, and Thomas Publishing are being launched.

What makes the Java language unique is that the applications or applets written in it do not run directly on your computer like ordinary applications. Instead, they run on a virtual machine—a Java-emulation engine. This means that PC, Macintosh, and UNIX users can access a Web page with a Java applet embedded in it, and the same applet will work on all the systems. Java's biggest benefit is that developers have to write only one application, and nearly anyone with a computer can run it.

This was one of the attractions for Ovid, which was looking to offer a search engine on the Web that had the full functionality of its proprietary retrieval software. Its Java client has gained a commercial release. Another firm embracing Java is news specialist Desktop Data. Its NewsEDGE service lets corporations distribute information from 650-plus live news sources via their own internal LANs or intranets. Desktop Data already offers a choice of 15 different user interfaces including Lotus Notes and Microsoft Exchange, and says that offering Java, HTML, and ActiveX NewsOBJECTS components, small programs which the end-user downloads, is the next logical step. In the case of Thomas Publishing, it is using Cadis' Java-based Krakatoa Web Catalog Publisher technology at the heart of the Product News Network (PNN), which Thomas hopes to be the world's largest on-line product news and reference service. (Source: *Information Today*, 14 (10) November 1997)

Use of genetic programming to build Boolean queries

For some years, Boolean retrieval has been displaced to some extent by best-match searching. It is easy to incorporate relevance feedback into the latter, but more problematic with Boolean techniques.

Genetic programming aims to evolve a computer program through processes analogous to those of natural selection. The technique was applied to the problem of creating a Boolean query able to retrieve documents with good performance as regards recall and precision. The Cranfield 1400 test collection of documents was used for searching.

Initially, 1,000 Boolean "organisms" were generated using the three operators (AND, OR, NOT) and the terms encountered in relevant documents. These were then tested for "fitness", i.e. their capability for retrieving relevant documents. The more effective ones enjoyed a better chance of being selected for "breeding", i.e. being used as the basis for developing new queries for use in subsequent iterations. The process continues until a query achieves optimum performance.

The system proved able to create optimal Boolean queries relatively quickly, provided there were only a few relevant documents. the process was slower if there were larger numbers of such documents.

A number of enhancements to the system are envisaged. Firstly, mutation can be used to speed up evolution, and this needs to be incorporated into the system. Another important requirement is to improve the system housekeeping to prevent it crashing (due to memory problems) after 30,000 queries have been developed. A more effective fitness function also needs to be developed: this might improve the speed at which Boolean queries can be generated. (Source: *Journal of Information Science*, 23 (6) 1997)

Bypassing the traffic jams

Making use of the general Internet network can be a frustrating experience for many users, especially overseas-based customers. National, Cisco and many other US electronics firms are looking for faster ways to delivery their Web pages to visitors. One way is to make use of a service from Digital Island which offers more direct Internet links that bypass congested Internet network access points. Digital Island's "Overnet" has been chosen by National to offer customers, manufacturing partners and its own staff connected to its Intranet, with much faster connections through what is known as a "single hop" Internet connection

and the use of virtual mirror Web servers to cache content. (Source: *Electronics Weekly*, 19 November 1997)

New warning on Year 2000 dangers

The Institution of Electrical Engineers has stepped up its campaign to warn industry of the dangers of one of the lesser known aspects of the Year 2000 computer problem—the possibility that information technology systems that rely on date information for their proper operation will break down at midnight on 31 December 1999, because they will be unable to recognize dates represented in a double digit "00" format. The IEE has launched a comprehensive guidance package on how the problem is likely to affect "embedded systems" or "intelligent devices"—the relatively simple devices, generally "dedicated" to controlling a narrow range of operations in specific pieces of equipment.*

Despite their more restricted application areas compared with conventional computers, embedded devices are found in a wide range of equipment ranging from photocopiers through security systems in buildings to process control systems in industry. They are also widely used in banking and finance to control, for instance, credit card and point-of-sale systems and may also carry out critical procedures in medicine, such as patient monitoring.

The implications of widespread failure of embedded systems are extremely serious. According to Dr. Ian Nussey, Chairman of the IEE's Public Affairs Board, there is a possibility that such failure "could bring many aspects of life to a halt precisely because affected units could be 'almost anywhere'." He also says that the precise moment of failure could, in fact, itself be unpredictable: "Some may fail on the stroke of midnight, some when first switched on in the year 2000, while others may fail before that—perhaps after an annual service in 1999."

The new printed guide supplements an existing IEE website on the Year 2000 problem, which the IEE says has received 63,500 "visits" over the last three months. The website address is http://www.iee.org.uk/2000risk. (Source: *Engineering*, October 1997)

Driving test

Computers continue to play a crucial role in the development of inspection, test and measurement systems. This point is particularly clear in the NUREN engine fault diagnosis system from Anthony Best Dynamics which uses a neural network to analyse the noise emitted from an engine on a cold test stand. Only a few years ago neural network technology was limited to esoteric applications in artificial intelligence research laboratories around the world. Originally conceived in attempts to make computers that mimic the operation of the human brain, neural networks have proved to be ideal for difficult pattern-recognition tasks, such as identifying faults in engine assemblies from the noise they make.

Embedded Systems and the Year 2000 Problem: IEE Technical Guidelines 9. Price £50. Available from IEE, P.O. Box 96, Stevenage, Herts SG1 2SD. Tel.: 01438 313311, Fax: 01438 742792.

The NUREN systems is used at the end of the production line, its principal purpose being the detection of missing or incorrectly assembled components. Engines are turned over at up to 1,000 rpm by an electric motor, and their sound signature is collected using a group of probe microphones. The collected sound data is analysed in both the time and frequency domains and typically data from only 20 to 50 engine revolutions is required to identify faults. This allows the testing process to be completed in a matter of seconds.

Neural network systems differ from more conventional programming algorithms in that they are not explicitly programmed to carry out their task. Instead they must be "trained" by example, gradually improving their performance until they reach an optimum level. In the case of the NUREN system, this process involves running tests on a number of engines that are regarded as being correctly assembled.

Once the system has learned the signature of a fully functioning engine its performance can be enhanced by conducting further training using engines in which deliberate faults have been placed. This refinement teaches the testing system to recognize more common faults as well as simply identifying engines that do not produce characteristic sound patterns. (Source: *Engineering*, September 1997)

Interactive data analysis system

Austrian scientists have developed a collaborative augmented reality system that allows a group of users to visualize 3-D data simultaneously. Called Studierstube, the system is located at the Institute of Computer Graphics of the Vienna Institute of Technology.

Each Studierstube user wears a position-tracked, see-through stereoscopic display and can freely walk about the virtual image to observe the data from different viewpoints. Users can see both the data and each other, allowing them to communicate and work together.

Interaction with the virtual image occurs via a personal interaction panel (PIP). The PIP is a position- and orientation-tracked input device consisting of a notebook-sized hand-held panel and a pen for pointing at the virtual image. The data can be represented in layers, and each user can control the layers individually. This, the developers claim, will allow different classes of users to extract useful information from the same data. The 3-D data can also be annotated with text or other 2-D information.

The computing algorithm of Studierstube consists of two data loops that connect users to a display server and a visualization server. The display server sends images to the user and processes the signals from the displays and PIPs. When a user interaction occurs, the display server sends mapping parameters to the visualization server which then generates new geometric data. This geometric data is sent to the display server to be converted into an updated image that is sent to the users' head displays.

An initial evaluation of Studierstube suggests that true 3-D viewing and manipulation of complex data is superior to traditional screen-and-mouse techniques because it is less computer-driven and easier to learn.

Looking towards the future, the Austrian researchers envision an augmented laboratory that allows scientists to conduct virtual experiments that are executed completely inside computers. (Source: *Scientific Computing World*, September 1997)

G. COUNTRY NEWS

Argentina

Government blamed for half of losses from software piracy

Software companies based in Buenos Aires claim that more than half of the $170 million lost each year due to piracy is the result of piracy by Argentine Government institutions.

Federico Galiardo, spokesperson for Software Legal, an organization representing software manufacturers Adobe, SCO, Symantec and Microsoft, said that while the industry has been able to reach accords with some half dozen Argentine provinces, in several provinces police raids on public agencies have only led to insults and political stand-offs.

The pirace problem, along with Argentina's controversial patent law, prompted the Office of the U.S. Trade Representative to place Argentina on its "priority watch list" in 1996 for failing to protect intellectual property; in April 1997, Argentina lost duty-free benefits on about $270 million worth of exports to the United States for the same reason.

According to the Business Software Alliance, 68 per cent of software for personal computers in Latin America is pirated, representing losses of $911 million annually. BSA contends the largest offenders are Costa Rica, Ecuador, Guatemala, Jamaica, and Trinidad and Tobago, with piracy rates of between 80 and 90 per cent. In 1996, the software industry registered sales of $2.8 billion in the region and with a growth rate of 35 per cent a year, sales are expected to jump to just under $10 billion by 2000, BSA said.

One solution to the problem, or at least a partial solution, has been held up in the Argentine courts for more than five years since Microsoft initiated a raid on one of the country's most powerful business groups, Grupo Roggio, and uncovered $50,000 worth of unlicensed AutoCad programmes.

The courts unltimately ruled against the software industry because the word "software" is not included in Argentina's intellectual property law and moves to reform it via presidential decree have been struck down. The industry has appealed the decision, which has been awaiting a Supreme Court ruling for more than two years. In the meantime the indsutry is faced with no legal precedent for protecting copyrights.

To counteract the problem, various congressional commissions have approved proposed reforms of the intellectual property law, introducing the word "software" into the law's first article. (Extracted from *World Intellectual Property Report*, vol. 11, 1997)

Australia

Telecentres, information technology and rural development: the Australian experience

The Australian federal Government's Rural Communities Access Program (RCAP) seeks to provide remote districts with access to information and other facilities via telecentres and "phone-based" advisory services. The telecentre component of this programme was initiated in 1992 by Telstra (the State-owned telecommunications company) and the Department of Primary Industries and Energy (DPIE).

Telecentres are equipped with a range of computing and communications equipment, such as satellite dishes, computers, fax machines, scanners, printers, Internet connections, video conferencing equipment and photocopiers. Central funding pays for the purchase of such equipment and at least part of the salary of a (usually part-time) centre manager, but there is also significant input from local communities in the form of provision of buildings, voluntary labour or cash support.

DPIE has supported 43 centres, of which 41 are still in operation. The Western Australian telecentre network, established in 1993, now comprises 68 linked centres (including 14 supported by DPIE). The centres undertake a variety of activities, the more common of which are computed and other training, desktop publishing and distance education. Few, however, have provided substantial opportunities for teleworking.

It is difficult to determine whether or not the centres have been a success. A key measure of success (particularly for funding bodies) is that they become self-sufficient, but most are likely to continue to require some form of public funding. In that most have survived, they have been successful. The future of telecentres, however, remains uncertain. (Source: *ASIS Bulletin*, 23(6) August/September 1997)

Belgium

Belgians collaborate on electromigration

A new test structure for the measurement of the electromigration-induced degradation of on-chip interconnects has

been developed and tested. This multivoltage probe test structure is an interconnect line with a number of voltage probes (typically 10) connected to it, enabling the resistance changes of sections of the line to be measured as electromigration takes place. The resistance changes of the individual sections of the line were measured using an electromigration test system having a high measuring resolution. The probe results from collaborative work between the Inter-University Micro-Electronics Center (IMEC, Leuven, Belgium) and the Institute for Materials Research (a part of Limburgs Universitair Centrum, Limburg, Belgium).

The researchers have shown that the resistance of the different sections of the line can show large variations during the electromigration test at elevated temperatures. It was found that the electrical resistance of some sections increased strongly, while the resistance of other sections decreased. Scanning microscopic investigations showed that these resistance changes could be attributed to void formation producing increased resistance, while hillock formation resulted in decreased resistance.

The large variations found in the resistance changes of the sections is not reflected in the resistance change of the full interconnect. The latter was found to slowly and smoothly increase. According to Luc De Schepper, professor at the University of Limburg, "This work on multivoltage probe test structures has provided a better insight on the interpretation of changes in the electrical resistance of interconnects during electromigration testing." (Reprinted with permission from *Semiconductor International Magazine*, June 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

New European initiative

The Government of Flanders, the Northern State and one of the three regions comprising Belgium, launched a new initative to develop a semiconductor manufacturing industry. Already, it has allocated several hundred million dollars to be offered in various incentive programmes to attract investment by global integrated circuit producers in the region.

Filip Vandenbussche, director of Business Development in the Flanders Foreign Investment Office (FFIO) in Palo Alto, CA, said Flanders is already well known in the semiconductor industry, partly for the ongoing work being done at Belgium's world-class research organization, IMEC (Inter-University Microelectronics Centre), and also from MIETEC, Alcatel's successful ASIC manufacturing plant, recently renamed Alcatel Semiconductor. IMEC is Europe's largest independent research and development organization. In addition to developing attractive financial incentives, the Government believes that the reputation of IMEC and other research organizations focused on microelectronics throughout Belgium will be a strong magnet to help attract some of the world's most important semiconductor companies, many of whom already have ties with these research organizations. Flanders has placed research and development at the core of the many benefits it can offer IC producers.

IMEC has the skills to enter into technology partnerships and can provide valuable assets to support designs for system-on-chip integration, needed to fill fab capacity in the near future. With fundamental and applied research being done in Belgium by universities as well as by respected centres such as IMEC, Flanders has the capability to produce skilled workers needed to staff modern technology facilities.

In addtion, there are various innovation and incubation centres as well as several policy-supporting institutions such as IWT, the Flemish Institute for the Promotion of Scientific and Technological Research in Industry, which will co-fund technology research and development. (Extracted with permission from *Semiconductor International Magazine*, September 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

European Union

EU fears trade dispute over data privacy

It is said that the European Union is not convinced a code of conduct for international data transfer would alone provide "adequate" protection against breaches of privacy as required by EU law.

The code of conduct, proposed by the United States and formulated by industry, is scheduled to go into effect as law in October 1998. There are concerns on both sides of the Atlantic, however, that disagreements on protection of data transferred over the Internet, seen as critical to the growth of electronic commerce, could erupt into a major trade dispute.

European Commission officials are advising that some sort of U.S. regulatory body must be established to monitor and referee complaints if a trade dispute stemming from a disruption of data transfer is to be avoided in 1998. (Extracted from *World Intellectual Property Report*, 1997, vol. 11)

France

France's Minitel in the Internet age

France's Minitel, which is navigated by a book of four digit codes rather than the Internet's word searches, lacks the easily understood icons and menu bars of Windows or Apple Mac. The high service costs and awkward service have convinced many thousands of French people to return the Minitel sets, which were distributed free by its creator France Telecom.

However, rumours of Minitel's death remain greatly exaggerated. PC penetration in France is among the lowest of the major world economies. Also recent consumer research shows that Minitel businesses are still working the magic that makes French people buy online, while companies selling in other countries struggle.

After 17 years of online selling experience, Minitel businesses have worked out how to satisfy customers' concerns over security and service, both of which hamper selling over the Internet. All Minitel services are charged on the user's telephone bill, giving a breakdown of how much customers spent and where they spent it. Unlike the Internet, where customers risk losing their shirt trying to buy a new one, Minitel businesses are backed by service standards.

France's National Railway SNCF, whose Minitel service is one of the most popular on the network, is typical. About two million people connect to SNCF's Minitel site each month. Ninety per cent of those people are paying for train times and ticket prices—information which would be nearly impossible to charge for on the Web. (Source: *Information Strategy*, October 1997)

Italy

Italy hosts supercomputer training centre

The Italian InterUniversity Consortium (CINECA) in Bologna is to become host to a training centre for the

application of supercomputing to interdisciplinary research, funded by the European Union (EU).

The training programme will be run by CINECA computing experts and will cover vector and parallel computers as well as the use of a scientific visualization laboratory. Participants will be given free access to CINECA's facilities, which include a Cray T3E and an IBM SP2.

Disciplines covered by the training centre will include biotechnology, chemistry, materials science, computer science, earth sciences, economics, computational fluid dynamics, physics and archaeology.

After completion of the training programme, participants will have continued access to CINECA's computing facilities from their home institutions. This will be provided by the high-speed Italian research communication network (GARR).

Funded under the EU's Training and Mobility of Researchers Programme, the training centre is part of CINECA's Intensive Computing for Advanced Interdisciplinary Research of European Scientists (ICARUS2) project. The programme will run until August 1998. (Source: *Scientific Computing World*, July 1997)

Myanmar

Myanmar establishes data links via Singapore

Myanmar has set up its first data communications link with the world and has chosen to use Singapore as its gateway. In March 1997, Singapore Telecom and Myanmar PTT established a 64 kbit/s link between the two countries. The link using Telepac, Singapore Telecom's packet-switched service enables Myanmar to reach out to over 110 destinations in more than 90 countries and 200 data networks worldwide.

With this connection, companies can now set up inter-corporate and intracorporate communications for their e-mail and data transfer, and access computer hosts anywhere in the world.

Singapore Telecom soon plans to offer other data services such as X400 and X500 to Myanmar. It is also in the process of negotiating with the relevant authorities in Cambodia and Lao People's Democratic Republic to establish similar data links with these countries. (Source: *ITU News*, May 1997)

Russian Federation

Russian computers

A rare success story amid the general slump of Russian industry, the assemblymen are the bright young firms which put together own-brand personal computers—called "red" in the Russian trade to indicate local origin (western imports are "white", Asian ones "yellow"). These local firms have beaten back established foreign brands, raised sales sharply, and narrowed the discount at which their products sell against comparable computers from abroad.

The leading assemblyman is VIST, a personal-computer firm that is moving fast into the market for larger corporate "server" computers. According to International Data Corporation, an industry research firm, VIST sold about 180,000 personal computers in Russia in 1996, giving it 17 per cent of the market. VIST says it sales were higher than this and claims that surveys underestimate the size of the Russian market.

In all, the Russian computer firms have about two thirds of the market between them—probably twice as much as they had four years ago. The ferocity of their competition has bitten into the importers' plump margins. A "white" computer might have sold, three or four years ago, at double the price of a comparably equipped "red" one. Today the differential has narrowed to about one third.

One reason for VIST's success has been the availability of a modern, automated assembly line at a factory in Zelenograd, a town about an hour from Moscow. VIST was able to rend capacity, and to expand production as demand grew. VIST has just started breaking ground for an additional assembly plant of its own, to accommodate its new and more complex product lines.

There is surging demand for high-performace home computers in Russia. In the past two years hundreds of thousands of Russian households have discovered the joys of CD-ROM. At the same time government procurement, which is the mainstay of imported brands, has been weak. So local firms captured most of the growth in the $1.5 billion personal-computer market.

VIST has set itself apart from its rivals at home by the care it has taken to persuade customers to trust its products. It sells with two-year guarantees, and offers the biggest regional network of any Russian computer firm: 250 dealers across the country, full-service centres in 60 cities.

But the wider lesson from the red assemblymen is for the rest of Russian industry. Their success proves, if nothing else, that Russian consumers are as shrewd and sceptical as any other country's consumers: they are not arbitrarily prejudiced against Russian manufactured goods, but they demand international standards of performance and reliability from the products they buy. (Extracted from *The Economist*, 2 August 1997)

Singapore

Siemens to expand in Kuala Lumpur

Siemens will invest more than $83.33 million to expand and modernize backend production for memory chips in the southern Malaysian state of Melaka. Siemens said the move allowed the company to further expand its involvement in semiconductor production in Malaysia, besides making Melaka a suitable production location for the latest generation of DRAMs. (Reprinted with permission from *Semiconductor International Magazine*, June 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

United Kingdom of Great Britain and Northern Ireland

United Kingdom of Great Britain and Northern Ireland to coordinate SiGe R&D

Britain will coordinate the funding of various SiGe research programmes so that the money will be applied to the effort as a whole and produce a closer collaboration between various centres. The Government's Engineering and Physical Sciences Research Council (Swindon, Wiltshire) is investing more than $6 million, while GEC Plessey Semiconductors (Caswell, Northamptonshire) and the Government's Defence Evaluation Research Agency (Malvern) are providing more than $3 million in facilities and materials. The universities of Southampton, Glasgow,

Liverpool, Queen's Belfast, Surrey, Liverpool, Newcastle, Sheffield, Warwick, Loughborough and Imperial College London are also involved. (Extracted with permission from *Semiconductor International Magazine*, June 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Plasma techniques for reducing industry emissions

AEA Technology PLC (Culham, Oxon, England) is developing non-thermal plasma techniques for destroying the environmentally hazardous gases produced by the semiconductor industry. The company feels plasma-based technology is ideal for treating waste gases from fabs, as it can handle the very broad range of pollutants from this industry, including volatile organic compounds, perfluorocarbons, dioxins, the oxides of nitrogen and sulphur, organometallics and organosilicons. If emitted into the atmosphere, such gases can result in global warming by the greenhouse effect, unpleasant local odours and the direct or indirect formation of ground-level photochemical ozone.

Two techniques are being used to generate the required plasma in the gas stream carrying the compounds to be removed. A microwave plasma system is very suitable for treating the fairly low flow rates found in the semiconductor industry of up to about 200 litres/min. The second technique, which uses high-voltage pulses to produce a pulsed corona plasma in the gas stream, is suitable for high flow rates of up to 5000 m^3/hr per system. The almost empty corona tube is tolerant to particles in the gas, such as silica, which cause no clogging. In both techniques, energetic electrons interact with gas molecules to form the active species that in turn react with the pollutants and destroy them.

Many pollutants can be destroyed by high temperatures, but this requires a fuel such as natural gas or, for higher temperatures, hydrogen. The high temperatures may result in the formation of nitrogen oxides, while gases containing halogens may corrode burners and form hazardous dioxin. Plasma processing offers the advantage that the treatment is carried out at relatively low temperatures (from room temperature up to 2,000° C), so the input energy is used to break bonds rather than to generate unwanted waste heat. No subsequent recombination occurs, since the pollutants are converted into stable compounds. Volatile organic compounds are transformed mainly into carbon dioxide and water, while the nitrogen dioxide formed from oxides of nitrogen is easily removed by scrubbing. (Reprinted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahens Publishing Co., Des Plaines, IL, USA)

United States of America

Foreign R&D challenges US semiconductor industry

According to the Center for Trade and Commercial Diplomacy of the Monterey Institute of International Studies, the US semiconductor industry's leadership in R&D is being challenged by aggressive applied research programs of foreign industries. The study carried out by the Center was commissioned by Semiconductor Research Corporation and partly funded by the Semiconductor Industry Association. The study results indicate that Asian and European R&D capabilities are growing rapidly and that foreign chip firms have close partnerships with their Governments, their applied research spending is higher than that of US industry when calculated as a percentage of sales, and that foreign semiconductor companies are extremely interested in pursuing research done at US universities. (Reprinted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

New centre to address energy issues

The Electric Power Research Institute (EPRI), the science and technology consortium for the electricity industry, and SEMATECH have formed a new centre to address productivity, environmental and energy issues in the electronics industry, particularly semiconductor manufacturing. The centre will be called the EPRI Center for Electronics Manufacturing (CEM).

The EPRI CEM, to be based at SEMATECH, will work on behalf of EPRI's Electronics Industry programme to coordinate the involvement of EPRI members and all semiconductor industry firms and associations in cooperative efforts to improve plant operations, reduce cost of ownership and promote environmental stewardship through technology-based solutions.

EPRI has more than 30 similar centres throughout the country, including 11 that focus on specific industrial sectors, such as the food and textile industries. (Extracted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

H. STANDARDIZATION AND LEGISLATION

Standardization

DigiTAG calls for set-top standard

A European body has called on broadcasters and manufacturers to work together to produce a standard for set-top boxes to aid the uptake of digital television.

Herman wan Wijk, chairman of DigiTAG which promotes digital terrestrial television (DTT) in Europe, said that proprietary designs fragment the market, make digital receivers more expensive and confuse the consumer.

DigiTAG proposes that the current method of building digital television based on payment services alone should be moved to more open transmissions where the majority of channels are accessible to all, adding pay-per-view services on top.

Operators such as BSkyB and Canal+ who are the first to market digital services look set to oppose the proposals. (Source: *Electronics Weekly*, 24 September 1997)

The X.400 standard—what does it mean for electronic communications?

X.400 offers an alternative or complementary service to Internet-based communications. It is widely used by large organizations. Major European telecommunications providers such as British Telecom, Racal, Cable and Wireless and France Telecom have made a commitment to provide public services based on the standard.

A broad-based messaging standard, it includes e-mail facilities. It offers considerable advantages over other e-mail protocols in that messages can be transferred in the same format (e.g. Microsoft *Word*) in which they were created. X.400 messages are carried within "envelopes" which can be exchanged by most e-mail systems, including *cc:Mail*, Microsoft *Mail* and the Internet. An application such as *MailmaX.400*, for example, enables text, data or graphics to be sent from within any *Windows* program with the ease of printing. Another key feature of X.400 is the audit trail established: the sender is notified when a message has been delivered, and when the envelope is opened.

The audit trail also means that X.400 can support electronic data interchange (EDI). Indeed, some EDI standards, such as EDI-FACT, are themselves X.400-based, since X.400 is the European Community standard for electronic message exchange.

X.400 provides access to the Internet, but not to the World Wide Web. For some companies, this might be seen as an advantage. Although an X.400 message is more expensive than its Internet e-mail equivalent, it is considerably more secure. It must also be borne in mind that although an X.400 message can be sent to a non-X.400 user, the security features depend on both the sender and the recipient being X.400 users. (Source: *Online & CDROM Review*, 21 (4) August 1997)

Standards threaten super mobile phone

The adoption of next-generation mobile phone systems is likely to be delayed due to a lack of a global standard. So argues Ovum, the telecommunications and IT analyst group, in its report *Third Generation Mobile Systems*.

UMTS in Europe, PCS in the US and J-FLPMTS in Japan all belong to the International Mobile Telephony (ITM)-2000 framework but are incompatible. Unless the three groups agree on a common, global standard the appearance of mobile multi-media will be stifled.

Another factor threatening the early uptake of next-generation mobile systems is operator uncertainty over whether they should continue spending their money on enhancing current, second-generation systems of developing the next generation one.

Ovum also believes that the notion that users will adopt a single terminal is false.

There are also significant technical challenges to be overcome in the development of a single terminal capable of delivering voice, data and video. Battery life, memory, processing power and display technologies will all need to be enhanced if users are to interact with multimedia content over the mobile network.

Ovum forecasts that by the year 2005 there will be 61 million third-generation subscribers worldwide. By 2010 this will increase to 570 million subscribers—50 per cent of the entire mobile subscriber base. (Source: *Electronics Weekly*, 3 September 1997)

World standard DAB setback

The worldwide adoption of the European Eureka 147 standard for DAB, or digital audio broadcasting, has taken a blow after a US decision to favour a satellite-based system.

To this aim, the US Federal Communications Commission (FCC) has auctioned frequencies in the S-band spectrum (2,310 to 2,360 MHz). However, satellite-based DAB systems, unlike Eureka 147, cannot deliver cd-clarity audio to stationary and mobile users in open and urban areas, countering the whole purpose of adopting DAB.

The US Government's decision has been described by the Consumer Electronics Manufacturers Association (CEMA) as "disastrous for digital audio radio in the US".

CEMA now hopes to sway the US Government towards giving up the L-band frequencies (1,452 to 1,492 MHz), currently reserved for Pentagon use. The L-Band is suited to the improved quality terrestrial delivery of DAB, and CEMA is lobbying to get the Eureka 147 system implemented in the spectrum, even though it believes the licence fees demanded for Eureka 147 are too steep for US broadcasters.

Eureka 147 has been selected by 20 countries worldwide. Japan has still to choose and is watching developments in the US. (Source: *Electronics World,* June 1997)

Serial SCSI standard may not link with SSA

The emerging standard for SCSI serial interface, which links the host and peripherals of high-end computer systems to achieve data transfer rates in excess of 100 Mbit/s, is likely to be incompatible with Serial Storage Architecture (SSA) products currently in use.

The ANSI X3T.11 standards committee is considering two proposals for the SCSI interface, called Torn and Aaron. Both are based on the Fibre Channel (FC) standard while adopting certain features from SSA. The main difference between the two is the way they link peripherals.

Some computer peripheral manufacturers have highlighted the possibility that the new standard may not be backward compatible, and may require additional adaptor cards with SSA systems.

The appearance of the serial SCSI interface standard is expected to be delayed as deadlines continue to slip. First compliant products are expected in 1999. (Extracted from *Electronics Weekly,* 18 June 1997)

ITU agrees on global standard

The International Telecommunication Union (ITU) has agreed on a global standard for digital terrestrial television broadcasting (DTTB) which will unify two competing standards. The two proposals—the US-favoured ATSC and the European-developed DVB—will form a single system for end-to-end digital TV broadcasting.

ITU believes that the standard will give equipment manufacturers the go-ahead to start delivering TV sets anywhere in the world. It will also prevent colour and image distortions, frequently encountered with current systems.

ITU has also agreed on the move towards a single HDTV production standard. (Source: *Electronics Weekly,* 18 June 1997)

Low-voltage standard announced

The low-voltage logic Alliance, consisting of Fairchild Semiconductor, Motorola Semiconductor Products Sector and Toshiba Corp., announced the industry's first 2.5 V CMOS logic standard with 3.6 V-tolerant inputs and outputs.

Jointly developed by the three member companies, the new standard is intended to provide designers with a flexible, multiple-sourced solution for their next-generation low-voltage designs.

With new high-end microprocessors moving from 3.3 V to 2.5 V operation, there is increasing demand from system designers for logic optimized for this lower voltage, according to the Alliance. New low-voltage designs are moving towards higher performing logic not only for speed, but also for the ability to operate with memory and other components that are currently at 3.3 V.

A unique feature of the standard is its ability to interface to either pure 2.5 V or both 2.5 V and 3.3 V in the same system without sacrificing performance. This mixed-voltage capability allows designers to get the speed and performance benefits of this new standard even before

systems move to full-2.5 V operation. The standard also specifies 0.35 µm geometries and is optimized for 2.5 V system loads and power supplies.

The low-voltage logic Alliance was created in July 1993 to standardize the next generation of high-performance, low-voltage CMOS logic and to accelerate the market's acceptance of low-voltage logic products. According to Insight-Onsite Research, the low-voltage logic market is expected to reach $286 million by the year 2000. Low-voltage CMOS logic is expected to increase its market share from 40 per cent in 1996 to 62 per cent in 2000. The first standard from the Alliance was LCX, which offers 3 V operation with 5 V-tolerant inputs and outputs. (Reprinted with permission from *Semiconductor International Magazine,* May 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

C++ gets worldwide standard

The most widely used high-level programming language, C++, is set to have its own global standard, allowing it to be used on projects where standardized languages are mandatory.

The standard should be ratified following recent approval by the C++ committee of the International Standards Organization (ISO). Developers will now be able to use C++ on those projects, especially military ones, where a standardized language is required.

Users of C++ will not need to relearn the language. Compiler companies are on the committee and have been bringing their compilers and libraries up to the standard for some time. (Source: *Electronics Weekly,* 26 November 1997)

MPEG-4 draft cleared for submission

The Moving Picture Expert Group has approved the committee draft of the MPEG-4 phase 1 multimedia standard, clearing it for submission to the various national bodies for their comments. A late addition to the draft included support for video interlacing. Subsequent stages towards achieving international standard status in February 1999 are the final committee draft in July 1998 and draft international standard in December 1998. The standard was split into two phases earlier this Year to speed up its introduction. The second stage will be a superset of the first. (Source: *Electronics Weekly,* 12 November 1997)

ITU standards build the global information infrastructure

ITU has created a new series of recommendations specifically dedicated to standardization of technologies that will underpin the new Global Information Infrastructure.

While many countries are already beginning to implement their own strategies to put in place new high-speed information infrastructures, there remains a need for a global approach which will foster worldwide compatibility between new technologies. ITU, with its 188 government members and around 450 members from private industry, represents a global forum where members can develop standards that reflect the needs of a broad cross-section of the infocommunications industry, from operators and governments to service providers and consumers.

ITU-T series Y recommendations, as these new standards will be called, are the result of a meeting of Study Group 13 of the ITU's Telecommunication Standardization Sector, held in Toronto, Canada, from 8 to 19 September 1997.

The first three draft Recommendations agreed at the meeting that will now be proposed for formal approval are:

- Y.100, which gives a general descriptive overview of the GII;
- Y.110, which describes the basic principles and concepts for the GII architecture;
- Y.120, which describes methodologies and scenarios which may be used for developing the GII.

The creation of the new Series, and the three draft Recommendations, are the first practical results of the GII Project which has been established under the leadership of Study Group 13 of the ITU Telecommunication Standardization Sector (ITU-T). The project was established with the aim of responding quickly to market requirements for standards on which to base the new kinds of equipment which will form the basis of the new global infrastructure. (Source: *ITU News Release*, 20 October 1997)

SEMI adopts Echelon's LONWORKS as standard

SEMI has adopted Echelon Corp.'s LONWORKS control network technology as part of its E-61 standard, specifying the Palo Alto, CA, company's LONWORKS as a sensor bus for connecting simple and complex sensors, actuators, and instrumentation within and between equipment. Of the sensor bus standards approved by SEMI, this is the only one allowing sensors and actuators to be connected in systems with more than 128 nodes or across distances >500 metres. The standard covers plantwide systems such as vacuum pumps, gas distribution, leak detection, cleanroom airhandling, etc. (Reprinted with permission from *Semiconductor International Magazine*, October 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Driven by speed

The modem market is famous for bringing technologies to market before they have been ratified by any official body and it has been true to form with 56 kps technology. In one corner is US Robotics with its X2 standard and in the other is Lucent and Rockwell's standard K56 Flex. Meanwhile ITU, the official standards body for telecommunications technology, has been working on its own version scheduled to appear in January 1998.

The 56 kps technology is bound to compete with ISDN, the digital telephone technology offered by BT and operators throughout Europe. This allows companies to connect at 64 kps speeds—not much more than the 56 kps technology being offered by the modem vendors. However, ISDN can have significant advantages over 56 kps technology. ISDN can be aggregated into 128 kps, as every ISDN link consists of two 64 kps lines. There is also the benefit of instantaneous setup. Whereas modems have to undergo an arduous hand-shaking process at the start of every connection, ISDN connection takes around half a second at which point data can be sent freely.

The other option for truly mobile users is to use a GSM modem. Being the adopted standard for mobile communications in Europe, GSM enables mobile phone users to communicate while in one of the many supporting countries, and with GSM cards available, companies can set up their field staff to transmit and receive data from almost anywhere. The downsides, however, are high cost and low bandwidth: the maximum communications bandwidth using most commercially available cards is 9.6 kps. (Source: *Communicate*, July/August 1997, pp. 24-26)

Legislation

Discover patent information

It is now practicable to carry out a simple patent search through the Internet, although for most intents and purposes only United States patents are freely available. The US Patent and Trademark Office has its own Web site which allows searching from 1976 to date using words from the title and the abstract, the name of the patent owner and a large range of other fields. The results are output with full bibliographic details and abstracts.

The IBM Patent Server is another free site service which allows searching of words in the title, abstracts and claims, and a limited range of other bibliographic fields for patents issued from 1971 to the present. Images of the full text of the patent including drawings can be viewed for patents issued since 1980. The Micropatent Web site allows text searching of recent US patents and the Derwent site permits searching of recently issued patents from around 40 countries.

CD-ROM databases are available for a number of countries and convention organizations, though none is truly international in its coverage. The most useful for those based in the UK are the ESPACE-ACCESS-EPA disks covering the patent applications published under the European Patent Convention and the Patent Co-operation Treaty.

Another source for a first search of patents is a specialist patent library. In the UK there are 14 Patent Information Network libraries open to all and each provides help and search tools for the newcomer and specialist patent searcher alike. Although the scope of each library is different they are all able to direct the visitor and the remote inquirer to appropriate databases, hardcopy sources and other services. (Source: *Managing Information*, 4 (8) October 1997)

10 M gate ASICs: A matter of intellectual property rights?

Mentor Graphics Corp. (San Jose, CA) has come up with a way to help chip designers resolve intellectual property rights issues when building high-density application specific integrated circuits (ASICs). "The 10-million-gate integrated circuit is not about changing tools sets, it is about changing business practices," said Walden C. Rhines, president and CEO of Mentor Graphics.

To this end, Mentor Graphics, a supplier of electronic design automation (EDA) tools, has created a new business model—the industry's first full-line Intellectual Property Publisher—which allows for the integration of multiple intellectual property building blocks, regardless of the design tool being used.

The company said the new model already promises one customer the ability to reduce silicon costs by as much as 70 per cent; Telular, a Chicago company that develops equipment for cellular and wireless telephones, is using intellectual property "cores" from multiple vendors, then integrating and testing the results before committing to production. (Reprinted with permission from *Semiconductor International Magazine*, May 1997. Copyright 1997 by Cahners Publishing Co., Des Plaines, IL, USA)

Copyright law could affect research

International treaties being proposed by the World Intellectual Property Organization could inhibit common uses of published research.

Even browsing the Internet could be subject to copyright if the treaties are approved. The treaties propose that digital information such as the display of an image from the Internet on a computer screen could be as copyrighted. One related article of the proposed treaties that has also caused concern defines the rights of a creator to receive royalties when copyrighted digital information is reproduced.

Such treaties could make it impossible for Canada to allow what is commonly known as fair dealing—royalty-free copies of small portions of a copyrighted work for private study or research purposes. While Canadian law allows a person to make a paper copy of a paper work, the Geneva treaty would prohibit a researcher from printing a paper copy of a digital work. The treaties also propose separate royalties when copyrighted digital information is reproduced.

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I. RECENT PUBLICATIONS

Developing a data warehouse

Developing a data warehouse (DW) or operational data store (ODS) is similar to other software projects. There are differences, however, whereby developing a DW or ODS departs from normal projects. ODS and DW are applications of data warehouse approaches. Many data warehouse efforts stutter when it comes to developing the project plan and managing the project because of these differences. Without some type of guidance, "tribal knowledge" fails project teams when they embark on a DW for the first time. Very few information technology (IT) departments have a team experienced with data warehouse technology and approaches. DW projects are nearly always done in an iterative, rapid development mode. Rapid development requires a degree of rigour that many IT departments are unfamiliar with. Some type of documented process is needed to get by the departures from so-called conventional development methods.

A methodology is the formal definition of the processes required to bring an IT solution from an initial idea to a useful result. Methodology is also a concept that has great implications for IT organizations and businesses. (Joyce Bischoff and Ted Alexander, *Data Warehouse Practical Advice from the Experts* (Prentice Hall, 1997)) (Source: *Datamation*, June 1997)

The ups and downs of Europe's IT industry

For those who wonder why most computing technology seems to be supplied by Japanese or American companies, or what happened to names such as Honeywell and Burroughs, Paul Gannon's book *Trojan Horses and National Champions* will provide some answers. The book gives an insightful overview of the development of the European information technology (IT) industry in the light of changing political and economic influences. It succeeds in this task despite the author's caveats that space constraints limit discussion to a small selection of technologies and examples.

The book is split into three sections. The first examines the ambitions and delusions behind the National Champion policy of the 1990s, where companies such as Philips in the Netherlands, Olivetti in Italy and ICL in the UK were tasked with pulling the IT industry out of recession. Overall, the policy failed. Gannon tells an interesting tale of why this happened, illustrating along the way the complex relationship between State and industry and the contrasting situation in Japan.

The second section provides a more general view of the European industry, charting its development from the 1940s onward and beginning with an entertaining account of the first successful electronic computer to be built in each of a number of European countries. When compared with developments in the USA, and in particular when compared with the investment in an incredible success of IBM, to which an entire chapter is devoted, Gannon describes development in Europe as "slow and weak" at best. His suggestions for why this is the case are revealing and well researched, much hinging on inappropriate policy at both national and European Government levels.

Most of the book focuses on developments in the hardware sector, but software and telecommunications are not neglected. The final section looks at the technological changes affecting these and other areas and moves on to an analysis of what impact the "information age" is really going to have.

Trojan Horses and National Champions is, above all, a cry for change, if the European IT industry is to survive in the face of intense competition from the USA and Japan. A thorough account of the "repeated failure of European company leaders and policy makers to overcome the fragmentation of the European computer industry" points to an immediate requirement for these key decision makers to adopt an approach that acknowledges a wider common interest across the continent.

Those with just a passing curiosity in the European IT industry will probably find this book rather hard work, exploring as it does economic and political factors in such detail. For those with a keener interest in the reasons why the tools that appear on scientists' desks seldom originate in Europe, it offers a readable, erudite and comprehensively researched study. (Paul Gannon, *Trojan Horses and National Champions*, 1997, Apt-Amatic Books, 392 pp., £30 hardback) (Source: *Scientific Computing World*, July 1997)

Practical approach to neural networks

When I first received *Pattern Recognition Using Neural Networks* by Carl Looney for review, I was puzzled. The same publisher, Oxford University Press, had just published the fine book *Neural Networks for Pattern Recognition* by Christoper Bishop on the same subject—what could Looney add? The answer is that the two texts approach the subject from completely different points of view. Bishop's book stresses the theoretical aspects, whereas Looney's emphasizes practical algorithms and applications.

Pattern Recognition Using Neural Networks begins with chapters on statistical pattern recognition and decision theory. These concepts build a foundation for the material covered in the rest of the book. The third chapter deals with structural pattern recognition and the recognition

of discrete linear structures such as languages and DNA sequences.

Following this the neural networks that appear throughout the rest of the book are introduced. These include feedforward networks, recurrent networks and self-organized maps. Feedforward networks have a simple unidirectional chain of neurons and are useful for both detection and classification tasks. By contrast, recurrent networks contain neural loops and are used in learning temporal sequences and for associative memories. Self-organized maps represent an intermediate form in which neurons connect to their neighbours. These are used for classification.

Equal in importance to the network architecture is the leaning algorithm used to train the network. Local learning methods such as the back propagation algorithm and global methods such as genetic algorithms are discussed. The author compares different methods and discusses their advantages and disadvantages. The remainder of the book addresses engineering issues such as data pre-processing, optimization of the network architecture, and the training cycle. There is a wealth of practical advice about engineering issues, not seen in most other neural network books.

Pattern Recognition Using Neural Networks makes its subject easy to understand by offering intuitive explanations and examples. Most algorithms are described in a high-level pseudocode that should be understood by anyone familiar with C or Fortran, and a good bibliography ends each chapter.

The book lives up to its claim as a practical neural network text and will be an excellent resource for those who want to implement neural networks, rather than just learn the theory. (Carl G. Looney, *Pattern Recognition Using Neural Networks*, 1997, Oxford University Press, 416 pp., £25 hardback) (Source: *Scientific Computing World*, September 1997)

World communication report

The media and the challenge of the new technologies. The digital revolution combined with converging technologies have contributed to transforming the economics of information and accelerating the globalization of the media and the its contents. This report draws up a worldwide picture of these changes by describing the impact of the new information technologies on the workplace, and intellectual property. It also examines the relationships between power, information and democracy, providing a better understanding of the new challenges facing communications. (UNESCO Reference Books Series 1998, 280 pp., 21 x 29.7 cm, photos, graphs, charts. ISBN 92-3-103428-6/250 FF) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

Spreadsheet analysis for engineers and scientists

With this practical, hands-on guide, engineers and researchers learn, quickly and easily, the latest and most useful electronic spreadsheet methods. Using a variety of interactive techniques, including worksheets, self-test and practical programs on the included disk, *Spreadsheet Analysis for Engineers and Scientists* shows you how to harness the power and versatility of spreadsheet programs, including those that contain the fast Fourier transform, complex operations and Bessel functions, and how to customize your own applications. (Includes disk. 0471 126837, 336 pp., UK £37.50, Europe £39.50, ROW £49.50) (Available from Reed Business Publishing,

Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

Electronic component reliability

Fundamentals, modelling, evaluation and assurance. This text approaches the quality and reliability of electronic components from a unique standpoint

Traditionally the twin subjects of reliability physics and reliability statistics have been treated as separate entities. Here, the author examines both areas and reveals how components fail and how failures develop over a period of time. (0471 952966, 374 pp., UK £50.50, Europe £53.50, ROW £66.50) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

Fuzzy logic

Implementations and applications. Offering a new perspective on a growing field, this text explores the many hardware implications of fuzzy logic-based circuits. As use of AI increases, so the VLSI area of circuits is becoming a growth subject. Opening with an overview of fuzzy sets and fuzzy logic the book moves on to cover a range of non-standard solutions for fuzzy logic VLSI circuits. Future trends, new concepts and ideas are all examined and supported with practical examples from the author's research. (ISBN 0471 950599, approx. 346 pp., UK £50.50, Europe £53.50, ROW £66.50) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

Microelectronic switched-capacitor filters

Switched-capacitor filters and associated MOS integrated circuits are now an established technology finding applications in the telecommunications and instrumentation fields. With unrivalled breadth of coverage, this book surveys the design techniques of an important class of analogue signal processing systems. An accompanying diskette containing a comprehensive computer-aided design package (ISICAP) enables readers to gain a greater depth of understanding of the described techniques. Containing both source code files and an executable version of the main design package, this alone will be an indispensable tool for many circuit designers. (Includes disk. 0471 954047, 384 pp., UK £75.50, Europe £79.00, ROW £92.00) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

The I^2C bus

From theory to practice. With a special emphasis on the I^2C bus, this guidebook through the world of micro controller-managed serial buses presents comprehensive coverage of the theory necessary to design the best possible communications bus for any particular application. The book examines typical industrial and consumer applications and enables the reader to design effectively in a real-world environment. A disk containing software for the I^2C bus is also included. (Includes disk. 0471 96268 6, 314 pp., UK £54.50, Europe £56.50, ROW £65.00) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

High frequency analog integrated circuits

As one of the first textbooks to discuss integrated circuit design considerations and actual designs from the basic

concepts, this title provides a solid background in designing basic circuits, advanced circuits and synthesis techniques. (0471 530433, 424 pp., UK £80.00, Europe £83.00, ROW £95.00) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

Speed coding

A computing laboratory textbook. This is one of the first laboratory manuals with software dedicated exclusively to speech processing and coding. It takes advantage of the development of the personal computer by making this technology accessible to a wider audience. The manual and DOS-based software together create a user-friendly digital signal processing lab which allows the user to perform a wide variety of speech coding and speech processing experiments. The text presents and explains a set of basic speech coders analytically and in terms of the specific parameters controlling each coder. The manual leads the student through the experimental process of understanding how speech coders work and sound via over 70 exercises and projects. The class-tested menu-driven, DOS-based software can be operated by students with little or no training. (Includes disks. 0471 516929, 194 pp., UK £28.95, Europe £30.95, ROW £36.95) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

Solar cells and their applications

The past decade has witnessed numerous important breakthroughs in solar cell technology, many of which have occurred in just the past few years. Far cheaper to produce and maintain, exhibiting a longer lifetime, and considerably more efficient than ever before, solar cells are, at last, in a position to compete with traditional technologies for both small and large-scale energy conversion applications. Including contributions from some of the world's leading experts in the field, this book reports on the most important recent advances in solar cell technology. From in-depth discussions of breakthroughs in cell, module and system technologies to a probing look at important environmental, health and safety issues in the photovoltaic industry, it covers a broad range of topics of vital interest to solar cell researchers, power systems designers and all those with professional interest in current and future capabilities of this important technology. Offers a detailed look at cutting-edge solar technology from an international team of researchers.

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Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

Introduction to high-speed electronics and opto-electronics

Lasers, fibre optics and high-speed optical systems share many concepts with microwave devices.

Furthermore, semiconductor-based optoelectronics and microwave integrated circuits share evolving process technologies. It is only natural, therefore, that students of optoelectronics be introduced to high-speed concepts in a unified manner.

This highly practical intensive introduction enables electrical engineers, applied physicists and students to develop and identify tools for understanding, analysis, design and characterization of high-speed components.

Broad in scope, this unique text/reference examines the complementary nature of electronics and optics and emphasizes high-speed technology in which the two fields are less differentiated.

Beginning with an overview that develops a perspective and appreciation of analog high-speed technology in general, the book goes on to cover devices and circuits used at microwave and millimeter-wave frequencies, optical components and optoelectronic integrated circuits and subsystems. Particular attention is paid to applications in the area of high levels of interest in this area and because many of the concepts are applicable in other fields. The book concludes with important coverage of the often-overlooked area of measurement and characterization of high-speed devices. Fully referenced and supplemented with hundreds of helpful illustrations, *Introduction to High-Speed Electronics and Optoelectronics* is equally useful as a professional reference or a textbook for senior undergraduate and first-year graduate courses. (0471 015822, 312 pp., UK £65.00, Europe £67.00, ROW £77.00) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

RISC systems and applications

Professor Daniel Tabak has completely revised and updated his two previous books on Reduced Instruction Set Computer architecture to produce this new book, *RISC Systems and Applications*. The text is a unique, concentrated, detailed description of the architecture and implementation of most recent high-performance RISC systems, such as DEC Alpha AXP21164, IBM/Motorola/Apple PowerPC 620, Sun Microsystems and Texas Instruments UltraSPARC and SuperSPARC, MIPS technologies R10000, Intel i860 XP, Motorola MC88110, Hewlett-Packard PA-7100/8000 and the transputer. It also includes details of pioneering devices such as Berkley's RISC II and Stanford's MIPS and multiprocessor, real-time and workstation systems. (ISBN 0863 801889, 452 pp., UK £50.50, Europe £54.00, ROW £67.00) (Available from Reed Business Publishing, Quadrant House, The Quadrant, Sutton, Surrey, SM2 5AS, UK)

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- ❑ ENVIRONMENTALLY SOUND MANAGEMENT OF BIOTECHNOLOGY (The Task Managers' Report on Chapter 16 of Agenda 21)
- ❑ FOOD PROCESSING TECHNOLOGIES FOR AFRICA
- ❑ HYDROGEN ENERGY TECHNOLOGIES
- ❑ THE USE OF GIS IN DEVELOPING COUNTRIES: SOCIAL & MANAGEMENT ISSUES
- ❑ NATIONAL INFORMATION INFRASTRUCTURE POLICIES IN INTERNATIONAL PERSPECTIVE

* available only on microfiche or photocopy at US$ 10 per copy

FAMILY NAME AND GIVEN NAMES	
TITLE OR POSITION	
ORGANIZATION OR COMPANY	
STREET AND/OR P.O. BOX NO.	
CITY AND COUNTRY	

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