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**EMERGING
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Technology***



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INFORMATION TECHNOLOGY 1 & 2/1999

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SPECIAL ARTICLE

*DEVELOPMENT INFORMATICS:
INFORMATION AND COMMUNICATION
TECHNOLOGIES, POVERTY AND
DEVELOPMENT*

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TO OUR READERS

Article 19 of the Universal Declaration of Human Rights states that "Everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers." In many ways, the Internet reveals itself as a tool at the service of these ideals.

However, access is not equal for all. On the one hand there is a divide between developed and developing countries. The latter represent only some 10 per cent of the total number of users worldwide and this proportion does not seem to be on the increase. On the other hand, the divide between developed and developing countries appears to be a mere reflection of a deeper divide between the "haves" and "have nots". Use of the Internet spreads rapidly within the middle classes of both developed and developing countries. The faster demography of developing countries goes hand in hand with an expansion of poverty, with the result that the middle class of developing countries grows at pace with that of developed countries. Thus the gap continues.

For this issue of *Information Technology*, we are extremely privileged to present a paper by Professor Richard Heeks of the University of Manchester on the question of whether information and communication technologies will ultimately alleviate poverty in low-income countries.

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A. Special Article

Development Informatics

Working Paper Series

The Development Informatics working paper series discusses the broad issues surrounding information, information systems, and information technology in the process of socio-economic development

Paper No. 5

INFORMATION AND COMMUNICATION TECHNOLOGIES, POVERTY AND DEVELOPMENT

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June 1999

Abstract

Can information and communication technologies (ICTs) help to alleviate poverty in low-income countries? The paper investigates this question, focusing particularly on the role of ICTs in assisting the development of small and micro-enterprises. The investigation is based on a systemic understanding of both technology and enterprise. This suggests that ICTs will play a role mainly as a communication technology rather than as an information processing or production technology. Serious inequalities exist that constrain the use of ICT-based information by poor entrepreneurs. Information and communication technologies may therefore have a greater role to play in giving "voice" to the poor; that is, in making the poor information providers more than information recipients. However, effective application must first overcome the "ICT fetish" that dominates much development thinking at present, and which creates a series of identified

opportunity costs. The paper concludes with a set of development priorities for information and for ICT use in poverty alleviation.

Introduction

Hundreds of billions of dollars per year are spent on information and communication technologies (ICTs), reflecting a powerful global belief in the transformatory potential of these new technologies. For multinational corporations, certainly, ICTs have become essential. Globalization demands such great flows of information and processing of information that it simply could not take place without ICTs.

But what about a more direct relationship between ICTs and development. What, for example, do ICTs have to offer the poor? Some clearly believe the technology has a lot to offer:

¹ An amended version of this paper will appear in the chapter on 'Technology and Development' in *Poverty and Development in the 2000s*, T. Allen & A. Thomas (eds), Oxford University Press: <http://www.oup.co.uk/>

- “This new technology greatly facilitates the acquisition and absorption of knowledge, offering developing countries unprecedented opportunities to enhance educational systems, improve policy formation and execution, and widen the range of opportunities for business and the poor.” (World Bank, 1998:9)
- “Governments, donors and development organizations are rushing to realise the benefits that Internet access promises in the fight against poverty.” (Panos, 1998a:1)

There are opportunities for applying the new technology in supplying health, educational and agricultural information. In this paper, though, the particular focus will be the scope for ICTs in small and micro-enterprises. Why? Because these enterprises have such a direct and growing relationship to poverty alleviation.

A. Understanding ICTs and enterprise through systemic models

We need to take a systemic, contextual view of technology in order to understand it (Heeks, 1998). The same is also true of enterprise, and so systemic models of each will now be presented.

Information and communication technologies

Information and communication technologies can be defined as “electronic means of capturing, processing, storing, and communicating information”. ICTs are based on digital information held as 1s and 0s, and comprise the

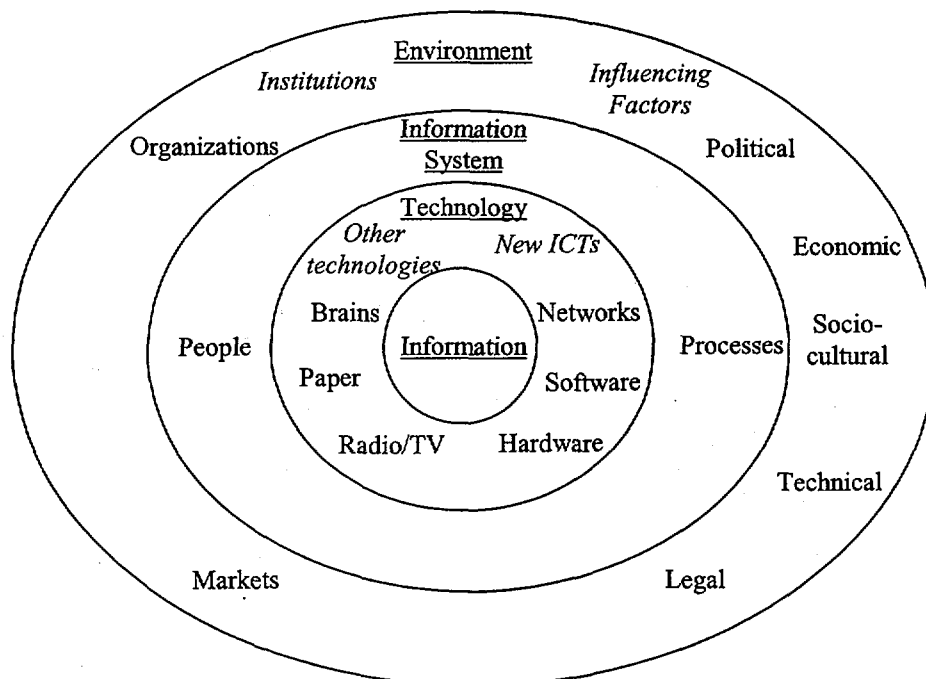
computer hardware, software and networks. These will be the main focus of the paper, but they are not the only technology that deals with information. Others include:

- “Intermediate” technology, still based largely on analogue information held as electromagnetic waves such as radio, television and telephone.
- “Literate” technology, based on information held as the written word such as books and newspapers.
- “Organic” technology, based solely on the human body such as the brain and sound waves.

In building up a model of ICTs, two separate elements have already been identified: the technology itself and the information on which it operates. In order to make this useful, we add in two further components: processes of purposeful activity and people to undertake those processes. All of these together now make up an “information system”, such as a support system that helps members of a non-governmental team share information using electronic mail. But this information system cannot sit in a vacuum. It exists within an environment of institutions (organizations, groups, markets) and of influencing factors (political, economic, socio-cultural, technical and legal). Putting all this together, we arrive at the model shown in figure 1.

Both description and diagram are a reminder that information and communication technologies cannot be understood unless one also understands: (a) information and its role, and (b) the institutional and factorial environment.

Figure 1: A systemic view of information and communication technologies



Small/micro-enterprise

A similar systemic model can be built for the operation of an enterprise, as shown in figure 2.

From this diagram and the earlier definition, four main potential roles for ICTs can be identified:

- *As an output and as a production technology.* Some enterprises produce either tangible (computers, networks, components) or intangible (software, Web pages) ICTs as an output. Other enterprises, such as designers and publishers, produce heavily information-based outputs. Both use ICTs as a production technology, and both form part of a nation's "information economy". Such enterprises are becoming increasingly vital to low-income countries, and represent a beneficial application of ICTs in terms of income, skill and export generation. However, thanks to scale economies and input barriers, these areas have traditionally been the preserve of large and/or highly-skilled, capital-intensive firms. Barriers are coming down but these enterprises still remain at one step removed from "mainstream" poverty alleviation, and will not be the focus here.
- *As an information processing technology.* All enterprises need to process the information that arises from both inside and outside the enterprise. However, the requirement of most small/micro-enterprises for processing formal information is relatively limited, and it can frequently be met by paper-based methods.

Also, given relatively high ICT costs and relatively low labour costs in low-income countries, ICTs can easily raise rather than lower processing costs. Again, this will therefore not be the focus here.

- *As an information communication technology.* Small/micro-enterprises do have a significant need for both receipt and provision of information. Add in the fact that ICTs normally lower communication costs substantially, and this can be seen as the main potential area for ICT application by low-income country small/micro-enterprises. The paper will now look at ICTs' role in relation to both receipt and transmission of information.

B. The poor as information recipients

As noted, ICTs cannot be understood without understanding information, and developing an enterprise requires information about several different things. It needs information relating to *supply*, such as the availability and sources of finance, labour, technology, raw materials, and other enterprise inputs. It needs information about *demand*, including market opportunities and characteristics of this market demand like location, price, size and quality. It also needs information about *other environmental factors*, like competitors, laws, etc.

Turning raw data into this kind of usable information is a staged process (the "information chain"), illustrated by the "4 As" model in figure 3.

Figure 2: A systemic view of small/micro-enterprise

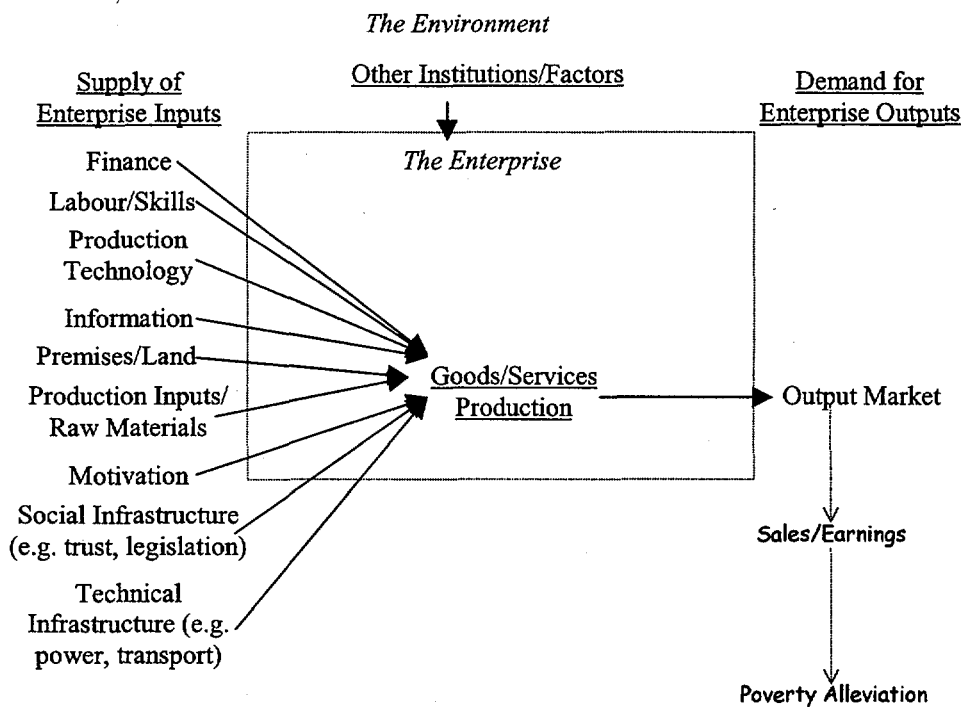
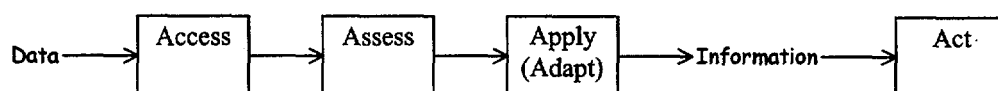


Figure 3: The information chain



In order for the information chain to function, environmental components must be present that will now be investigated. These include *overt resources* (money, skills, technical infrastructure), *embedded/social resources* (trust, motivation, knowledge, power) and *relevant raw data*.

Overt resource inequalities affecting access

- “New communications technologies are revolutionizing access to information—but the revolution is likely to reach everyone but the poor.” (Panos, 1998b)

Accessing ICT-carried information requires a lot of overt resources including a telecommunications infrastructure to provide network access, an electrical infrastructure to make the ICTs work, a skills infrastructure to keep all the technology working, money to buy or access the ICTs, usage skills to use the ICTs, and literacy skills to read the content.

The poor simply do not have these resources. In a world where 80 per cent of the world’s population has no access to reliable telecommunications, and one third has no access to electricity (Panos, 1998a), it is hardly surprising that the Internet reaches few poor people: there are more account holders in London than in the whole of Africa and many of the latter are affluent, white, urban South Africans.² Likewise, more than half of the low-income countries’ population is illiterate, with a far greater proportion unable to read English, the language that dominates digitized information (UNDP, 1998a).

Governments and donor agencies are working to provide the overt resources, but realistically the poor will not own the ICTs, and the poor will be very unlikely to control the ICTs or to use the technology hands-on in any significant numbers for the foreseeable future. The main strategy has therefore been to provide ICTs to intermediary institutions such as government agencies, non-governmental organizations and community-based organizations.

The most popular model is the community “telecentre” with an Internet-linked computer providing a multi-function resource (Talero and Gaudette, 1995). Only a few exist so far in low-income countries. Bringing them

² Such figures must be treated with care. Western models of one e-mail account serving one individual do not hold in low-income countries. Instead, several individuals are likely to make use of one account through family, friends, acquaintances or organizations. Formal statistics therefore seriously underestimate the extent of coverage, perhaps by a factor of five or more.

to all poor communities would be a massive operation requiring huge diversion of investments and taking at least a generation. Most would also require large ongoing subsidies to sustain them in the midst of poverty.

But even this would not be enough.

Social resource inequalities affecting assessment and application

Poor entrepreneurs need more than money, skills and infrastructure in order to make use of the data delivered by ICTs. They need other resources to interact with sources outside their own community, including (World Bank, 1998, Panos, 1998b):

- “*Source proximity*”. Data is created within a particular context and retains embedded characteristics of that context: it contains what its creators do know and do feel is important and misses out what they do not know or do not feel is important; it reflects their political and economic beliefs; it reflects their culture. Unless poor entrepreneurs come from the same context as the sources creating information, problems of miscommunication and misunderstanding can arise.
- *Trust*. Before they will accept data, recipients must trust both its source and its communication channel. For most entrepreneurs, sufficient trust to justify business decisions will mainly be created through personal contact, through interaction and, ideally, through shared context/proximity.
- *Knowledge*. Information creates knowledge, but knowledge is also needed to create information. It is knowledge that helps us to access information, by knowing where to find and how to use information sources. It is knowledge that helps us to assess information, by assessing whether it is truth or lies, of value or not. It is knowledge that helps us to apply information, by adapting it to our particular needs and circumstance. For the poor, such knowledge is frequently limited to their local context.
- *Confidence and security*. In order to use new communication channels, recipients must have confidence and feel motivated to take a certain amount of risk. In general, because of their social circumstance and experience, the poor lack confidence and are risk averse.

None of these represent insuperable barriers and they should not be seen as excuses for inaction. However, they do all add to the problems of using ICTs particularly because the poor lack the power to access or demand further social and overt resources.

Resource inequalities affecting action

Information supplied via ICTs (or via any other means) has no value unless it informs decision making and action. Yet action implies resource endowments that have nothing to do with ICTs. Information received about a new supplier is of no value if the entrepreneur does not trust the supplier. Information about a new market is of no value if the entrepreneur cannot increase production to supply that market, through lack of capacity or aversion to risk. Information about new government tax rules is of no value if the entrepreneur cannot afford to pay tax. Inequality in endowment of both overt and social resources for action therefore keeps poor entrepreneurs poor regardless of whether information is supplied to them via ICTs.

We can therefore see—as figure 2 has already pointed out—that information (and, hence, information and communication technologies) is only one resource among many overt and social resources that are required for successful development of a small/micro-enterprise. Put another way, information is a necessary resource for poverty alleviation but it is by no means a sufficient one. Equally—indeed more—important are factors such as financial credit, skills, production technology, demand for outputs, plus other social resources. All of these have to be borne in mind when assessing the relative priority to give to ICTs in the development process.

Lack of relevant data

As has been argued above, poor entrepreneurs get their most valuable information via informal information systems from those around them and like them. Unfortunately, the information from such systems can be inaccurate and is certainly incomplete. Formal information sources, however, can be just as bad in meeting needs as they are increasingly dominated by commercially-inspired data or trivia. The Web, for instance, mainly provides the information-thirsty poor with a flood of “noise”: digitized, westernized irrelevance.

Markets therefore fail poor entrepreneurs not just in terms of information chain processes but also in terms of input: they do not provide enough relevant raw data for the poor (especially not in digitized form) about everything from materials suppliers to market prices to government regulations. In part, this is due to the inability of the poor to voice their demand for information and their inability to pay for supply of that information.

Where markets fail, national and global institutions may—and do—step in. United Nations bodies provide data about technology suppliers; governments provide data about market prices and regulations. Yet there are many problems here, in part because such interventions tend to be rather haphazard and frequently unsustainable. There can also be data problems. The data provided is rarely in digitized form, making it suitable only for non-ICT-based media, and it is often driven by the objectives of the source rather than the needs of the recipient (see box 1). Lastly, unless the provider is a community-based institution, there remains a lack of proximity between such sources and poor entrepreneurs as recipients.

Box 1: ICT failure and success in South Africa Adapted from Benjamin, 1999

In 1995, a project was begun by the Office of the Premier in North-West Province to provide information to six rural communities through touch-screen computer kiosks. The kiosks provided general demographic and economic information about the province, details of main government programmes, and speeches by the Premier and by Nelson Mandela. This did not meet community needs and it became apparent that this had been more a public relations exercise than a development initiative. The project was scrapped in 1997.

In 1995, a project was begun by the local government in Alexandra township (near Johannesburg) to create a database of local resources. All township organizations were asked to provide details, a process often organized by schoolchildren as homework. The database was made accessible over the Internet. Not only did it provide information about local capabilities to community members, it also enabled community enterprises to win contracts from larger firms in Johannesburg.

C. The poor as information sources

There is a general assumption within much writing about ICTs that the poor are merely recipients: of technology, of information, of knowledge. Of course, this is not correct. Poor countries now all produce at least some information and communication technologies, in the form of customized software systems. Poor communities all produce their own information and knowledge. ICTs can play a positive role, as in Alexandra (see box 1), by allowing that information and knowledge to be more widely disseminated.

ICTs could be used to transmit information from poor entrepreneurs to donor and government agencies. The main reported ICT use, though, has been to transmit marketing information about small/micro-enterprise products and services to potential customers; typically via the Web to Western export markets (World Bank, 1998; Hegener, 1998). However, there are far more one-line, rose-tinted vignettes of claimed success with ICTs than there are long-term analytical studies by independent researchers.

We can see, once again, that ICTs are neither a universally necessary nor a sufficient condition for giving voice to poor entrepreneurs. In the first case, there are many other—potentially more appropriate—mechanisms to assist the poor, from face-to-face meetings to telephone conversations to newsletters and even radio/TV programmes. On the second point, technology only affects part of a much broader social process. Poor entrepreneurs must also have the capacity to generate relevant information about themselves, and to access and use the ICTs. Frequently they do not have this capacity, and they will again have to rely on intermediaries. At the other end of the transmission chain, someone must also be listening and able to act on what they hear. Panos (1998a), for example, describes the termination of a Web service

selling low-income country products to Western consumers due to lack of use.

D. Examining the contemporary ICT fetish

So far, this paper has analysed the opportunities, challenges and problems for poor people that are posed by ICTs in relation to small/micro-enterprise. However, such analysis is rare, for, like any new generic technology, ICTs lend themselves to sweeping statements about what they can do for development. If the poor are considered overtly at all, the feeling is that they *must* gain eventually from adopting the technology because the technology *is* development. This dominant "technology-as-solution" view has its challengers, of course, and one can place different views into perspective through use of a viewpoints framework.

Such a framework about ICTs can be constructed from two continua (see figure 4). First, a continuum of *technology impacts*, from optimism to pessimism. Some people—optimists—associate ICTs with largely positive impacts like wealth creation and improvements in service quality. Others—pessimists—associate ICTs with largely negative impacts like unemployment and alienation.

Second, a continuum of *impact causes*, from technological determinism to social determinism. Some people—technological determinists—believe that it is mainly inherent features of the technology which determine impacts of introducing ICTs; for example, that computers cause job losses. Others—social determinists—believe that it is mainly human choices within social structures which determine impacts of introducing ICTs; for example, that any job losses from computerization arise when managers decide to exploit employees.

Each continuum has a midpoint of, respectively, neutrality about impacts and contingency about the causes of those impacts.

Such a framework necessarily simplifies a complex reality, but it can be used to understand differing positions on technology and development. For example, the analysis presented so far in this paper can be classified as roughly neutral to positive about the impact of ICTs, and contingent to socially determinist about the causes of those impacts. However, the position on impacts should be rather more balanced since two things have been downplayed.

First, failure has been downplayed. Yet estimates suggest that the majority of ICT-based initiatives end in *total failure* of a system that never works; *partial failure* in which major goals are unattained or in which there are significant undesirable outcomes; *sustainability failure* that succeeds initially but then fails after a year or so; or *replication failure* of a pilot scheme that cannot be reproduced (Heeks and Davies, 1999).

Second, negative impacts have been downplayed. Yet, as well as reducing costs and improving processing and communication of information, ICTs have also been associated in some cases with negative impacts. These have included job losses, increased stress, reduced

flexibility, centralized control and surveillance, and impoverished communications (Heeks, 1998). The overall analytical viewpoint of this paper therefore lies around position A in the framework diagram.

However, this is not the viewpoint adopted by many of those involved in setting the current development agenda. Two sample quotes were provided at the start of the paper, and there are plenty more:

- "Information and communication technologies (ICTs) are not only a significant factor in the performance and growth of economies—the importance of which is continuously growing—but they also represent a novel and effective tool to help advance sustainable human development." (UNDP, 1998b)
- "Economic development can be fostered by teleworking and tele-services in some of the developing countries. These applications can help to increase the competitiveness of rural and remote areas and tele-services in future may provide opportunities for tele-shopping, on-line reservation services, entertainment, and commercial information." (Mansell and Wehn 1998:83)³

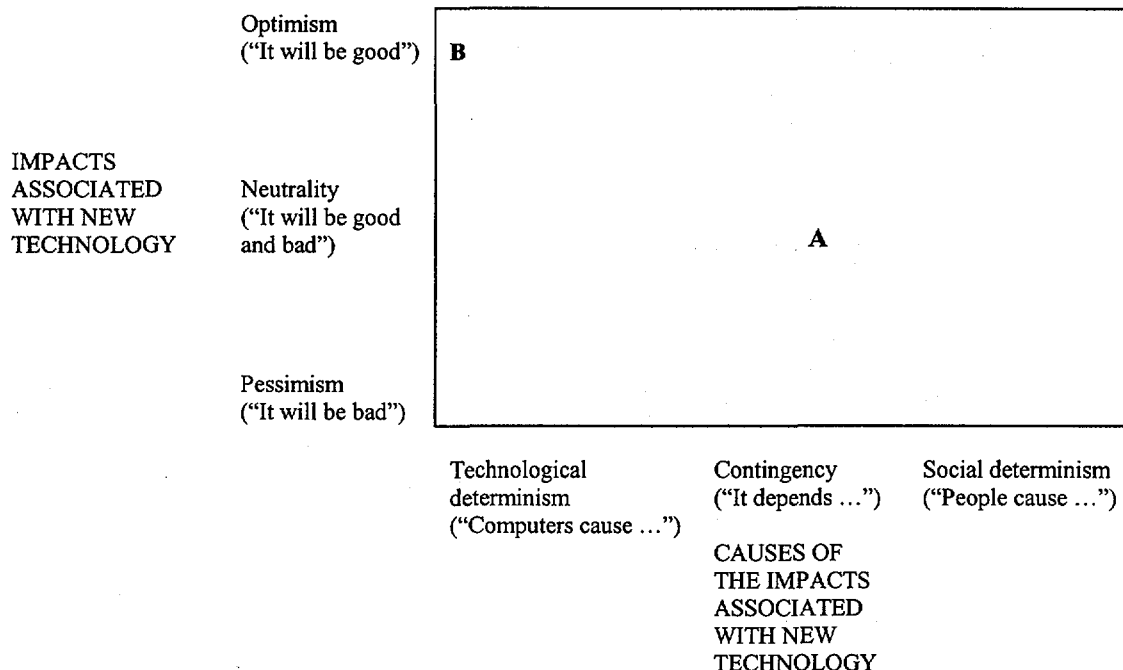
Here there is a pervading sense that the new technology's impact will be positive, and that the technology itself is the cause of that impact. Much of the development discussion therefore lies firmly in position B in the diagram. It is driven on by hype from ICT vendors and the media that makes ICTs an icon for modern development, turning use of ICTs within development into an end in itself rather than a means of achieving other development goals. The main development objective becomes bringing as much technology to as many people as quickly as possible so that they can obtain the claimed benefits it provides. The main development problem becomes inequality of access to ICTs.

But is there anything really wrong with the position B view? After all, we could do with a bit of good news and optimism about development, couldn't we?

There seem to be a number of things wrong with position B which have not been grasped by many working within the development field. In the first place, there are *development opportunity costs* of the investments this position promotes. Panos (1998a) recounts more than 50 major initiatives aimed at increasing Internet connectivity in Africa alone. Add in other ICT expenditure and other low-income countries and we see significant investment by donors and by governments in this area. All of this comes with an opportunity cost since there are finite amounts of money, time and attention. Investing these in ICTs means explicitly not investing them in other development areas. Yet the "ICT fetishists" have so far been unable to demonstrate how ICT-based information represents a more important resource than water, food, land, shelter, production technology, money, skills or power in the development process.

³ This quote particularly seems to push things a little far. Can we really envisage a peasant household, dateline 2005, as follows: "I'm sorry I can't fetch water from the well today darling, I'm busy using my credit card to buy a new dishwasher from the Internet, and the hoeing and weeding will have to wait until I've completed this manuscript on Sartre for my publisher in Paris."

Figure 4: Framework for analysing different views about ICTs and their impacts



There are also more specific *information system and technology opportunity costs*. “Radio covers approximately 75 per cent of Africa’s population and television 40 per cent. The Internet’s 0.1 per cent shows just how marginal a medium it still is.” (Panos, 1998a:2). Radio, television and newspapers have all been used to disseminate agricultural, educational and business information to the poor. These technologies have capacity, interactivity and ownership limitations the new ICTs do not. However, in access and coverage terms they beat ICTs hands-down now and for the foreseeable future. The trouble is they are just not “sexy” enough to capture decision makers’ attention. Even telephones have slightly slipped down the visibility league tables because of this.

Likewise, a focus on ICTs and ICT-based information means that “organic information systems” and “indigenous knowledge”—the systems and knowledge which arise from within poor communities—are being systematically ignored and overridden. These provide, respectively, the best communication channel and best information source for the poor. Yet, again, they cannot match up to the sales pitch and glitz of the new technology, and even poor communities come to devalue their own resources and to overvalue new technology.

Lastly, there are *factoral opportunity costs*. This approach to development means that attention switches to the technical factors underlying development and, since attention is finite, away from the political, the economic and the social factors underlying development. Experience suggests that, where this happens, “development” allows those with political, economic and social power to reinforce their position at the expense of those without such power.

E. Development priorities for information, ICTs and poverty

Given the opportunity costs and other issues identified above, where should the main priorities lie for the development agenda? What are the implications of the analytical position presented here? One may conclude that:

- *The poor need knowledge to access, assess and apply existing information and need resources for action more than they need access to new information.* Information deficits are certainly an issue for poor entrepreneurs, but a more important part of the total picture—and a prerequisite for making use of information—are resources like skills, knowledge and money.
- *The poor need access to new locally-contextualized information more than access to existing information from an alien context. The information needs of the poor will be met more by informal, “organic” information systems than by formal, ICT-based information systems.* The poor lack, and need, information of relevance to their local context. This may come more from interaction between communities and community members rather than from the typical ICT-based pattern of data transfer from North to South. Based on both overt and social resourcing, such new information will best be delivered to the poor by organic information systems that arise from within their community. Failing that, because of access issues, information may be better delivered by literate or intermediate technologies—such as telephones—than by new ICTs. Where ICTs

are used, they should provide a supplement, not substitute, to existing information systems.

- *The poor need ICTs more to give them "voice" than to give them "hands", "brains" or "ears".* ICTs can play a limited enabling role in the alleviation of poverty, but will be of greatest value as a technology to provide information from and about the poor. The new technology will also, given resourcing and data points made above, be of value in helping community members interact, though only where it beats face-to-face or telephone interaction. This may principally occur via e-mail with members based in distant potential markets either at home or overseas.
- *The poor need "intelligent intermediaries" to use ICTs.* These intermediaries are needed to bridge both the overt and the social resource endowment gaps between what the poor have and what they would need in order to use ICTs. Indeed, ICTs currently have a far greater enabling value in building capacity within intermediary institutions—in "helping the helpers"—than in directly affecting the poor. For example, ICTs have enabled non-governmental organizations to share experiences about—and thereby improve—their microcredit programmes and have assisted "those campaigning for greater democracy, social equality and protection of the environment" (Panos, 1998a:2; World Bank, 1998). There are also individual examples of ICTs assisting government agencies, universities and hospitals, some of which—albeit often indirectly and imperfectly—can serve the poor (Talero and Gaudette, 1995).
- *The poor need "community intermediaries" to use ICTs.* The identity of ICT-using intermediaries is critical. Following discussion of proximity, trust and knowledge (including the ability to combine "tech-knowledge" about ICT with "context knowledge" about the environment in which it is used), we can see that the best intermediaries will be drawn from within poor communities, as in Alexandra. Poor communities with the highest "social capital" of effective community institutions will therefore be the most effective users of ICTs. Initiatives in which technical and contextual knowledge are disconnected, with intermediaries and control located outside the community, are more likely to fail, as in North-West Province.
- *The poor will only reap the fullest benefits of ICTs when they own and control both the technology and its related know-how.* Intermediaries are a currently necessary mechanism. Yet their presence reduces the ability of the poor to directly control definition of information problems, design of new information systems, and ownership and operation of those systems. This is essential to truly effective management and steering of the new technology. However, the current resource and contextual barriers to this are massive: an order of magnitude greater than those for connecting up intermediaries.

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B. News And Events

Information and communication technology infrastructure and sustainable development

Information and communication technology (ICT) infrastructure is considered as the most dominant paradigm of development in recent years. It consists of the information transfer mechanisms like newspaper, radio, television, telephones, mobile phones, fax machines, Internet hosts, computers, etc. The key component of the new paradigms is to provide greater equality in the distribution of these ICT parameters to facilitate development. It is believed that constructive changes in the socio-economic development of the nations could be established only through the widespread diffusion of ICT infrastructure among the communities. There are a number of other fields that have been affected by the development of ICT. Besides, there seems to be a strong correlation between the growth of ICT-related activities and the development in the national economy, the evidence for which is found in a series of reports.

(1) The penetration of ICT parameters ensures a competitive economy, democracy and nation building. (2) A greater percentage of GNP has been accounted for through knowledge communication and information work. (3) The economic advancement of the majority of the developed nations has been attributed to their fast and widespread diffusion of ICT. (4) Apart from these, in several countries ICT has become the largest component of fixed capital formation. Those countries which intend to participate actively in the world economy could not afford to ignore the development of ICT in their region. (5) In order to establish a wider distribution of informatics, a vast majority of the developed countries have framed effective ICT-related policies and operational strategies conducive to achieve their goals.

It is concluded from analyses that the differences between the groups of nations with respect to their ICT infrastructure is ever-widening and this calls for revamping of the ICT policy of the governments in the developing countries to arrest the widening gap between the groups of countries. Unless some serious measures are evolved to develop and apply the modern technology to a greater level in these middle and low income countries, it is not possible to participate actively in the global economic competition, knowledge sharing and empowerment to facilitate self-development efforts by individuals, groups and communities. (Source: *Intl. Forum of Information and Documentation*, 23(2) April/June 1998)

Policies for an information society

At a time of profound technological change, many countries are responding by developing policies that are intended to shape the development of information societies. The goals of these information policies are very similar. The first broad goal is to achieve cheap and efficient telecommunications infrastructures which enable individuals and institutions to communicate with one another. The second goal is to improve industrial and commercial competitiveness and productivity by making organizations use information as a resource. This requires an educated and skilled workforce. An information society is seen as a means of promoting social harmony and cohesion. In developing countries, there is concern about the degree of fragmentation that has developed over the past 30 years where rising crime levels, unemployment and social deviancy are noticeable. There is a great concern for culture as the development of an information society should enhance and strengthen the home culture and, as appropriate, promulgate it elsewhere.

Most information policies seek to provide some support to the information services sector as this is seen as a key strategic asset for the future and most States are trying to do something to nurture it. When the underlying motivation for policy aspirations is analysed, differences can be determined. In the developed world, especially in North America and Europe, motivation comes from fear as the dominant economies in the global economic system see their positions being eroded. In the less developed and newly industrialized countries, an information society is seen as a path towards future prosperity through accelerated economic growth. In some countries there is a desire to move to a new socio-political order. There is a wide variation in policy mechanisms which can be described as neo-liberal and dirigiste. It is concluded that the neo-liberal approach has not proved effective and a different approach is needed that does not rely totally on market forces but recognizes the need for clear vision and a radically different approach to the achievement of policy goals. (Source: *Aslib Proceedings*, 50(1) January 1998)

Multi-skilling for the knowledge age

People who saw themselves as professional information scientists, librarians or learning resource staff are having to learn new skills in today's constantly changing world. Customer expectations are becoming

more focused and value-added services and products are now required. One key reason for acquiring new skills is the integration of technologies with computing, media, graphics and multimedia all converging. Practically speaking, multi-skilling is essential as human resources are limited. The integration of knowledge and learning is happening both in philosophical terms and also practically, as many companies are merging information and training centres. The winners in the future will be those who can successfully integrate internal and external information and learning. It is possible that the winners will be multidisciplinary teams with leadership and involvement coming from top management. Areas that lend themselves to the development of multi-skilling are software use and development; technical support; and media equipment. It is also necessary to become more involved in marketing and public relations.

In addition, presentation skills for either formal inductions or informal tours and introductions are required. The area of research writing and distilling is a skill that is being requested more frequently. A growth area is the distilling of relevant Web sites and repackaging them for use on a corporate intranet. The knowledge agent role will increase in the future. The main potential problem with the multi-skilling approach is professional pride and status as many professionals view their information training and skills as sacrosanct. There is a genuine fear that everyone will be reduced to mediocrity. Managers have to balance staff skills and aptitudes as everyone will not be able to be an expert in everything. Training for this new breed of worker can be expensive as time must be allowed for technical and interpersonal training. Ideally, a career development plan needs to be put in place. There are a number of practical things that can be done to make multi-skilling become a reality. Procedures and staff manuals are essential. Easy-to-use guides and documentation for users are essential, while adequate user education makes life easier for everyone. The omnipresent "easy to use, yet sophisticated" continuum is a difficult balancing act. It should be remembered that the initial reason for multi-skilling is customer orientation. Multi-skilling is not simply a series of enduring skills and competencies, it is a state of mind that puts the customer first. (Source: *Business Information Review*, 15(4) December 1998)

The role of the information professional in the "knowledge economy"

A discussion on the role of the information professional in the new "knowledge economy" should first and foremost keep in mind that certain extremely important developments in the area of electronic information manipulation are currently taking place "outside" the information professional's traditional jurisdiction. However, information professionals have always played a key role in the knowledge economy. The ability to weave information and knowledge into flexible and adaptable structures will be a key requirement for current and upcoming information professionals.

The roles foreseen for information professionals include implementing systems where services could move from traditional information delivery to that of information analysis, such as sifting, monitoring and evaluating information sources, and/or writing of executive summaries or in-depth conclusions. Library and information professionals have a good understanding of how to assess the value of information and knowledge, both within an organization and within the wider community.

Ultimately, we might see two groups of information professionals: one group that acts as internal (and external) organizational consultants, advising on knowledge structures and other technical aspects of information management; and another group of information professionals. The specialist skills of the information professional—information management, organization and dissemination—will be vital to the future success of organizations of all types and sizes. (Source: *The Electronic Library*, 16(6) December 1998)

Sharing expertise in practice: the way forward for knowledge management

Knowledge management is vital to the exploitation of an organization's resources and for many companies is crucial to their information strategy. There are, however, many different approaches to the implementation of knowledge management, and decisions taken about this will mean the difference between success and failure, and should reflect the overall goals of the company.

The most obvious approach is that of organization and storage. This involves the sourcing and classification of material, and is suitable for organizations where decision-making is often based on what has gone before—in a legal firm, for example. A controls approach is suitable for companies where process management standards are important, such as in engineering firms. For some sectors, dissemination of information is the key element, whilst for others information is collected by discussions with others. Providing signposts to knowledge, information mapping and collaboration are all techniques frequently employed. Companies must decide for themselves which of these to prioritize.

Crucial to the success of any knowledge management strategy is the sharing of information, but there are many obstacles to be overcome, including that of persuading experts to part with the knowledge they have acquired. It is common to set up infrastructures using IT systems or procedures for collaboration with external bodies. Tapping in to processes and procedures may be another way of capturing knowledge, using document management systems. Knowledge management can be controversial and some employees may be wary of it. Focus groups or committees may help persuade people to comply. The most important thing, however, is to develop a culture where such a management tool can flourish, and to review the strategy on a regular basis. A company will only be as good as the systems underpinning it. (Source: *Serials*, 11(3) November 1998)

Knowledge management

Knowledge management continues to be at the forefront of the information industry some 18 months after it first came on the scene. Interest in it grew very quickly, and some people see it as the natural successor to traditional librarianship. It has made little impact on the higher education sector, however, although some universities are doing research in this area.

As with all things there is debate about the definition of knowledge management, and a natural gap between theory and practice. Defining knowledge management itself, however, is less important than an understanding of the differences between "tacit" and "explicit" knowledge, which is crucial to the success of a knowledge management system. Related to knowledge management is the concept of intellectual capital, and an example of its management is given at Skandia, the Swedish insurance company. It is noted that knowledge management is not as new as it sometimes seems and is well established in legal firms, but has brought about changes in organizational culture, which are necessary for collating and facilitating knowledge.

There are several applications, including knowledge databases and repositories, knowledge route maps and directories, and knowledge networks and discussions. Knowledge management is prevalent in professional service organizations: for example, Ernst and Young has a Centre for Business Knowledge. Technical issues are very important, but are less difficult than setting up systems for acquiring information. Information professionals often become involved when content management becomes an issue, and some corporate libraries have found themselves metamorphosing into knowledge centres.

Many higher education institutes are already using intranets to manage some types of knowledge, but there is plenty of scope to expand this. Best practice in course administration is just one of the areas that could be suitable for knowledge management. (Source: *Ariadne*, 18 November 1998)

Outsourcing, teaming and special threats and opportunities

Outsourcing is a beast that first roared in the 1980s, but continues to be common today. Corporations trying to accommodate a palatable bottom line will often look to the most vulnerable sections of the company when cutting costs. In times of hardship, a department that is not generating revenue—however much the service is appreciated—will be a low priority when budgets are allocated.

A typical example is the computer company Apple, once the height of hardware fashion, but which got into severe difficulties when PC suppliers fought back. Its information centre, which boasted 20 staff in good times, was disbanded when the downward slide began. Now employees must find information themselves, or use researchers employed by particular departments. In this way the costs are absorbed into the main budget without the term librarian appearing anywhere.

Understandably, librarians see outsourcing as a great threat to their existence, but they can reinvent themselves or appear under another guise. Librarians should concentrate on integrating themselves into the corporation, specifically in departments where they can shine as researchers, often having greater status and a higher salary than they had previously.

Librarians should also note that many libraries are started up again using contractors and, although this is not ideal in terms of company benefits, it is often easier to find work this way, as turnover tends to be high. Even better, some companies will then revert to insourcing. Sun Microsystems is one such example: the librarians working in the library were able to prove that they could provide a more cost-effective service than the management company taking a hefty fee each month. (Source: *Information Outlook*, December 1998)

The infomediaries (suppliers of customer information)

Although consumers in first world economies may celebrate personalized and customized services, they are increasingly resistant to the idea that they should supply companies with personal data. They are unhappy with the notion that firms wish to know about their personal lives or behaviour or preferences. When America Online announced that it would sell the names and telephone numbers of its 10 million subscribers to a direct marketing organization, the resultant outcry forced it to abandon the proposal.

Given this conflict between companies' desire to know more so that they can target their efforts more effectively and customers' intransigence, we may expect to see the emergence of the "infomediary". This will be a business which captures customer data and develops detailed profiles of individual consumers for use by third parties.

In one sense, this is not new: readers of magazines and viewers of television stations have long been aggregated according to their preferences and these broad brush analyses employed in order to sell advertising. Also, discount clubs, credit unions, and charge and credit cards have for many years represented "packages" of consumers. What is new, however, is the ability now to build profiles of *individual* consumers, enabling marketing to be targeted very precisely indeed.

An indication of what can be achieved is provided by the "frequent flyer" programmes operated by most airlines, although even these lack the breadth of information about their customers which can be achieved. The new breed of company goes much further. One of the earlier examples of this type of firm now appearing is Request, a UK company operating as a matching agency in the financial services market. (Source: *Information Strategy*, 3(8) October 1998)

Records and information management challenges for the developing world in the new millennium

It is now virtually impossible to discuss records management (RM) without any reference to information

technology, which has had a marked impact on the profession. This is as true in developing countries as elsewhere, and RM professionals there face much the same challenges as their counterparts in the developed world.

In the last 50 years, there has been considerable expansion of records and information management infrastructures in many developing countries. The mere existence of such facilities, however, does not guarantee the availability of effective services. A UNESCO survey in 1992 concluded that the level of effectiveness varied considerably from country to country.

Three opportunities for RM are expected to become evident in the next millennium: the application of new technologies, the use of new management techniques and the improvement of its status within many organizations. The transient nature of electronic records means that RM staff will have to become involved at an earlier stage in the records. Fortunately, and at long last, there are signs that they are putting themselves in a position to become more involved, such as their adoption of standardized descriptions and indexing, bringing them into line with other information management professionals.

On the other hand, RM still represents a potential target for reorganizations aimed at concentrating on the core business and so improving operational efficiency and effectiveness. It is up to RM professionals to demonstrate that their function is in fact central to achieving such improved levels of performance. (Source: *Records Management Bulletin*, (87) August 1998)

Superfast network goes global

US researchers who need high-speed computer lines to collaborate with colleagues abroad can look forward to a whole new world of possibilities. The National Science Foundation (NSF) announced that it is hitching up its high-speed network to computers in Russia and the Pacific Rim. The connections should help scientists collaborate across oceans on everything from remote microscopy to astronomy and nuclear weapons control.

NSF director Rita Colwell unveiled the international hook-ups to the agency's very high speed Backbone Network Service (vBNS), which currently connects 56 US research institutions. The links will run on underwater fibre-optic cables already in place between the United States and Japan and Russia and will be managed by Indiana University and the University of Tennessee. The connections follow vBNS links to Singapore and Canada established in 1997.

In Asia, the 34 million bit per second (Mbps) pipeline called TransPAC will be hooked to an existing research network connecting Japan, Republic of Korea, Singapore, and Australia. MirNET, Russia's link, will operate at a mere 6 Mbps. (That compares to a dizzying 622 Mbps for the vBNS—fast enough to send 46 copies of a 300-page book every second (Source: *Science*, Vol. 282, 2 October 1998)

Reach for the sky

With the vision of a future demand for fast data anywhere, there are plans to employ low-Earth

orbit (LEO) satellite networks to deliver broadband services—which should not be confused with voice and narrowband services, such as Iridium. High-speed data LEOs could provide multimedia access in those places out of reach of the normal terrestrial networks.

It is worth considering the implications of such broadband services in general and in particular SkyBridge, the broadband LEO network which aims to be first to market.

Alcatel is the general partner of SkyBridge with other partners including Loral, Toshiba, Mitsubishi and Sharp who together are investing a total of some \$4 billion.

Market surveys commissioned by SkyBridge indicate that, by the time that its system is fully operational in 2005, it could well have a user base of about 25 million. This is based on a projection of there being some 400 million users of broadband services of which a quarter could use satellite—many because they are out of reach of terrestrial services—with SkyBridge being able to attract 25 per cent of these.

Initial costs of user terminals are expected to be around \$700 but it is possible that service providers, which will be local telcos, will offer subsidies to accelerate take-up of the service.

Downstream data rates between 16kbit/s and 20Mbit/s will be offered with up to 2 Mbit/s for residential users and any multiple of this capacity provided to business users. The form that usage charges will take is still under discussion but, as the company expects, globally 30 per cent of its users will be residential. At least some of its tariffs will need to be priced accordingly.

Here it should be noted that there are two complementary satellite technologies.

While geostationary (GEO) satellites are ideal for broadcast and point-to-multipoint services—software downloading and information streaming as well as television and audio broadcasting—they are less acceptable for interactive services.

This is because the 500 millisecond round-trip delay inherent in GEO communications is too much for video-conferencing, videotelephony, wide area network (WAN) access and high speed Internet.

On the other hand, the 20 to 30 ms delay that occurs with LEOs orbiting at a height of 400 to 1,000 miles is quite acceptable. Hence, it can readily be seen that the two types of service are complementary.

While at first sight it may appear that satellite services will only be of relevance to the third world, in fact it is not necessary to travel far off the beaten track to be out of reach of terrestrial broadband services.

While narrowband services such as telephony can often be provided in remote areas by terrestrial means (such as cellular services), they cannot effectively provide broadband. One of the major reasons for satellites being employed is that it is not feasible to install copper or fibre in, for example, the remote areas where the telecommunications operator cannot expect to generate an adequate traffic revenue.

Hence, even though copper or fibre can deliver broadband to the urban user, the bottleneck of the last

mile still remains, despite technological advances, so that they cannot economically provide these services to remote locations.

Furthermore, even where long-term economics will justify terrestrial cabling, satellites can provide a valuable and speedy interim solution prior to cables being put in the ground.

Rather than competing with the telcos, broadband LEO services will offer a complementary service.

The SkyBidge strategy is to use established technology wherever possible. For example, it will operate in Ku band (10-18 GHz) where reliable components and systems are widely employed for satellite communications. In fact, one of the technical and political issues which had to be resolved before SkyBridge could go ahead was a complex frequency re-use scheme. This also involved SkyBridge beams being switched off when within $\pm 10^\circ$ of the beams from geostationary satellites.

Similarly, the system will employ ATM (asynchronous transfer mode) to provide interconnection with the ATM terrestrial infrastructures of telecoms companies.

In space, the network will consist of a constellation of 80 LEO satellites.

As they orbit the globe they will provide coverage from the equator to 68° latitude north and south. User terminals will have steerable antennas so that they can track the transiting satellites which will take 15 minutes to traverse from horizon to horizon.

Ultimately there will be 202 gateway Earth stations, each serving an area of 600 to 700 km diameter. These gateways will be operated by cooperating local telcos with the data moving from terrestrial network, through to the gateway and, via satellite link, onto the end user.

The design of the terminals has yet to be finalized. For example, even though electronically-steered phased array antennas would be ideal, it is probable that they would be too expensive initially.

In fact, simplicity of installation and operation of these terminals will be an important issue in the success of SkyBridge—just as it is with today's launch of digital television.

However, with any new service it is difficult to predict the speed and extent of the take-up, though there still appears to be an insatiable demand for bandwidth. As users demand the same high quality of communications across the WAN as they get across the local area network (LAN) within their office, they will rapidly come to expect the same level of access to sites even in the most remote location.

While this will no doubt be more expensive, the benefits in ease and freedom of communications will be a price that companies could soon be prepared to pay. (Source: *Electronics Weekly*, 28 October 1998)

Building roam in a day

Internet roaming allows you to access the Internet from a foreign country by making a local telephone call without having to subscribe to a foreign Internet service provider (ISP).

Moreover, notebook users do not need to reconfigure their Internet access settings in order to dial in to a new ISP. Users are billed by their own ISPs back home and so are able to maintain a single account for all Internet access. Also, no foreign exchange is needed to pay for service fees.

The service is similar to cellular roaming, you pay a small hourly rate when you connect to one of the thousands of dial-in numbers around the world.

ISPs take one of two approaches to providing the service. The big ones, like US online service CompuServe, simply provide the service using their own infrastructures. Most ISPs, however, join global ISP consortia. Currently the market is dominated by two consortia: GRIC and iPASS. GRIC was developed by Aimquest in 1996 as an alliance of ISPs and telephone companies working to deploy global Internet-based communication services. In Ghana, AfricaOnline has joined GRIC, and NCS Internet Gateway has joined iPASS. (AfricaOnline in Kenya has also announced GRIC membership.)

Some ISPs provide roaming as part of the regular access service. You will need software to run on the remote PC. A dial-up utility is provided free of charge by most ISPs. It contains an international directory of access points and their log-in information. For most countries, more than two dial-up numbers are listed so as to reduce busy signals. The software is user friendly and requires almost no configuration. Once installed, it can be used to dial up from any country with a participating ISP.

Usually, there is a once-off set-up fee. Then, network access is charged once the roaming service is used. In Ghana, NCS is currently waiving some charges so as to encourage its customers to make use of this service. It is advisable to check pricing of the country you are visiting before you travel.

A spokesman for Ghana's NCS advises users to do the following before departing for foreign shores:

- Test the dial-up utility before roaming to ensure it is fully operational.
- Ensure that your modem is compatible with the telephone network in your country of destination.
- Notebook and laptop users must ensure they have the appropriate electrical power adapters.
- Ensure the dial-up utility lists the recent release access numbers.

How the remote connection works

A remote connection is achieved through a simple procedure:

1. The user logs in to the remote ISP and enters his usual domain name (e.g. your-name@africa.co.af) and password.
2. The remote ISP recognizes the log-in attempt as a roaming request.
3. If identification is verified, the log-in attempt is encrypted and sent to the user's home ISP for security clearance.
4. Given the security authorization, the remote ISP enables the connection.

The user can then use all the regular Internet services.

Some of the global access providers

- CompuServe Network Services, www.compuserve.net
- UUNet Technologies, www.uunet.com
- IPass, www.ipass.com; e-mail: info@ipass.com
- Global Research Internet Connection (GRIC), www.gric.com

For information about international telephone systems, go to www.teleadapt.com. (Source: *CIA*, October 1998)

Corporate intranet without information overload

Information overload is considered to be a major obstacle for most knowledge workers, while the interoperability of systems and the ability to move freely between a variety of information sources and applications is vital in any enterprise. Information technology is capable of generating volumes of data and information and the effective management of an enterprise's intellectual assets reduces costs; replaces simple inventories with valuable information and insight; removes the need for expensive fixed assets; and promotes corporate adaptability. The enterprise intranet is perceived as being a customized, internal web which possesses heterogeneous functionality that can be used for coordination and collaborative endeavours such as team participation and group projects. Because it is derived from Internet technology, the intranet can take advantage of various open standards and protocols.

The impact of an intranet on knowledge management can be seen by examining knowledge acquisition; information distribution; information interpretation; organizational memory; and the organizing content on the intranet. One guideline suggested for designing a corporate intranet for knowledge workers is to design an interface which allows employees to easily locate information that enables them to perform their work effectively. A technical infrastructure such as an intranet should consist of systems and structures required for the pursuit of learning and innovation as well as the recording of corporate memory. Once the cultural issues and the concept of information dynamism have been articulated, it becomes possible to propose a strategy for the design of the corporate intranet within the context of knowledge management practice. It is concluded that the design of a corporate intranet is extremely complex when evaluated within the knowledge management context. The main difficulty lies in knowing what kind of empirical data should be gathered. The initiative involves establishing the information needs of the various stakeholders and creating criteria by which different types of information can be evaluated and selected for inclusion in the intranet. Such decisions require consultation and teamwork. (Source: *Aslib Proceedings*, 50(1) January 1998)

Embracing the new technology and keeping harmony: in search of a new balance

At the present time technological advancement in information transfer and delivery are occurring at an unprecedented rate. This means that the academic library environment is being forced to change faster and become

more complex, more competitive, and more global than ever before. A conclusion reached is that diversities make each culture unique. The process of sharing global information means that the same challenges have to be faced. As there is increasing dependence on technology, it must be remembered that it is people who reconceptualize knowledge; create new knowledge; reinterpret existing knowledge; and preserve knowledge.

The emerging technology that requires quick responses means that staff must have current knowledge and keep themselves informed about new developments. This means that staff development must be supported and become an integral part of strategic development and implementation. (Source: *College & Research Libraries*, 59(4) July 1998)

Supergrid

The first permanent international grid of supercomputers came on line in November 1997, at the SC97 supercomputing conference in San José, CA.

The grid, called GUSTO (for Globus Ubiquitous Supercomputing Test-Bed), links about 3,000 processors at 15 sites in the United States and Europe. Instead of scheduling computer time in advance and getting the results of a calculation days later, scientists will be able to use the new network to choose an available supercomputer for a job and receive the results right away. The grid will also allow several computers to team up on a problem or enable people thousands of kilometres apart to share the same three-dimensional virtual environment.

Globus project co-leader Ian Foster of Argonne National Laboratory near Chicago predicts that the new grid will evolve as the Internet did—eventually serving to “integrate [supercomputers] into the set of tools that scientists use on their desktops”. If the NSF's new high-speed backbone, called vBNS, represents the hardware of the new “metacomputer,” Globus is the operating system, explains Foster, who developed it with Carl Kesselman of the University of Southern California in Los Angeles. (Source: *Science*, Vol. 278, 28 November 1997)

Netting a cyber catch

Who says you cannot make money from the Internet? Two tiny islands off the African coast with fishing economies have a new high-tech export: one-of-a-kind Internet addresses. The world's largest online bookstore, Amazon.com, has already taken up the offer. Ascension Island and St. Helena, which together are just over twice the size of the District of Columbia, are selling World Wide Web addresses using the unique two-letter suffixes assigned to the islands: ac and sh. Their offers mean a company that failed to seize popular generic Web site names, such as “diapers.com” or “computer.com”, can buy “diapers.ac” or “computer.sh”. Each address costs from \$60 to \$100.

These are hardly high-tech outposts in the South Atlantic. Reference books show their combined population is just over 7,000 people, and there are no television sets, a single AM radio station on St. Helena

and only about 500 telephones. (Source: *CIA*, September 1998)

TechOnLine university

TechOnLine, the Web-based free information service for engineers, has started a university.

Called TOLU—TechOnLine University—it currently offers five courses that are free to engineers. “We take our money from our advertisers in sponsorship and for on-screen banners and adverts”, said Rachel English, TOLU’s marketing manager.

The courses are: xDSL: Digital subscriber lines explained; Understanding wireless communications; An overview of digital signal processing; Theory and practice of technical standards; and Visual DSP development tools.

Only the last course is company specific, having been written by Analog Devices, www.tolu.com. (Source: *Electronics Weekly*, 25 November 1998)

Montreal Protocol links efforts on climate change and ozone depletion

Government officials from more than 100 countries have begun to take on the challenge of making policies to protect the ozone layer consistent with efforts to reduce emissions of greenhouse gases linked to climate change.

“For the first time, we are seeing the emergence of an integrated approach to the global atmosphere”, says Klaus Toepfer, executive director of the United Nations Environment Programme (UNEP).

“We need to ensure that the scientific and policy responses underlying the two most important agreements on the global atmosphere—the Montreal Protocol and the Kyoto Protocol—are mutually supportive and fully coordinated”, he says.

Late last year, Mr. Toepfer spoke in Cairo, Egypt, at the 10th annual meeting of the parties to the Montreal Protocol on Substances that Deplete the Ozone Layer. The landmark treaty is aimed at reversing the destruction of the Earth’s protective ozone layer.

Several gases that are being used as ozone-safe replacements for CFCs—notably hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)—contribute to global warming and are targeted for reduction under the 1997 Kyoto Protocol.

Another link is that global warming may slow the ozone layer’s healing process. Scientists caution that the warming of the atmosphere near the ground could cause the stratosphere to become even colder.

Based on a recommendation by its working group in July 1998, the Montreal Protocol parties agreed on a process for coordinating their scientific, technology and economic assessment panels with similar panels and committees linked to the convention on climate change.

In early November, parties to the United Nations Framework Convention on Climate Change, meeting in Buenos Aires, Argentina, also called for greater scientific cooperation between the ozone depletion and climate change treaty organizations.

Industry officials, however, say the move towards consolidating objectives ignores differences between the treaties.

The 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change commits industrialized countries to binding reductions of emissions of carbon dioxide, methane, nitrous oxide, HFCs, PCFs and sulphur hexafluoride.

A multilateral fund created in 1990 to help developing countries phase out ozone-depleting substances has spent millions of dollars converting industrial processes from CFCs and HFCs. However, the growing uncertainty over HFCs could prolong the use of CFCs in those countries.

The Cairo meeting also reviewed the problem of non-compliance with the Montreal Protocol by Russia and seven other members of the former Soviet Union. All have failed to curb their consumption of ozone-depleting substances, and many have not enacted other legal obligations of the treaty, including bans on imports of some substances.

The UN say Russia has made significant progress in recent years, with CFC consumption dropping from 20,990 tons in 1995 to 12,345 tons in 1996. Ten donor nations have pledged a special contribution of \$19 million to the multilateral fund to shut down Russian CFC and halon production by 2000. (Source: *Reporting the Business of Chemicals since 1871*, 7 December 1998)

Negotiating interconnect agreements

Negotiating interconnect agreements is the key to profitability for entrants to the telecommunications market, as interconnect charges can easily form 80 per cent of the costs incurred in the early stages of business, according to a new report entitled *Negotiating interconnect agreements from analyses*. Without such agreements, say the authors of the report, it is impossible for entrants to offer a viable service to customers.

The new report, published at the end of July 1998, provides a practical framework for network operators, service providers and regulators worldwide to gain the understanding needed to formulate successful interconnect strategies and negotiate the most advantageous interconnect agreements. It also provides a detailed overview of the regulatory environment in more than 30 countries, including the European Union member States and the United States.

The number, range and complexity of interconnect agreements will increase enormously over the coming years, says the report, with telecommunication operators offering different types of service on different platforms: Internet protocol (IP), asynchronous transfer mode (ATM), global system for mobile communication (GSM) and universal mobile telecommunications system (UMTS).

Salient points of the report

- The role of national regulators will change as the telecommunications market matures, but will continue to focus on meeting objectives to increase com-

petition and ensure that reasonable prices are set and innovative services are delivered to customers.

- Trends in regulating interconnection will result in cheaper international calls driven by capacity-based pricing, price de-averaging and network element unbundling.
- Service unbundling will continue, giving entrants and service providers access to operations and support systems, and increasing the range of services that must be offered by the incumbent operator. As a result, service providers will be able to offer new services over the incumbent operator's physical infrastructure, without making the substantial investments needed to roll out their own infrastructure.
- Progress towards local loop unbundling, based on the United States experience, is likely to be slow.
- Internet service providers (ISP) will have to pay more for access to the Internet backbone.
- Interconnect agreements are becoming more and more open as the number of players increases. Arrangements include cost-based pricing, revenue-sharing agreements and peering arrangements and, with the emergence of players specializing in wholesale (interconnect) services, such as Hermes and Illuminet, interconnection is fast becoming a normal business for operators and not just a regulatory inconvenience.
- Regulators are expected to intervene on the rights and obligations of Internet telephony service providers.
- The convergence of telecommunications, information technology and broadcasting means that the demarcation between content, application and delivery systems is becoming blurred and, as a result, network interconnection will become a key policy issue. (Source: *ITU News*, October 1998)

Electronic Forum on Quality Management

One of the most recent activities of the International Telecommunication Union Virtual Training Centre and a pilot activity of the project GTU/GTTI (Global Telecommunication University/Global Telecommunications Training Institute) was the Electronic Forum on Quality Management for the countries of Latin America.

The forum was organized in three discussion groups according to the level of use of the quality management philosophy by organizations:

- Group No. 1: Introduction to the quality management philosophy;
- Group No. 2: Consolidation of quality management in the organization;
- Group No. 3: Internal quality assessment and certification processes.

The forum was held over eight weeks, with one theme per week. It was coordinated from Geneva by Jaime Herrera, Head of the Human Resources Development (HRD) Division, with the assistance of Mario Maniewicz, regional expert based in Brasilia. Each group had a tutor, of whom two were in Buenos Aires and one in Montevideo.

Delegates from operators and regulators in 13 countries took part: Argentina, Bolivia, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Honduras, Paraguay, Peru, Uruguay and Venezuela.

The working method was as follows:

- The coordinator supplied the support documents every week;
- The tutor provided questions for discussion;
- The participants sent their contributions with comments, examples from their own organizations and any other input they considered relevant;
- The tutor and the participants exchanged views and experience;
- At the end of the week, each tutor summed up the discussions and conclusions;
- The coordinator gave instructions for the next step, carried out follow-up and solved any problems.

The work was very dynamic and productive with participants discussing the problems and solutions raised in each organization very openly, thus making it possible to carry out interesting benchmarking on the use of quality management in the region. A report of the results is being published, setting out the topics discussed in each group, the conclusions, the contribution of each participant and the support documents used.

The project GTU/GTTI is a virtual organization comprising universities and training centres associated with ITU and providing refresher courses and training for professionals (universities) as well as training programmes for technicians and supervisors (training centres) on a distance-learning basis, using information technologies and telecommunications. The project is financed out of the TELECOM surplus and is implemented by the ITU's Telecommunication Development Bureau (BDT) HRD Division.

Work is currently under way on the creation of a network of associates in various regions and there are already some affiliated institutions such as the University of Moscow (Russia), and the University of Zilina (Slovakia).

Recently a mission took place to the Arab countries in order to identify interested institutions and possible courses for short-term implementation as pilot courses for the evaluation of results. Work is proceeding on formalization of this activity.

On 3 and 4 September 1998, a round table was held in the Latin American Region with universities there to continue negotiations regarding participation by some of them in the BDT project. Fifteen universities attended, of which about five were ready to sign participation agreements with ITU while the rest were interested in proceeding with negotiations. It is hoped to set up a joint training plan to be offered and delivered during 1999. Various techniques will be used to deliver the courses but, basically, Internet and videoconferencing, which are both interactive, are the content providers' preferred media.

The project, which is entering its most important stage, now has a sound basis and it is hoped that in 1999 the first meeting of a council comprising the system's

active members will be held to discuss how to establish joint courses for telecommunication organizations in the areas of new technology and management, as well as the possibility of offering diplomas, and other aspects of the normal operation of this virtual organization. In other words, we would be moving from the current pilot course phase to a normal activity phase.

The "Centre of Excellence" concept is used to identify a mechanism for the provision of very high-level training and technical assistance aimed at those who take strategic decisions in the telecommunication sector: managers and directors of regulatory bodies and telecommunication operators, ministries and other bodies involved in strategic decision-making in the sector.

In fact, there are four ongoing projects with somewhat different characteristics. In Africa, it was decided to begin by converting the two regional training centres into Centres of Excellence (the Higher Multinational School for Telecommunications (ESMT) in Dakar, for the French-speaking countries of Africa, and the African Regional Advanced Level Telecommunication Institute (AFRALTI) in Nairobi, for the English-speaking countries).

In the Americas Region and the Asia-Pacific Region, the idea is to set up a virtual organization consisting of a network of institutions which can provide the above-mentioned services.

The four projects are under way and are being worked on individually. The Americas Region project is perhaps the one which is showing most concrete progress. A project document has already been accepted by all the top telecommunication authorities in the region, after discussion and negotiation with the help of the Inter-American Telecommunication Commission (CITEL), the organization grouping all telecommunication authorities in the region. There is a long-term work plan and a short-term plan to begin to implement specific activities, which are showing first results.

The short-term plan was discussed at the recent XIth Regional Symposium on Training and Human Resources held in Santafé de Bogotá from 7 to 11 September 1998. Recommendations were made on the organization of the system, the formation of the network with nodes grouping countries from the different subregions and, essentially, the definition of the first courses to be developed and delivered in 1999.

Two important recommendations state that:

- The courses to be developed by the Centre of Excellence are to be based on various sources of information and experience in the region, so as to obtain the necessary synergy to ensure that the product will be better than one that could be developed by any of the participating institutions acting individually.
- Priority will be given to developing courses in four main areas:
 - Telecommunication policies;
 - Telecommunication regulation;
 - New telecommunication technologies;

- Telecommunication management.

This is the short-term challenge that the HRD Division has accepted; it must develop and deliver the courses in 1999 and at the same time continue with the process of setting up the Centre of Excellence, under a long-term plan which will lay a sound foundation for the establishment of this virtual mechanism or organization in the Americas Region. Obviously, the organization will then become part of the world network of Centres of Excellence. (Source: *ITU News*, October 1998)

United States Government provides funding for WTO information technology project in developing countries

The United States Department of State has made a grant of US\$ 90,000 in support of the World Trade Organization information technology initiative for least-developed and developing countries.

This initiative aims, through the use of information technologies, to support the integration of some 50 least-developed and developing countries into the multilateral trading system.

The United States grant will help provide Internet connections, computer equipment (personal computers, printers, modems, etc.) for the operation of WTO Trade Reference Centres in these countries. The centres enable trade ministries to keep in touch with WTO activities via the WTO Internet site (www.wto.org) and the Trade and Development Centre (www.wto.org), jointly operated by the WTO and the World Bank.

Through these and other trade-related Internet sites, ministries can gather information from electronic trade databases which enable governments to utilize better the multilateral trading system.

This contribution comes in addition to grants already provided for the same project by the Governments of Norway, Hong Kong and the Netherlands. (Source: *ITU News*, October 1998)

Eurovision network: digitization complete

Eurovision, the transmission network of the European Broadcasting Union (EBU), has been completely digitized since the end of August 1998, with a total capacity of 20 channels on four transponders on the EUTELSAT-II F4 satellite. This is one of the most extensive distribution networks for television images in the world. It covers the whole of Europe from east to west, as well as North Africa and the Middle East, with 55 transmit and receive satellite Earth stations located in most of the major cities in its footprint area.

The new features provided by digitization include the possibility to encrypt the signals to ensure total security for certain transmissions, in particular sport, which are subject to transmission rights.

The Eurovision network is used to distribute and exchange television programmes, in particular sport, but also cultural and news programmes, between European broadcasters. It carries some 70,000 television transmissions each year. (Source: *ITU News*, October 1998)

Automated computer-mediated negotiation—the seed of perfect markets?

Markets are inefficient because they need to provide better information that is up to date. Now that electronic commerce is beginning to happen, there is a possibility of increased transaction volume and rapid transaction execution. The Web allows customers to know almost everything about their purchases, their vendors, and the options from vendor competitors. This would allow customers to pursue low-cost options. However, from the seller's point of view, this could be a negative factor as it would reduce customer switching costs, erode customer loyalty, and create a downward pressure on profits. Fully automated computer mediated negotiation is just beginning to emerge. A small early player is Priceline which allows purchasers to name their price.

Customers contact Priceline and state their destination and the price they wish to pay. Priceline then uses its proprietary databases and searches millions of constantly changing fares automatically. However, there is a lack of optimization as Priceline will match the stated fare but not give information if fares are available below that quoted by the customer. In the future it is possible to imagine a comprehensive buyer-driven commerce system which would allow the customer to name their price for everything from everyday commodities to vacation packages and financial services. The only drawback to e-commerce is the Web development which has poor organization of information; broken search engines; and other frustrations. The next hot search and retrieval technology is XML which will introduce a new kind of Web that is built on logic, objects and methods, not simply pages and graphics. Browsers will be able to use XML to read and understand a Web page and the Web can become a database with accessible fields. With increasingly large content databases being assembled, the time could come when users are offered interactive business choices. (Source: *Interactive Media International*, 11(12) November 1998)

Internet in the workplace: managing the unmanageable

Eager but uninformed enthusiasts assert that the Internet can meet all of an organization's information requirements. Given this, information professionals run the risk of being unheard, unless they establish themselves as authorities on content and quality. They must change their focus, become proactive, and manage the Internet as they would any other resource.

The messages should be: the Internet is useful but must be used appropriately, its limitations can be costly in terms of loss of employee time and the use of inaccurate information, and information professionals are exactly that—experts who can ensure that the Net is used effectively. The messages should be directed first at senior management, then attention can be turned to middle and junior management.

Once the attention of the organization has been gained, some of the commoner problems and misconcep-

tions can be addressed. Many users, for instance, are unaware of the distinction between Web-based material and that available from commercial, i.e. paid-for, databases. They—or their supervisors—may need to be tactfully reminded of the distinction, and of the need to observe copyright restrictions. Staff may also need to be advised to check the validity of Internet sources, and when the material was last updated, otherwise they risk using unauthorized, incomplete or out-of-date information.

A very real problem is that of Internet searches which become unnecessarily prolonged, when the information professional could have provided the required answers more quickly and cheaply from alternative sources. Again, tact and discretion will need to be employed when educating colleagues as to the realities of information economics. (Source: *Online*, November/ December 1998)

Teaching and exposing grey literature

Over the past few years, the definition of grey literature has changed drastically. Publishers and individuals can now create new products and release information in many different ways. Now that there are choices for access and delivery in diverse formats, the difficulty once associated with the publishing of grey literature at a relatively low volume has disappeared. Electronic publishing using HTML and PDF/Adobe Acrobat options has created new opportunities and models. When considering electronic publishing in science, new modes of grey literature that have been developed are the pre-print services and technical report literature. This means that there has to be rethinking regarding the value of published works; interest lifespan; and the role of libraries in protecting the archival function. Electronic publishing allows non-customary information to be captured in the Web environment. In considering the handling of electronic information in libraries, the information professional must disregard the lack of structure or format. Work in progress is a new form of grey literature which has value.

Today librarians are better able to integrate the new grey literature as it is now more widespread and its added value is understood. The challenge of managing new electronic collections requires substantial new training and charting new policies and procedures. Selected examples of scientific grey literature are discussed in detail—scientific visualization (biological mapping, human genome projects); science policy; scientific protocols; and scientific journalism. The examples discussed can have an impact on distance education; professional meetings and conferences; additional opinion collected from experts worldwide; and provision of improved access for the information poor. While legal issues remain unsolved and complex technology is expensive, the new language of the Web is more universal than anything else available. It is concluded that there are creative opportunities available to the information professional to become better informed about grey literature. (Source: *Collection Building*, 17(4) 1998)

Does information make any difference?

Information scientists seem to have suddenly become aware of the fragility of their historic justification. In the middle of industrial concentration, re-engineering, downsizing, deregulation, globalization, etc., a solid justification is needed to support the axiom that information is the most critical resource that is needed in order to succeed. Studies, publications and a recent conference have cast new light from different angles. It is clear that understanding the value and impact of information will address the immediate and more practical need for a credible ground on which the effectiveness and sustainability of information systems and services can be based. This may also feed public policies related to the pervasive applications and implications of the new information and communication technologies which form the fabric of the promised knowledge society golden age.

Information is usually used when solving problems, so it is usually assessed on the basis of its contribution to the solution. However, the information model developed by the author in 1997 shows that information is obtained in conjunction with a particular problem which is complemented by an existing internal knowledge base. The content and structure of this knowledge base play a major role in securing the right answer and the right use of information. This internal knowledge base is running under the control of two engines—knowledge activating attributes and adaptability attributes. This means that the core of the information system is people, not information resources or technology.

The impact of information which is illustrated shows that the changes in the content and structure of both the knowledge base and the engines give enhanced capability to cope with similar situations. A complication is that the provision and use of information occur as part of a series of discrete activities aimed at solving a particular problem. In attempting to isolate the elusive impact of information, it may be wiser in the first place to take stock of the particular conjunctions of circumstances and conditions. It is concluded that anthropological methods and longitudinal studies may be most appropriate in this area. (Source: *British Library Research and Innovation Centre Research Bulletin*, No. 21, Autumn 1998)

Promoting and marketing communications in the information marketplace

Promotion activities from producer to customer are one side of the communication process, while market research obtains information from the customer to feed back to the producer. In some cases, communication in both directions can be achieved directly and is to be encouraged. However, much promotion, especially in consumer markets, appears to be predominantly one way as the marketing message is sent out through selected channels and the feedback is in the form of sales. This makes it difficult to differentiate between the role of promotion and other factors in the marketing mix. The information marketplace is an interesting mixture of

consumer and business-to-business marketing which can include service promotion, library suppliers, on-line search services, database producers, journal publishers, and indexing and abstracting services. Promotion is one of the key factors in the marketing mix and has a key role to play in market success.

Promotion is concerned with ensuring that customers are aware of products that the organization makes available to customers. More specifically, the objectives of promotional strategy are to increase sales, maintain or improve market share, create or improve brand recognition, create a favourable climate for future sales, inform and educate the market, create a competitive advantage, and improve promotional efficiency. The tools in the promotional mix are advertising, direct marketing, sales promotion, public relations and publicity, personal selling and sponsorship. Typically, organizations will use a combination of these.

The stages in designing communications strategies are to identify the target audience, determine communication objectives, design the message, select communication channels, establish promotional budgets, decide on promotional mix and measure results. It is concluded that promotion is an important component of the marketing mix. And that the design of appropriate communication strategies involves a number of considerations. (Source: *Library Review*, 47(8) 1998)

A model of virtual organizations

The concept of the virtual organization was developed about 20 years ago when working at home using technology became possible. The literature discusses three types of virtual organization: (1) organizations which outsource some of their business activities and form virtual alliances to achieve organizational objectives; (2) an abstract concept which exists in the mind and is the antithesis of the familiar physical organism; and (3) organizations built up by virtual links using IT. In building a model, the variables that have to be considered are connectivity, purpose, technology and boundary.

Research on IT-enabled organizational change provides a general background for organizational design. It is suggested that the proposed model could be useful both conceptually and practically in either establishing new virtual organizations or transforming existing ones. One aspect of the proposed model is the power to predict the stability of virtual organizations. When taken together, the four key characteristics give guidance for stability assessment and the design of new virtual organizations. The combination results in sixteen possible types of virtual organization which have high connectivity, purpose, technology and boundary. It is concluded that new barriers will need to be attacked in the future using new technology. These are some concerns which should be researched in the future as empirical studies are needed to test the model further and explore design and implementation characteristics. (Source: *Journal of Information Science*, 24(5) 1998)

Knowledge professionals need skills beyond information skills

It has become a truism to say that information professionals need to develop new skills and approaches if they are to maintain and develop a central role in information and knowledge management within their organizations. However, this is not universally true. Some information managers are marginalized and have little influence in their organizations. This may be determined by the corporate environment in which they are operating.

There is also a constant refrain from senior information managers that library and information studies departments in our universities are not producing the kind of young professionals who can make the necessary, and urgent, contribution required. Certain fundamental questions arise over a number of areas: are IT skills sufficiently deep and sufficiently up to date? As technology plays an ever more important part in our management and delivery systems, are there areas we need to improve in order to become more effective and credible?

Older members of the profession may have problems in keeping up with the constant change and continuing professional development (CPD) and programmes need to be in place to help these people. However, most young people coming out of our universities from information services track appear well able to cope with IT—indeed, some show highly tuned competence.

Our information services are more complex and under greater pressure than ever before. As the barriers between library, information, IT and knowledge management functions continue to break down, we obviously need a new breed of professionals who can contribute in all these areas. The curricula of departments of information studies need to continue to evolve to address this requirement. Many are well placed to do so, but a lot of work has to be undertaken before it can be realized. (Source: *Information World Review*, 141, November 1998)

Enterprise-wide workflow: the change dimension

Forecasting—and therefore planning for—change has always been extraordinarily difficult. This is especially true given today's business environment. The only way a business can hope to survive, therefore, is to emphasize pragmatism and flexibility, so that it can adapt quickly to changing circumstances.

For the last few decades, it has been a commonplace that companies must invest in new technologies and systems. Many have done so. Although some have succeeded in re-inventing themselves and continuing to prosper, however, there are many examples of firms whose expectations have not been fulfilled. What can be done to increase the possibility that such investment will produce the desired result?

The more important processes will be those which impinge on the quality of service offered to customers. These processes will be subject to constant change as new products and services are introduced. It is likely that the company will have to work with legacy systems rather than start afresh, and "middleware" can be deployed to

put a new gloss on old systems. The key to successful implementation of middleware is to make the effort which goes into integration re-usable—now (across a series of business processes) and in the future (when the system has to be revamped yet again).

The routing or flow of work must be divorced from tasks performed at the desktop. This permits the organization to change the order and priority of process steps rapidly and without disruption to those same processes. Choosing the right work-flow "engine"—in terms of scalability and performance—is of paramount importance. (Source: *Information Management & Technology*, 31(6) November 1998)

Just a minute

In the past year, the following changes occurred in the world EVERY MINUTE. In most cases, the rate this year and next will be even faster.

- The net amount of forest in Australia, which has very little forest to begin with, was reduced by an area the size of a soccer field.¹
- The net amount of tropical forest in the world was reduced—mostly by burning—by an area the size of 60 football fields.²
- In the United States, suburban sprawl spread over another one hectare (2.5 acres) of land.³
- Almost one-half square kilometre of good land turned to desert.⁴
- 570 people were driven from their homes by weather disasters, many of which had been greatly worsened by global warming, deforestation, and other human actions.⁵
- 23 children died of starvation or malnutrition.⁶
- 50 people died of pesticide poisoning.⁷
- 245,000 gallons of raw municipal sewage were dumped into the Ganges River in India, which is regarded by Hindus as a Holy Place, and is where millions bathe to be purified.⁸
- \$19,000 worth of endangered animals or animal parts were sold on the global black market for endangered species.⁹
- The global economy burned up an amount of energy (mostly fossil fuels), each minute, that the planet took 10,000 minutes to produce through solar energy collection and photosynthesis.¹⁰

¹Ashley Mattoon, *WORLD WATCH*.

²Ed Ayres, *God's Last Offer: Negotiating for a Sustainable Future*.

³Eben Fodor, *Better Not Bigger*.

⁴*Encyclopedia of World Problems and Human Potential*.

⁵Janet Abramovitz, Worldwatch Institute.

⁶Optimum Population Trust.

⁷Paul Hawken, *Ecology of Commerce*.

⁸UNDP, *Human Development Report*.

⁹Donovan Webster, *New York Times Magazine*.

¹⁰Hawken.

C. New Developments

Silicon Valley turns to levitation

First it was trains, then futuristic spacecraft—and now microchips may be levitated by magnets. Engineers at the Massachusetts Institute of Technology believe that maglev technology will halve the time it takes to etch a microchip by positioning silicon wafers more quickly and more accurately.

Silicon wafers are normally positioned under the lenses used to etch them by supporting them on a cushion of air. Each wafer is about 200 millimetres in diameter, so it has room for a large number of chips, which are typically about 20 millimetres square. The wafer has to be moved between about 30 mask printing shots for each chip. "These are \$3 million machines. You need to move chips rapidly because the time spent not printing is wasted", says David Trumper, a mechanical engineer at MIT.

Placing the wafer on a magnetic stage and surrounding it with electromagnets allows it to be positioned with nanometre accuracy at a speed of 300 metres per second. The other advantage is that, apart from the wafer itself, the new system has no moving parts, so there is no friction or wear. (Source: *New Scientist*, 23 January 1999)

Total recall

Holograms no larger than a CD could soon be used to store huge quantities of rewritable data, thanks to the development of a new kind of polymer. Within five years, a German team hopes to store a terabyte of data, the equivalent of 200 CD-ROMS, on a CD-sized hologram. They also believe they will be able to access data at a rate of one gigabit per second, which is 100 times faster than a DVD drive.

Scientists at the Bayer Institute in Leverkusen, Germany, are turning to holography because in the next few years traditional two-dimensional storage—in hard drives and DVDs—is likely to reach its data density limit.

When polarized laser light passes through Bayer's new photo-addressable polymer (PAP) its chain-like molecules become aligned and stay like that even after the beam has been turned off. This alignment, or its absence, can then be read by an unpolarized laser beam.

The holographic effect is created by shining two laser beams that are in phase onto the PAP. One of the beams, the data beam, falls first on an object which encodes the data, in his case a liquid-crystal display "template". This changes its phase. When the two beams meet on the polymer an interference pattern indicating the difference between their

phases is etched into the substance. Then, by adjusting the angle of the beam slightly, an entirely new pattern can be recorded on the same substance without disrupting any of the information already recorded. The aim is to store a thousand data images, each 1,024 by 1,024 pixels, on a single cubic millimeter of the polymer, and to be able to read each image in a millisecond.

The Bayer team has narrowed its choice of PAP down to just five out of 300 that it has tested. The ideal is to combine all the desirable features of these five substances into a single polymer.

Previously, scientists had hoped that lithium niobate crystals could be used to store holographic memory, but these have so far proved far too unstable. Although they are effective at storing data, they tend to lose it once the information has been read. Early research into polymers showed that they could store data, but they too were unstable. The Bayer polymers, on the other hand, are proving much more stable, but need fine tuning.

Hans Coufal, a holographer at IBM's Almaden Research Center in San Jose, CA, says another advantage of using polymers is that they can be shaped more readily than crystals, making them easier to mass-produce. (Source: *New Scientist*, 23 January 1999)

University develops optical modulator

A novel optical modulator has been developed at the University of Southampton.

It is based on "simple and cheap" materials, claims Nikolay Zheludev who is leading the Southampton research group. "It is the interface between a dielectric—silica or glass—and metallic gallium."

Under easily maintainable conditions, the interface becomes a light-sensitive mirror, reflecting varying amounts of an optical signal under the control of another optical signal.

Applications for the modulator include routing optical signals in communication networks and controlling lasers.

"Routing is done electronically at the moment, light in fibres is converted to electrical signals, routed, and converted back. The gallium switch can do this optically."

The change in reflectivity of the switch, according to Zheludev, is record-breaking, "no such material shows something nearly as strong".

It is also fast. "It turns on in nanoseconds ... Turn-off is slower, between 10 ns and microseconds", he said.

Changing the reflectivity of one of the mirrors can also be used to control the output power of a laser. (Source: *Electronics Weekly*, 27 January 1999)

UK researchers put knee into 3-D model

The University of Sheffield has combined medical scanning technology with computer image analysis and modelling to create a virtual knee.

"There are a few other 3-D knee models around, but ours is probably the most geometrically and kinematically accurate", said Justin Penrose, research associate at the University's department of medical physics and clinical engineering.

Raw data for the model came from an MRI scan of a stationary knee. Manually-assisted software then identified the various tissues and assembled the slices into a 3-D model. Further processing, with mechanical modelling software from Paris-based ESI Group, added physical parameters and realistically animated the model.

The virtual knee will now be used to help with the development of knee prosthetics, such as replacement menisci (commonly misnamed cartilages), parts that footballers are prone to injure. (Source: *Electronics Weekly*, 27 January 1999)

New LCD screen

Designers and computer gamers could soon be watching 3-D computer images minus the unwieldy headgear. The new screen, developed by the London-based company RealityVision, plugs into a standard computer like any normal display.

As with other stereoscopic systems, the RealityVision display achieves a 3-D effect by projecting a slightly different image into each eye. In the new system, the two images are interlaced on a standard LCD: the image destined for the left eye is displayed on even-numbered rows of pixels, and the right image is displayed on odd rows.

The key to making this work is a novel backlighting unit, in which light from an ordinary light source is directed towards each eye by a holographic pattern recorded on a plate fixed to the back of the LCD. The unit ensures that light passing through even-numbered rows is directed towards the left eye, while light passing through the odd-numbered rows only reaches the right eye. Provided that the viewer's eyes are in the correct area, they will see separate images.

The signal that drives the LCD can come from either a pair of video cameras, or 3-D software such as a game, a computer-aided design program or a virtual-reality simulator. According to co-inventor David Trayner, the screen could also be used to show two different TV programmes—to two people sitting side by side.

The only constraint is that the viewer's head must stay within a certain area in front of the screen. Move too far to the left or right and you lose the 3-D effect. But Trayner says most people naturally sit in front of a display in the right position.

Trayner says his system provides a wider viewing zone than other 3-D techniques. Rival systems are also

limited by the fact that sideways movement leads to what he calls the "picket-fence effect", where the image periodically disappears when the eyes are in certain positions. Even worse, the left and right images can swap over as the viewer's head moves.

RealityVision is now working on increasing the viewing zone, and increasing the resolution from its current 800 x 600 pixels to 1,280 by 1,024. The company also hopes to develop a system that tracks the motion of the viewer's head and moves the light source to maintain the stereo effect over a wider range of angles.

The display can be changed to 2-D by repositioning the light sources so that odd and even rows are illuminated identically. (Source: *New Scientist*, 6 February 1999)

High-output power GaAs FET for large outputs

NEC Corp. has developed a new field effect transistor with a field-modulating plate (FP-FET) that increases the output power of high-output GaAs FETs, which are used in the transmitting amplifiers of cellular telephone base stations, by as much as three times compared with before. The FP-FET is characterized by the use of a metal-insulator-semiconductor (MIS) type field plate installed between the gate electrode and the drain electrode. This field-modulating plate improves the breakdown voltage considerably by easing the electric field concentration at the gate and also reduces the parasitic resistance caused by the edge depletion layer on the GaAs surface. As a result, while the operation voltage limit of previous products was 12 V, it can attain better performance up to 35 V, and the output power per millimetre of gate width is increased from the usual 0.5 W/mm to 1.7 W/mm. At present, an output of about 100 W has been realized, and a larger output power up to 200-300 W will soon be possible. Further details from: NEC Corp., Public Relations Dept., 5-7-1, Shiba, Minato-ku, Tokyo 108-8001. Tel.: +81-3-3798-6511; Fax: +81-3-3457-7249. (Source: *JETRO*, February 1999)

Quantum computing

If there is one sure thing in the computer industry, it is that, sooner or later, engineers will not be able to squeeze any more circuits onto chips. But an enthusiastic group of researchers is speculating about a whole new realm of miniaturization: devices so small that they operate according to the unfamiliar quantum laws of the atomic world. Quantum computers could remain a dream unless physicists can find a way around the vexing tendency of quantum information to leak away and degrade. Now a team of Los Alamos theorists and East Coast experimenters has shown that quantum computers could identify errors and fix them.

According to David Deutsch of the Centre for Quantum Computation at the University of Oxford in England, "it is an important step toward the goal of building a useful quantum computer".

Current "classical" computers process information, or bits, as digital 0's and 1's. In quantum computers the element of information, the qubit, is a blend of both a 0 and

a 1, their relationship expressed by the qubit's "phase". This mingling allows an array of qubits to carry a whole swath of numbers simultaneously, even though actually reading the array will yield just one value as the quantum states "collapse". By working on entire sets of numbers all at once, a quantum computer can in principle solve certain types of problems incredibly efficiently. Factoring big numbers, for example—a taxing task for today's computers—would be a cinch for quantum computers and would render obsolete today's most secure encryption systems, which are based on the difficulty of this task.

Unfortunately, a passing atom can interact with a qubit, causing some of its information to leak away and introducing errors. Skeptics say that the fragility of quantum information threatens the whole idea of a practical quantum computer. Because there is no way to avoid the errors, the next best thing is to correct them. This is not easy for quantum information, because reading it out to check for errors or correct them instantly collapses the qubit array, spoiling its number-juggling capacity.

In 1996 Peter Shor of AT&T Bell Labs and, independently, Andrew Steane at Oxford devised a theoretical scheme for doing so. The basic idea is to spread the information of one qubit into a family of linked qubits so that, should any be corrupted, the information can still be recovered from its partners. Now Raymond Laflamme and his team at Los Alamos National Laboratory in New Mexico have teamed up with a group of Massachusetts-based specialists in nuclear magnetic resonance (NMR) to demonstrate the scheme with atomic nuclei that encode qubits in their magnetic orientations.

A nucleus can behave like a small magnet and point either up or down relative to a strong magnetic field. Thus a molecule could be used as an array of qubits, with the nuclear orientations encoding 0's (up) and 1's (down). To control such an array, the researchers used NMR to manipulate the orientation of nuclear magnets by twisting the nuclei with radio-frequency waves.

In the 7 September *Physical Review Letters*, the team describes tests on two molecules: alanine, an amino acid, and trichloroethylene. Both provide a suitable set of three neighbouring nuclear magnets: a single information qubit plus two control qubits to provide error correction. The researchers first used a radio-frequency pulse to twist the linked nuclear magnets into a particular position, then left them to the mercy of their surroundings. Errors caused the three magnets to drift out of alignment before a further radio-frequency pulse reversed the initial twisting. Because the three magnets are linked magnetically, enough information was contained in the misalignment of the two control qubits to allow the team to figure out the error on the information qubit without having to measure it directly. The experimenters then showed that they could correct the error with another pulse.

Although enthusiastic about this demonstration of principle, other researchers emphasize that this is just the first step toward full quantum error correction. (Source: *Science*, Vol. 281, 18 September 1998)

A case for ever-smaller electronics

Researchers at the Georgia Institute of Technology, Atlanta, are studying the possibility of a practical application of electron wave effects in extremely small-scale circuits. They have observed ballistic conductance—a phenomenon in which electrons pass through a conductor without heating it—at room temperature in multi-walled carbon nanotubes up to five microns long. "This is the first time that ballistic conductance has been seen at any temperature in a three-dimensional system of this scale", says Professor Walter de Heer of the School of Physics. "There would be interest in this for ultra-small electronics, because it shows that you can constrain current flows to narrow areas without heating up the electronics. It also introduces a new stage of electronics in which the wave nature of electrons becomes important." (Source: *Industry Week*, 7 September 1998)

Merced cartridge

Intel's first 64-bit chip, Merced, is due for release in 2000. Merced will have three levels of cache, the first two being on-chip. A large third level cache will be made on a separate die and, like Pentium Pro, mounted with the processor on a substrate. Internally, Merced will have a large floating point register file—128 registers. It will contain two extended precision multiply accumulate (MAC) units and two single precision MACs. These will give a massive boost to floating point performance, if utilized properly. Intel has been frugal with silicon area when processing old 32-bit instructions. When in 32-bit mode, the instructions are sent to a small control block which then dispatches 64-bit operations to the execution units. (Source: *Electronics Weekly*, 28 October 1998)

Xilinx hits a million gates

A million gate programmable logic chip is now being shipped, claims Xilinx.

The device from the Virtex family of FPGAs contains 75 million transistors—ten times the number in a Pentium-II. Each die occupies around 400 mm².

Called the XCV1000, the chip has over 27,000 logic cells and 128 kbyte of RAM.

These resources are aimed at replacing Asics in a range of applications including wireless and satellite basestations, graphics editing machines and high-definition TV broadcast systems. The first Virtex range of FPGAs covers 50,000 to a million gates. (Source: *Electronics Weekly*, 28 October 1998)

Marconi claims optical first

Marconi communications is claiming a world first with the demonstration of a reconfigurable optical technology telecommunications multiplexer in China.

The company claims that this photonics multiplexer will enable wavelength division multiplexing (WDM) techniques to be used to radically increase the capacity of optical fibre networks in cities worldwide.

WDM techniques will meet the capacity needs of all telecoms networks which are clogging up with the growth of Internet data traffic.

WDM allows multiple wavelengths of light from laser transmitters to be carried simultaneously over a single fibre.

Each light signal of different wavelength can carry a data stream which would originally have represented the fibre's total capacity without WDM. (Source: *Electronics Weekly*, 28 October 1998)

CDT polymer technology to shine for Seiko-Epson

Cambridge Display Technology (CDT) has developed its pioneering polymer display technology to the point of commercialization.

Lifetimes of 30,000 hours have been demonstrated for the displays, according to Philips, and a 2-in. diagonal, monochrome display containing 800 x 236 pixels has been developed.

Although 2 in. is the largest display size yet produced, the technology is not intrinsically limited by size. By using polysilicon the driver chips can be incorporated in the display's substrate. Using flexible substrates allows the displays to be configurable. The next step is full colour video.

Polymer displays have the potential to be between 40 and 50 per cent cheaper to produce than TFTs claims the company. (Source: *Electronics Weekly*, 28 October 1998)

UK researchers find a way to store facial images in just 50 bytes

Researchers at the University of Kent in Canterbury have developed a way to store a facial image in 50 bytes of memory—small enough to fit on the magnetic stripe of a credit card.

"There is enough space capacity on credit and bank cards to store the cardholder's image", said Jamie Booker, a PhD student working on the project.

Each byte is a coefficient for a template stored in the reading equipment. The final image is the sum of 50 templates multiplied by their coefficients.

The templates are generated once only, from 300 facial images of real people chosen to cover the population concerned, using the Karhunen-Loeve expansion.

The templates are ordered in significance. The first is a general human face. Adding template two makes it more masculine, subtracting template two makes it more feminine. The image is honed as each successive template is included. (Source: *Electronics World*, November 1998)

US researchers fabricate flexible transistors without melting plastic

The Lawrence Livermore National Laboratory in the US has fabricated polysilicon thin-film transistors on a flexible plastic substrate.

The plastic is polyethylene terephthalate (PET), the material used in most fizzy drinks bottles.

Plastic substrates are desirable because they are potentially cheaper, more rugged and more flexible than glass. Unfortunately, they also melt at the processing

temperatures required to make reasonable thin film transistors.

The Livermore engineers are using pulsed excimer-laser-processing to both crystallize sputtered amorphous silicon and to dope the transistor source-drain regions without melting the substrate.

The image shows a 100-mm plastic wafer with pager displays that contain around 2,000 pixels. The Livermore process uses six photomasks levels and a maximum temperature of 100° C. (Source: *Electronics Weekly*, 7 October 1998)

Processor clocks head for 1.5 GHz

Sun's microprocessors will reach clock speeds of 1.5 GHz by the year 2002, the company says.

The information comes from Sun's publication of its road map for the UltraSPARC series of 64-bit Risc microprocessors. While clock speed will quadruple over the next four years, performance will increase eightfold with the move from today's UltraSPARC II to UltraSPARC V.

For the gigahertz processors and beyond, Sun will use a 0.10 µm manufacturing process under development at Texas Instruments.

The UltraSPARC product family includes three variants on the basic processor: a scalable version (s) for multi-processor servers and workstations, an integrated chip (i) adding system functions, and embedded devices (e) for products such as high-speed network cards.

The next generation UltraSPARC III is slated to run at 600 MHz. (Source: *Electronics World*, November 1998)

Computers head for brain power

A computer with the raw processing power equal to that of the human brain will be built within five years. Moreover, it will be of a size, and have a power consumption, comparable to a living brain.

The claims come from US firm Irvine Sensors, which is engaged in military-funded research to develop a "silicon brain" capable of intercepting missiles.

Within five years the silicon brain will execute a thousand million million (peta or 10¹⁵) operations a second, fit in a shoebox and consume less than 10 W.

"As Moore's Law has managed to sustain itself ... the wherewithall exists to put a silicon emulator of a human brain in place", said John Carson, Irvine's chief technical officer.

In two dimensions, the silicon neuron's area is the same as a human neuron. The problem is in the third dimension.

Irvine has spent several years developing chips that stack vertically to achieve significant density increases. By shaving the back off the silicon die, Irvine is approaching the critical 10 µm mark, required to meet the volume targets.

The company already claims to have tera-ops (million million operations) performance from a cube measuring half an inch on a side.

Such a computer could also find civilian applications, for tasks where humans are at risk of losing concentration. (Source: *Electronics Weekly*, 7 October 1998)

NEC patents DNA computer

The Japanese electronics company NEC has been awarded a United States patent for the design of a "DNA Turing machine". The system, developed by Warren Smith and Allan Schweitzer of the NEC Research Institute in Princeton, USA, uses strands of DNA in the same way that the original Turing machine—an abstract model computer—uses strands of tape to store and manipulate data.

According to Smith, living cells have the ability to solve complex problems such as gene regulation, the assembly of complex structures and the synthesis of antibodies. To develop the DNA computer, the researchers created simplified models of biochemical processes and then investigated the computational power of these models.

Despite their success, the NEC researchers are sceptical that their design will be able to compete against conventional silicon computers. Computations could not be performed as quickly on DNA computers. Also calculations would be plagued by errors that build up exponentially as the computation progresses. (Source: *Scientific Computing World*, October 1998)

Wired for computing

IBM's Japan Yamato laboratory has unveiled a wearable Pentium-based computer only slightly larger than a walkman. The main processing unit fits in a pocket with the display, which is a translucent monochrome head-up type, close to the eye on a headset. Resolution is 320x240 with 256 grey levels. The headset also includes earphones for sound.

IBM intends the computer to be controlled mainly by voice and so a microphone shares space with a pointing device in a hand-carried control unit.

Processing is handled by a 233 MHz processor with 64 Mbyte of DRAM. This lives in the main unit which also holds one of IBM's new 25-mm 340 Mbyte hard disk drives and a battery pack. Battery life is said to be between 1.5 and 2 hours.

Total weight is 449 g, with the main unit accounting for 299 g of this. The three units are interconnected with wires and an infra-red IrDA link takes care of external communications. (Source: *Electronics Weekly*, 14 October 1998)

Optical circuits turn a corner

The ultimate aim of today's telecommunications researchers is to quit dealing with electricity. Communication systems already zip messages across the globe via satellite as microwaves or through optical fibres as infra-red light, but at either end of such transmissions the messages must be converted into electrical signals and passed through electronic circuits—a process that slows them down considerably. The

solution is to develop circuits that can process the infra-red or microwave signals directly. A team of researchers from Sandia National Laboratories in Albuquerque, NM, and the Massachusetts Institute of Technology (MIT) have described a crucial element of such optical circuits: an artificial structure called a photonic crystal that can transmit light with minimal loss and make it turn a corner.

Photonic crystals manipulate light in much the same way as semiconductor chips manipulate electricity, but the tiny components of a photonic circuit need to be wired together, and existing technology, such as fibre optics, is too crude, worse than joining the rooms of your house with a 12-lane freeway.

The key feature of photonic crystals is a repeating pattern of reflective elements, spaced at roughly the wavelength of the light or other electromagnetic waves to be manipulated. The Sandia experimenters made a photonic crystal from columns of alumina, or aluminum oxide, each a half-millimetre in diameter, set in a grid. Their spacing, about a millimetre apart, enabled the array to manipulate electromagnetic waves of millimetre wavelength, somewhere between the microwave and infra-red parts of the spectrum.

At the surface of each column, part of each wave is reflected and part passes through. The photonic crystal's repeating pattern causes the reflected waves to superimpose out of step, so that peak meets trough and they cancel out. Exactly which waves have the correct frequency to rebound around the crystal and cancel out is determined by the diameter of the rods and the spacing between them.

Although they work beautifully as filters, photonic crystals become really interesting when defects are added—in the case of the Sandia-MIT work, a missing row of alumina columns—which can support a wave otherwise banned from the crystal interior. This offers the prospect of micromanaging light within the body of the crystal. The researchers found they could pass millimetre waves along the missing row of alumina columns with virtually no loss.

Theorists had predicted that under the right circumstances, waves would turn a corner from one such corridor into a second. When the researchers added a second corridor at right angles to the first, they found that they could get waves to do just that, cornering in a distance roughly equal to their wavelength. Reproduced at higher frequencies, this bending would mean that infra-red waves—of interest to the telecommunications world—could turn through 90 degrees in about a micrometre, 1,000 times tighter than anything possible using optical fibres.

The team's eventual aim is to integrate numerous components, such as waveguides, filters, light sources, and modulators, onto a single photonic crystal. The challenge, however, is manufacturing such chips, because the pillars of an infra-red photonic crystal have to be fashioned accurately on a scale of micrometres. (Source: *Science*, Vol. 282, 9 October 1998)

Revolutionary spinner

Nanotechnology researchers have spun a tiny device at phenomenally high speeds. The researchers at Sandia National Laboratories in Albuquerque, NM, were demonstrating the size of a microscopic gear wheel when they found that the ultra-low friction component—part of the world's smallest combination lock—can spin at an undreamt of 350,000 revolutions per minute.

To demonstrate the size of their "nanolock"—a device that might one day keep hackers out of computer networks—the researchers placed a spider mite on top of a 0.3 millimetre diameter gear wheel. "It looked like an elephant by comparison", explained Larry Dalton, an engineering manager at Sandia. Out of curiosity they then started to spin the device with an electrostatic motor to see how fast it could go.

At 350,000 rpm they realized they were on to something. They calculated that if they designed a gear specifically for speed they could go as fast as 10 million rpm, which could make such devices ideal for use as high-speed switches in an optical computer.

In the macro world, the best machine tools can achieve speeds of around 20,000 rpm—any faster and friction becomes insurmountable. But in the microscopic world, friction and inertia are less of a problem owing to the decreased masses involved, says Sandia researcher Paul McWhorter. (Source: *New Scientist*, 24 October 1998)

Old before their time

Electronics companies are on the point of launching a new generation of digital TV receivers that will use hard-disk drives to record programmes. The news will dismay those who have invested in digital receivers that will soon be superseded, especially in Britain, where satellite digital broadcasting has been launched.

Digital TV experts revealed a specification for a set-top receiver dubbed "TV Anytime" that will learn what a viewer's favourite programmes are and automatically record them. The box can also be set to record particular genres, such as soaps, news or sport. Jean François Jezequel of French pay TV service Canal Plus, which has run digital TV for two years on satellite and cable, says his company "is already experimenting with the technology".

In the US, the California companies TeleWorld of Sunnyvale and Replay Networks of Palo Alto, along with the Duck Corporation of New York, are promising the first \$500 "storage receivers" this winter. They will record around 7 hours of programmes.

Meanwhile, in Britain, the Independent Television Commission has failed to ensure that the first digital pay TV receivers can be converted between terrestrial and satellite reception. European competition law allows the ITC to insist that digital sets have a "common interface" socket—this can connect to an add-on "sidecar" module that allows reception of rival services. But the ITC is only now talking to Oftel, the telecoms watchdog, about some kind of regulation to protect consumers. Digital sets are

already going on sale without sidecar units, so the first digital viewers risk being trapped with whichever pay service they try first. (Source: *New Scientist*, 3 October 1998)

Delicate operations

What can dock the space shuttle and spot a brain tumour? It is a neural networking computer algorithm designed by engineers at NASA. The system has become so adept at analysing the large amount of data needed to dock a spacecraft that it is also being harnessed by doctors to analyse tumours.

Recognizing patterns is neural networks' forte. They do well with a small number of parameters, but beyond 10 or so inputs and the neural nets become confused and hard to train.

For humans, by contrast, this sort of task comes quite naturally. For example, a surgeon taking a look at tissue might subconsciously analyse its colour, consistency and shape, and conclude that it is a malignant growth. All this can happen in a split second, without the surgeon being aware of the process.

Now a neural computer that handles many pieces of data at once has been designed by a team led by Robert Mah, an engineer at NASA's Ames Research Center at Moffett Field, CA.

Mah's neural net can take the data from a surgical probe—such as speed of blood flow, fluid pressure or optical reflectance—and discriminate between cancerous and healthy cells. Clinical trials are scheduled to start soon at Stanford University.

The neural net can also do things that are more obviously useful to NASA—like docking the space shuttle with the International Space Station. Instead of taking data from a biopsy probe, the neural network is connected to the space shuttle's navigational system. In simulations, and after a few test manoeuvres to learn the weight characteristics of the spacecraft, the neural net outperformed NASA's highly trained shuttle astronauts. Another application for the network might be in helping to learn the way a spacecraft rotates in space while firing its impulse jets. The system would then precisely slow the craft's rotation by burning the jets for the correct period. (Source: *New Scientist*, 3 October 1998)

Timely tasks

A Japanese team has increased the speed of parallel computing by using a genetic algorithm to schedule processing tasks. Tatsuhiro Tsuchiya and colleagues at Osaka University have designed their evolutionary algorithm to allow only the "fittest" task sequences—the computer equivalents of chromosomes—to survive. The surviving sequences become the tasks executed by each processor node in an array. Using task duplication, so that the task can be executed as soon as a node is free, the algorithm performed as well as—and sometimes better—than DSH, a common non-genetic task-scheduling system. (Source: *New Scientist*, 3 October 1998)

Crystal prism promises huge reduction in optical chip size

A "super prism" effect using a photonic crystal could enable optical communication chips just one hundredth the size of today's devices.

Developed in Japan by NEC, Tohoku University and NTT Optoelectronic Laboratories, the crystal prism is between 100 and 1,000 times more capable of refracting light than glass.

The move to terabit data rates in optical fibres is being driven by the increasing level of datacommunications. Techniques such as wavelength division multiplexing allow such speeds. But current refraction technology limits the number of wavelengths and the amount of integration.

The use of photonic crystals was proposed some ten years ago in the US. The Tohoku University research group first had success at refraction with the crystal in 1997, calling the effect a "super prism".

A photonic crystal is formed from layers of high refraction ratio silicon film and low refraction ratio silicon dioxide. As light passes through the three dimensional periodic structure, each boundary the light meets increases the angle of refraction.

The crystal is able to effectively split wavelengths of light between 0.9 and 1.0 μm , for which glass is unsuitable. At these wavelengths, with two individual sources of light differing by perhaps just 0.01 μm , the crystal can refract each wavelength up to 60 degrees.

The ability to refract wavelengths that are much closer together could lead to a greater number of wavelengths multiplexed together in a communications system.

With a size of between ten and several hundred microns, the prisms allow for a greater degree of miniaturization than conventional technology.

As well as communications, the inventors see applications in DVD players, with a photonic crystal replacing the complex arrangement of discrete devices used today. (Source: *Electronics Weekly*, 23 September 1998)

Parallel processing core embeds Philips in DSPs

Philips Semiconductors has entered the embedded digital signal processor (DSP) arena with a parallel processing core.

Called REAL, the processor is aimed at applications such as mobile phones and speech processing. It complements Philips' other DSP—Trimedia—suited to video processing and aimed at the digital TV market.

"REAL is the offspring of two previous architectures: EPICS and KISS", said Theo Claasen, chief technology officer at Philips.

The former was designed for automotive, while the latter was aimed at GSM mobile phones. REAL combines techniques used in both, particularly the low power consumption of the mobile phone processor.

The data computation core used with the REAL device uses what Claasen terms a "dual Harvard"

architecture. Two operational units are fed with data from triple buses, to reduce memory bottlenecks.

With two instruction streams, the processor can run two programs independently on different sets of data—a multiple instruction, multiple data (MIMD) architecture. When processing a more conventional single instruction stream, the dual path unit solves a particular DSP problem. Calculations on complex or double precision numbers, which each have two operands, run in a single cycle.

The computation unit can be split to double the number of arithmetic and logic units. Instead of the normal dual 40-bit ALUs, the core can implement four 16-bit ALUs. On single precision data, the number of instructions executed per clock cycle is doubled.

At a clock speed of 85 MHz, the processor can perform 166 million multiply/accumulate operations per second and over 800 million operations/s.

While a powerful architecture, the core's 16-bit Risc-like instruction set means more complex operations are difficult. Philips has included two mechanisms to solve this problem.

Hardware accelerators, such as a barrel shifter, can be linked into the processor during the Asic design process. These application specific execution units run in a single cycle—what would otherwise take several cycles in software.

The other innovation is application specific instructions. These are 96-bit user defined instructions for the computation unit, stored in look-up tables and pointed to by 16-bit program code. Thus a very complex operation can be included in standard programs.

In typical applications, Philips says the same performance can be achieved with a 1.7x lower clock frequency.

In terms of power consumption, Philips is claiming less than 1 mW/MHz running at 1.5 V on a 0.25 μm process. On a 0.35 μm process, the core occupies under 2 mm^2 of silicon. (Source: *Electronics Weekly*, 23 September 1998)

Quantum search beats classical algorithms

A search algorithm for a quantum computer that significantly outperforms classical methods has been developed at the USA's Xerox Palo Alto Research Center. The algorithm provides a solution to a set of highly structured search problems and was created by physicist Tad Hogg.

Reporting in *Physical Review Letters* (16 March 1998), Hogg claims that his work "provides another example for which quantum computers can outperform classical ones". Hogg states that the quantum algorithm is superior because it finds a solution in a single step. This is unlike classical methods which experience a linear increase in the number of steps required as the problem size increases. Hogg also claims that single-step algorithms are better suited for execution on hypothetical quantum computers because errors expected to arise from decoherence will not be as serious as those in multiple-step algorithms.

The new algorithm may be applied to the simulation of spin glasses and proteins. (Source: *Scientific Computing World*, May 1998)

Fast transistor may benefit portables

Scientists at the UK's Defence Evaluation and Research Agency (DERA) have used computer modelling techniques to design and build a very fast field-effect transistor (FET) from indium antimonide (InSb). The device was operated at 74 GHz by Tom Elliot and colleagues who claim that it is the fastest transistor, for its gate length, ever built. The DERA researchers also state that computer simulations reveal that the speed of the FET could be increased to 220 GHz through further miniaturization.

As well as being fast, InSb-based devices operate at low voltages. According to DERA, microprocessors made from InSb would be faster than traditional silicon-based devices and should also be less prone to over-heating. These properties would combine to make InSb an ideal material for portable equipment such as laptop computers.

Despite its attractive properties, InSb has not been used in semiconductor devices because it has a low band gap and is therefore plagued by large leakage currents. This was overcome at DERA using carrier exclusion and extraction techniques. (Source: *Scientific Computing World*, May 1998)

Yield enhancement through photostabilization

A photostabilization process (known as Photo-Kinetics, PK) that enhances post-deep UV lithography features and makes them more robust has been developed by Eaton's (Beverly, MA) Fusion Systems Division (FSD) process technology group. The impact of this technology is in better CD control and etch selectivity of deep UV resists.

The semiconductor industry still is transitioning to deep UV photoresist technology with a greater emphasis on increasing the yield parameters associated with deep UV implementation. Two significant parameters challenging deep UV technology are post etch CD control and the control of resist/underlying layer etch selectivity. Currently, the total error budget for across-the-field, wafer, wafer-to-wafer and lot-to-lot is within the ± 25 nm range, emphasizing the need for tighter CD control. Decreasing kl values for deep UV lithography places further importance on CD control. Deep UV resists however, tend to shrink with isolated and grouped lines and grow with contacts and vias, making CD control more difficult.

Deep UV resists currently do not have the same etch resistance implant processes. This technique may improve productivity and increase yields. (Reprinted with permission from *Semiconductor International Magazine*, September 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Polymer batteries pass test phase

Lithium Technology of Pennsylvania has finished testing its lithium-ion polymer battery for portable computers.

Lithium-ion polymer batteries are entirely solid state, having no liquid electrolyte inside. They can be made extremely thin—less than 0.5 mm—and with a high energy density.

These attributes make them suitable for notebooks, laptops and mobile phones.

High internal resistance, leading to poor current delivery, has been a characteristic of lithium polymer cells. (Source: *Electronics World*, October 1998)

Odds are good for bucky magnets

Six years after they created the first inorganic fullerenes, Israeli chemists have made minuscule magnets structured like buckyballs and nanotubes. These new magnetic materials could increase the amount of information stored on a hard disk by a hundred times or more.

The inorganic fullerenes made by Reshef Tenne and his colleagues at the Weizmann Institute in Rehovot, Israel, are layered spheres or tubes made from sulphides or selenides of tungsten or molybdenum. The new magnetic fullerenes are made of nickel chloride.

In bulk form nickel chloride is not magnetic because the magnetic dipoles in each layer of the substance cancel out.

Tenne's team, in collaboration with chemists at Oxford University, synthesized a mixture of spheres and tubes with between one and four layers of nickel chloride. Tenne says the single-layered and triple-layered materials will behave like tiny magnets less than 50 nanometres in diameter. Because these materials are much tinier than magnetic domains in today's hard disk drives, they could increase data density in hard disk by a hundredfold or more, Tenne predicts. (Source: *New Scientist*, 26 September 1998)

When Nobel dreams are too hot to handle

Anyone who discovers a superconductor that works at room temperature may be handing the world a poisoned chalice. A British superconductivity researcher suggests that the material might be too toxic to be usable.

Peter Edwards of the University of Birmingham has plotted data on the toxicity of top high-temperature superconductors against the maximum temperatures at which they work. He found a strong correlation between the two.

Extrapolating to a hypothetical superconductor that keeps its zero resistance up to room temperature results in a compound that is 10 times as toxic as cyanide. The LD₅₀ for this compound—the dose that would kill half of a group of laboratory rodents—is just 0.4 milligrams per kilogram of body weight.

Materials scientists working for IBM in Zurich have provided a ray of hope. They increased the temperature at which one superconductor conducts electricity with zero resistance by squeezing its atoms closer together. This technique might allow scientists to boost the top temperature for superconductivity while minimizing toxicity.

But Edward's main hope is a recently discovered class of compounds called carbocuprate superconductors, which unlike most high-temperature superconductors do

not contain heavy metals such as thallium or mercury. The toxicity of carbocuprates does not seem to correlate with their maximum working temperature. Unfortunately, those discovered so far are not very stable. (Source: *New Scientist*, 26 September 1998)

Nanotubes for flat TV displays

Hairy glass could pave the way for a new kind of flat-panel display for TVs and computer monitors. Researchers in the US have cracked a key problem; how to grow orderly arrays of carbon nanotubes on glass.

Nanotubes—the cylindrical version of the buckyball, or fullerene—are good electron emitters. A flat array of them could replace the bulky cathode ray tube in a TV. Instead of a single electron beam scanning the whole screen, electrons would be fired from the end of each tiny tube. Unlike today's flat-panel displays, which are all based on liquid crystal technology, nanotubes promise a brighter picture that can be viewed from a broader range of angles.

However, because nanotubes emit electrons only from their ends, rather than their sides, they must be aligned perpendicularly to the TV screen. Previous attempts at growing well-aligned nanotubes on glass worked at only temperatures high enough to damage the glass, but researchers at the State University of New York at Buffalo have now succeeded in growing well-aligned tubes at lower temperatures. In their method, the surface of the glass is coated with a thin layer of nickel.

Acetylene and ammonia gases are then introduced into a low pressure chamber containing the glass. Heat breaks the acetylene gas down into carbon and hydrogen, while the nickel and ammonia act as catalysts for the formation of nanotubes on the glass.

Using this approach, the researchers were able to obtain nanotubes between 0.1 and 50 micrometres long, and from 20 to 400 nanometres wide. Those nanotubes with diameters above 50 nanometres were well aligned. The next step will be to work out the optimum nanotube size and density for efficient electron emission. (Source: *New Scientist*, 14 November 1998)

Compact laser with 100 tera-watts peak power

The Japan Atomic Energy Research Institute (JAERI) has announced that it has succeeded in developing a compact titanium-sapphire laser which can generate an ultra-high peak power of 100 tera-watts (tera= 10^{12}) in an ultra-short pulse duration of 19 femto-seconds (femto= 10^{-15}) with a repetition rate of 10 pulses per second.

This is the first time that a small laboratory-size laser system has achieved the generation of 100 tera-watts peak power. Moreover, its repetitive operation of 10 Hz, which is also a first for 100 tera-watts peak power, will be a great advantage in various applications.

In March 1997, JAERI had succeeded in repetitive generation of laser light with 10 tera-watts peak power in 16 femto-seconds pulse duration by applying a special pulse-amplifying method called CPA to a titanium-sapphire laser system. The present achievement was

obtained by comprehensively promoting the development of such technical elements as: (1) a powerful and high-quality pump laser for the amplifier; (2) a technique to control the non-uniform intensity distribution of the laser beam; (3) a high efficiency amplification technique; and (4) a pulse compressor.

Since ultra-short pulse ultra-high peak power lasers are expected to miniaturize the X-ray laser which is called "the ultimate light source", and giant particle accelerators, many countries have been promoting the research and development of such systems. With present success, JAERI will further promote the R&D of ultra-high peak power ultra-short pulse laser technology towards the generation of 1 peta-watt (peta-watt= $1,000$ tera-watts) peak power. (For further information contact Laser System Development Group, Advanced Photon Research Center, Kansai Research Establishment, JAERI. Tel.: 029-282-5238.) (Source: *STA Today*, August 1998)

IBM first with copper chips

IBM has shipped the industry's first copper interconnect chips with a pair of fast PowerPC microprocessors.

The copper-based 740 and 750 PowerPC microprocessors, running at 400 MHz, are likely to be used by Apple Computer in a future line of Power Macintosh systems. IBM also said that copper-based chips will be included in a range of server families, and will be aimed at embedded systems markets. (Source: *Electronics Weekly*, 9 September 1998)

SQUIDS know what you are thinking

Thinking causes electric currents to pulse through some of the 100 billion or so neurons in the brain. These currents generate tiny magnetic fields. Superconducting quantum interference devices can detect such miniscule fields. Researchers at Los Alamos National Laboratories, Albuquerque, NM, have developed a new version of the sensor that will revolutionize magnetoencephalography (MEG) systems.

A MEG records brain activity using a special helmet fitted with several SQUIDS (superconductive quantum interference device). Data from the sensors goes to a computer which calculates locations and duration of the magnetic fields. A topographic map of the activity is then superimposed on an MRI display. The result is a three-dimensional snapshot of a thinking brain.

Conventional whole-head MEG systems are expensive, about \$3 million. A large part of the cost is for a special room to shield the SQUIDS. Without it, stray magnetic fields emanating from building wiring and lighting play havoc with the ultrasensitive sensors. The recent discovery at the laboratory could eliminate the fancy room and lower the cost of a MEG to less than \$500,000.

The development making this possible is a unique superconducting material chemically similar to that used for some kitchen counter tops. Fashioned from the material is a combination shield and helmet. It both repels interfering magnetic fields and acts as a substrate for the SQUIDS. Borrowing photolithography techniques from

IC manufacturing, SQUIDS are etched into the helmet interior. With this method, more of the conductive loop sensors fit into a limited space. More sensors allow for shorter scan times and provide more detailed information.

The system is expected to help physicians assess patients with brain injuries and diseases. It may also help solve the mystery of how the brain works. Ready for human subjects, it will eventually undergo clinical trials at the Albuquerque Veterans Administration Center. (For more information, call Jim Danneskiold, (505) 667-1640; e-mail: slinger@lanl.gov.

High-temperature superconducting SQUID microscope for measuring weak magnetic fields

Associate Professor Saburo Tanaka of Toyohashi University of Technology has developed a high-temperature superconducting quantum interference device (SQUID) microscope designed for application in biotechnology measurements and non-destructive evaluations. This microscope was developed by applying the technology established through a joint research project at the Physics Department of the University of California, Berkeley.

The SQUID is an element that utilizes its superconducting characteristics to convert magnetic field changes into voltage changes, and can detect weak magnetic fields weaker than one 100 millionth part of the Earth's magnetic field. Potential applications include medical treatment diagnosis for detecting the ultra-weak magnetic fields generated by the brain or heart, and for the maintenance and inspection of aircraft and nuclear power facilities which demand measurement reliabilities and accuracies of the highest levels.

The new microscope uses liquid nitrogen (boiling point 77 K), so it can be handled with ease, and suppresses the infiltration of heat into the heat insulating container, and can be used continuously for over 17 hours with only 900 ml of liquefied nitrogen. The SQUID sensor element is a device manufactured by Sumitomo Electric Industries, Ltd.

The microscope consists of a cylindrical vacuum heat insulating container with a diameter of 25 cm and height of 30 cm, and a battery-driven electronic circuit. When conducting measurements, it is accommodated in a magnetically shielded box to eliminate extraneous noises generated by terrestrial magnetism. Using this microscope enables non-contact, room-temperature measurements of weak magnetic information relating to various specimens. Previously, high-temperature superconducting SQUID systems were developed for measuring biological magnetism such as cardiac magnetic fields, but with most of these systems the sensor and the target measurement specimen are spaced several millimetres apart. The new microscope uses a high-strength sapphire at the window part separating the sensor and specimen inside the vacuum insulating container, by which the distance has been narrowed down to about 150 μm , which improves the microscope relative sensitivity tenfold. This is the first time such a high-temperature superconducting SQUID microscope has been developed in Japan.

The microscope has a wide range of applications, and the research laboratory has already started applying it to biotechnology research, non-destructive investigations and basic physical research. In future, by improving the resolution, it will become applicable to analysing the information relating to genes marked with infinitely small metal fragments. The new microscope will also be used in research on "vortex electronics" included in the Ministry of Education domain of special research. Further information from: Toyohashi University of Technology, 1-1, Hibarigaoka, Tenpaku-cho, Toyohashi City, Aichi Pref. 441-8580. Tel.: +81-532-44-6916; Fax: +81-532-44-6929; e-mail: tanakas@eco.tut.ac.jp. (Source: *JETRO*, November 1998)

Next generation all solid-state and ArF excimer lasers for steppers

Ushio Inc. has developed a 193 nm light source argon fluoride (ArF) excimer laser as well as an all solid-state laser for use in state-of-the-art steppers (used in semiconductor lithography). The ArF excimer laser is a next-generation product designed to supersede the 248-nm light source wavelength krypton fluoride (KrF) excimer laser that has recently gained wide application as a component within steppers. The KrF excimer laser is suitable for use in the manufacture of semiconductor DRAMs at the megabit (10^6) level of integrated circuit widths of approximately 0.25 μm ($\mu\text{m}/10^6$), but the ArF excimer laser and our all solid-state laser have a range of over one gigabit (10^9) and can be used for circuit widths of less than 0.15 μm .

The 193 nm ArF excimer laser was developed with optimal reliability and low maintenance costs in mind. As a result of an extensive research and development programme, Ushio has achieved extended gas lifetime. High performance optical materials, a unique surface treatment and characterization (analysis) technology have been employed to prevent the release of impure gases into the discharge chamber. Extended pulse width and high pulse stability have been achieved by adopting the company's excimer lamp technology for the pre-ionization process.

The realization of all solid-state lasers for steppers has been keenly anticipated within the semiconductor lithography field because this technology offers advantages in terms of price, running costs, maintenance required and compactness, compared with excimer lasers. The application of high-quality non-linear crystals (CLBO) allows high-power UV generation. Ushio has attained a world record for deep UV output power generated by a solid-state laser below 200 nm. The application of fundamental lasers pumped by laser diodes jointly developed with a specialist manufacturer in the United States can drive non-linear crystals and other tunable lasers. The extremely narrow spectral line width means that this system is suitable for application with high NA steppers and makes higher performance steppers possible. A high repetition rate with the same output power means smaller energy per pulse or smaller peak power, which extends the lifetime of the optical

components for both the laser and the stepper. Further details from: Ushio Inc., 2-6-1, Ohtemachi, Chiyoda-ku, Tokyo 100-0004. Tel.: +81-3-3242-1839; Fax: +81-3-3245-0589. (Source *JETRO*, November 1998)

Compact solid-state laser of high output

Oyokoden Lab. Co., Ltd. has developed a compact micro rod laser system that continuously oscillates a light beam in the wavelength band of 1.5 μm , which is used in the fields of optical communications, at a high output of over 50 mW. The laser system is the result of research conducted by Prof. Takao Kobayashi of the Faculty of Engineering, Fukui University. Whereas solid-state lasers are normally incapable of providing a high output, the new laser system features a compact design and a high output.

Optical communications and optical measurements use the laser system that oscillates light beams with a wavelength of 1.5 μm that is comparatively safe for the eyes and involves low loss in optical fibre systems. The laser systems for this wavelength band are either the semiconductor laser system or the erbium-glass laser (solid-state laser) system, but the former intrinsically has a low output. The latter uses glass of low heat conductivity, so is associated with the generation of high temperature and the disadvantage that a high output cannot be obtained.

The newly developed micro rod laser system has been made more adaptive to heat radiation by fabricating in the shape of a micro rod or microchip. This micro rod is connected to a good heat conductor such as a metal or sapphire to enable use for temperature control. By exciting with a semiconductor laser, it will be possible to produce a compact solid-state laser system generating a high output with stability. The cooling mechanism uses a Peltier effect element that performs cooling electronically.

The new micro rod laser system is observed to be applicable as a light source of optical communications circuit inspection, light source for functional evaluation and as a light source for laser radar system measurements. Further information from: Oyokoden Lab. Co., Ltd. 3-1-23, Niizominami, Toda City, Saitama Pref. 335-0026. Tel.: +81-48-445-6911; Fax: +81-48-445-6901. (Source: *JETRO*, November 1998)

Cutting molecules down to size

Using lasers to carve complex molecules into new and useful chemicals is a step closer following the invention of a computer-controlled laser system that can teach itself to break specific chemical bonds.

Ever since lasers were invented in the early 1960s, researchers have hoped to use them to control chemical reactions. Because they can be finely tuned, lasers can in theory be used to break particular bonds within molecules. By matching the frequency of the laser light to the characteristic vibrational frequency of a chemical bond, the laser can pump energy into the bond until it shatters.

But putting this simple idea into practice has proved difficult. In usefully large molecules, the precision of the

laser's pulse is lost because its energy rapidly diffuses throughout the molecule.

Now Gustav Gerber and colleagues at the University of Würzburg in Germany have developed a system that uses artificial intelligence to solve the problem. It uses a computer-controlled laser to fire an ultra-short pulse at the target molecule, and then analyses the resulting molecular fragments. The system initially knows nothing of the target's finer details so first attempts are crude, but the computer can learn from its mistakes.

A mass spectrometer analyses the fragments of the molecule, and the results are returned to the controlling computer. The data are run through what the team describes as "an evolutionary self-learning algorithm", which tunes the laser pulse to improve results in the next run. Successive runs thus become more and more accurately controlled.

The team used their system to produce two distinct bond-cleaving reactions in a complex organometallic molecule. Precise control of fragmentation reactions could open up new applications, Gerber says. The experiments represent a step toward synthesizing chemical substances with higher efficiencies while reducing unwanted by-products, he adds. (Source: *Chemistry & Industry*, 2 November 1998)

Web access on a chip

Toshiba launched its first Internet tuner chips in Autumn 1998. These deliver Internet functionality for any electronics product. The so-called Internet tuner ICs are based on a core from Santa Clara start-up iReady Corporation.

Seiko is to use the same iReady core in a range of miniature LCDs, with 240 by 160 or 320 by 240 pixels, which will have Internet tuners built into the display.

The iReady core gives any product the ability to surf the Web, receive e-mail instructions or deliver faxes over the Internet. One benefit of the system is that there are some household appliances which would benefit from being capable of remote operation.

The iReady core is implemented in 120,000 logic gates which cost \$6. This means that Internet capability can be added to a product for a cost of \$10 compared to the \$40+ solutions offered by a microprocessor, operating system and applications software.

iReady has raised \$8.5 million in two rounds of venture capital funding and is now looking for a third round from corporate investors. (Source: *Electronics World*, December 1998)

US firm claims "fastest" media processing DSP

Equator Technologies has detailed its MAP1000 media processor aimed at digital TV and image processing.

The US firm claims the device is the fastest DSP yet designed, capable of executing over three billion multiple accumulate operations a second.

The MAP1000 is aimed at image-processing applications such as medical scanners, set-top boxes, high definition digital TV and MPEG encoding/decoding.

Rather than implementing algorithms such as MPEG decoders and 3-D geometry calculations in hard-wired silicon, Equator will run them on a processor.

As algorithms change, the same hardware can be used reducing hardware costs in the long term.

The core of the MAP device is a very long instruction word (VLIW) processor running at 200 MHz. This can issue four instructions per cycle and process 3.2 billion 16-bit MAC operations/s.

A compiler has been developed to allow applications to be written in C, rather than assembler.

Hitachi is expected to use the Equator processor for digital TV in the US where 18 different formats must be capable of running on a single TV. (Source: *Electronics Weekly*, 2 December 1998)

Solitons in data record

A world record has been claimed in Sweden for using solitons to transmit data over fibre lines.

Data was successfully transmitted at a single wavelength bit-rate of 40 Gbits/s over 400 km of installed commercial optical fibre lines.

The trial was carried out by a research group from Chalmers University of Technology in Sweden together with Swedish network operator Telia, as the final stage in the European Union ACTS project, MIDAS.

This is the highest capacity field transmission experiment reported at a single wavelength bit-rate beyond 20 Gbits/s. A soliton is a pulse shaped so it does not spread out and lose strength as it is transmitted over long distances.

The system did not use any in-line soliton control and amplifiers were placed at 57 km intervals. The system transmitter used a specially developed mode-locked fibre ring laser and the receiver used an all-optical polarization-insensitive fibre-based demultiplexer.

The researchers believe the aggregate bit-rate can be increased further by using wavelength-division multiplexing. (Source: *Electronics Weekly*, 18 November 1998)

UK group shows video on flat panels

A consortium of UK organizations has produced a video-rate, limited colour display by combining a light-emitting polymer (LEP) backlight with a passive ferroelectric LCD (FLCD) shutter.

The light source for the display is alternate narrow stripes of green and red-emitting LEPs, laid down to make a square.

All the red strips are energized simultaneously followed by all the green strips in a repeating cycle.

By synchronizing the timing of the CRL-supplied ferro-electric LCD, which is a matrix of individually addressable 330 x 330 μm pixels, either green, red, or a combination of the two can be selected per pixel.

The University of Cambridge provided material characterization and failure analysis for the project, while funding was supplied by the Government.

Currently there is no blue in the backlight. The development of a blue LEP has lagged red and green types. (Source: *Electronics Weekly*, 25 November 1998)

Texas Instruments connects up 56k modem with ADSL device

A chip combining the functions of a 56k modem and asymmetric digital subscriber line (ADSL) modem is under development at Texas Instruments (TI).

The hybrid chip will form the heart of a half-size PCI board for consumers. By implementing the algorithms for both 56k and ADSL, users can automatically upgrade to the higher bandwidth system when it becomes available.

ADSL, even in its most basic form, will offer more than 25 times the bandwidth of today's 56 kbit/s modems.

The TI chipset will support ADSL right up to the full 8 Mbit/s downstream bandwidth, over 100 times faster than 56k modems.

Even when ADSL is installed, the 56k modem will not be wasted, as it is required to send faxes, something ADSL cannot do.

TI is basing the chip around its high-end TMS320C6x digital signal processor. (Source: *Electronics Weekly*, 25 November 1998)

Embedded push by ST

Embedded PC applications costing less than \$200 are the claim from STMicroelectronics for its latest PC-on-a-chip, the STPC Industrial.

The device is similar to previously announced STPC chips, but the industrial version adds controllers for TFT panels and a PC card interface.

Combining a Cyrix 586 core, 8 kbyte cache, PCI and ISA buses, and a host of peripheral interfaces, the chip is aimed at applications such as point-of-sale terminals.

The device is software compatible with all existing x86 code and ST's main claim is that it will simplify system development. (Source: *Electronics Weekly*, 21 October 1998)

Third generation Sharc DSP architecture

Analog Devices has unveiled TigerSharc, its third generation Sharc digital signal processor (DSP) architecture that could surpass the performance of Texas Instruments' flagship C67x floating point device.

If the chip reaches its targeted clock speed of 250 MHz, peak processing performance on 16-bit data will be two billion multiply accumulate (MAC) operations a second.

On 32-bit data this drops to 500 million MACs a second, with the device achieving 1.5 giga floating point operation/s overall.

To achieve such performance, the company has taken design cues from Risc and very long instruction word (VLIW) architectures. From Risc, the chip gains a deep pipeline for high speed, while from VLIW it uses instruction parallelism, allowing four instructions to be packed together.

As a DSP it is also adept at real-time operation, having a fast interrupt response.

The core has two computation units which can process either 8, 16 or 32-bit data. Each unit contains a multiplier, adder and shifter.

Future devices, through process shrinks and clock rate increases, will more than double performance, reaching 600 MHz at 0.1 μm .

Analog Devices' 16-bit DSPs are to be used for embedded speech recognition products such as "hands free" kits for in-car mobile phone use. A chipset from the firm includes a DSP and codec. It recognizes speech for control and dialling, and carries out echo cancellation. (Source: *Electronics Weekly*, 21 October 1998)

Thumbs up

Arm has unveiled its most powerful processor core to date, the ARM10 Thumb.

The core fills a gap in the Cambridge-based company's high-end offerings, and is aimed at multimedia products such as third generation mobile phones, set-top boxes and handheld computer devices.

An architectural enhancement introduced with the core is an optional VFP10 vector floating point unit capable of 600 Mflop/s.

Other additions include 64-bit data paths, separate 32 kbyte on-chip instruction and data caches, and a memory management unit.

The ARM10 core, when clocked at 300 MHz, will execute more than 400 million instructions per second (Mips) while consuming 600 mW. Once available, it will be one of the most powerful, yet lowest power, processing cores available. (Source: *Electronics Weekly*, 21 October 1998)

Ball Semiconductor claims world's first spherical chip

US-based Ball Semiconductor claims to have produced the world's first spherical chip.

The company, which is promoting its spherical technology to dramatically cut chip manufacturing costs, has made a 5 μm NMOS inverter circuit on a one millimetre sphere.

"Until now, we have proven such basic technologies as chemical vapour deposition, spherical lithography and etching individually, but the NMOS spherical semiconductor brings these processes together, producing a feasible product", said the CEO of Ball, Akira Ishikawa.

The achievement has encouraged Ball to develop a pilot line to prove the technology can be used for the mass production of chips. The initial focus will be on NMOS followed by the production of CMOS, RF devices and micro-electromechanical systems devices. (Source: *Electronics Weekly*, 14 April 1999)

0 to 1,000A in 200ns

Bolder Technologies of Colorado has re-spun lead acid rechargeable battery technology to produce more instantaneous power weight for weight than any other battery, it claims.

The cells are 9/5 sub-C size, 23 mm in diameter and 70 mm long, and yet they pack a huge punch. "If you make a 12-V battery with six of them", said company spokesman Brian Zonnefeld, "you could start between 15 and 20 V-8 engines on a single charge".

Unlike conventional lead-acid cells, which use a stacked plate construction, Bolder's cells are wound like a capacitor. This is not a new method of constructing lead-acid cells.

The difference, said Zonnefeld, is that Bolder is using very thin electrode materials (0.05 mm) and capacitor-like internal electrode terminations.

These measures are designed to reduce the internal cell resistance to 1.5 m Ω typically, which gives the 2-V cells the ability to deliver bursts of 1.5 kA. "It is possible to completely discharge a cell in under three seconds", said Zonnefeld.

The company has patented the thin electrodes, which it calls thin metal film (TMF) technology. It has also patented the method of termination. This involves offsetting the internal foils before winding, which results in one entire edge of each foil being exposed at the roll end—the cathode at one end and the anode at the other. Lead terminals are cast onto the exposed edges.

Low internal impedance, said Zonnefeld, brings fast charge capability. "With a charger, specifically for TMF, the cells can be fully charged in five minutes", he said.

With a cell optimized for high current charge and discharge, Bolder is looking at heavy duty applications. "Engine starting is an obvious one, particularly where light weight is important", said Zonnefeld. "Uninterruptible power supply is another. TMF cells are also very well suited to professional cordless power tools." (Source: *Electronics Weekly*, 4 November 1998)

350-GHz transistor is world's fastest

NTT researchers have developed what is now the world's fastest transistor, operating at 350 GHz. With a 3 ps gate delay, the transistors could be used to create digital circuits for telecommunications networks that could operate in excess of 100 Gb/sec. That is 10 times faster than today's standard.

NTT achieved the new speed record with an indium phosphide (InP) high electron mobility transistor (HEMT). The InP HEMT was lattice-matched to a InP substrate. The 350-GHz cut-off frequency is the highest value achieved by any kind of three-terminal device, according to NTT. If short channel effects are suppressed by reducing the barrier and/or channel thickness, it could be possible to achieve a 400 GHz cut-off frequency.

The transistor was fabricated with a 30-nm gate, the smallest gate yet achieved for InP-based HEMTs, using a fullerene-incorporated nanocomposite electron beam resist. (Reprinted with permission from *Semiconductor International Magazine*, November 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Strictly Decaf

A breakthrough method to replace the corrosive chemicals used to etch circuits on silicon chips is being tested at the Los Alamos National Laboratory in New Mexico. Carbon dioxide (CO₂) is heated to about 31 °C and subjected to intense pressure, turning it into supercritical CO₂—a substance that behaves like both a gas and a liquid. These dual properties mean it can rapidly

fill any container right down to the smallest pore. But because it also behaves like a liquid, other chemicals can be dissolved in it. The Los Alamos technique mixes the supercritical CO₂ with a small percentage of an environmentally safe benign solvent, propylene carbonate. The mixture can then be used to strip photoresist chip coating (a process used to remove the unwanted material) twice as fast as organic solvents or acids, without the danger of a toxic spill or environmental seepage. (Source: *Communications of the ACM*, Vol. 41, No. 11, October 1998)

Chunky chip

Bull and STMicroelectronics have developed a logic IC for mainframe computers that they claim is one of the world's most complex chips. The 7-million transistor chip has resulted from a EU-sponsored project within the MEDEA programme. The chip is manufactured at ST's site in Crolles, France using a 0.25 µm process. (Source: *Electronics Weekly*, 16 December 1998)

Commodity HPC

Several academic and commercial organizations in Switzerland are developing a series of parallel supercomputers based on commodity components. Called SwissTx, the series will comprise four machines: two eight-processor prototypes, Swiss T0 and Swiss T1', one 128-processor prototype, the Swiss T1'', and a 1Tflops production machine, the Swiss T2, to be complete for the end of the millennium.

All machines will be based on standard, mass-produced components, and will use desktop-type software environments. The consortium includes ETH Zurich, the EPFL in Lausanne, and the company Supercomputing Systems Ltd. The plan is to develop affordable, leading-edge systems that are suitable for commercial exploitation. The project is also intended to make Switzerland a leader in high-performance parallel computers, to enable the solution of problems that conventional machines cannot handle, and to develop contacts with major US-based research institutes such as Sandia and Los Alamos National Laboratories. (Source: *Scientific Computing World*, June 1998)

Hardware enables real-time X-ray imaging

A real-time, phase-contrast X-ray imaging system that can produce 20 Mpixel/s has been developed at the European Synchrotron Radiation Facility (ESRF) in France. Developed by Peter Cloetens and colleagues, it will be used to study the time evolution of dynamic systems, such as phase transitions or damage occurring in a stressed material. The system will also be used to quickly acquire very large data sets such as those involved in phase contrast microtomography.

The imaging system uses the Fast Read-Out Low Noise (FRELON) CCD camera developed at ESRF. The FRELON camera has a 1,024 x 1,024 pixel area with a 14-bit dynamic range. The fast read-out is facilitated by a workstation and VME-based data acquisition system that

uses the VCCD3 data read-out card also developed at ESRF.

Although the custom-built and very expensive VCCD3 card has been crucial to the success of the project, work is already under way to replace it with a cheaper option. ESRF researchers are currently developing a system based on the commercially available SDV image acquisition card that may be connected directly into a workstation using PCI or S-Bus technology. (Source: *Scientific Computing World*, June 1998)

Breaking the parallel barrier

The performance of shared-memory parallel code can be dependent upon barrier implementation, says a computer scientist in the USA. A barrier is an operation that synchronizes two or more processes or threads in a parallel computation. Rick Kuftrin of the National Center for Supercomputing Applications (NCSA) has reported that two-barrier mechanisms regularly used on a SGI Origin 2000 were responsible for a decrease in efficiency as the number of processors increased.

In a 64-processor configuration Kuftrin measured a 100 times difference in execution time between the fastest and slowest barriers. He claims his research "may explain why an otherwise optimized application is not performing as well as the researcher expects it to". See "<http://www.ncsa.uiuc.edu/~rkuftrin/projects/CompSci/Barriers>". (Source: *Scientific Computing World*, June 1998)

Data storage record broken

Scientists at IBM's Almaden Research Centre in the USA have built a hard disk drive that they claim has the highest storage density ever—11.6 Gbits per square inch. This was achieved through the use of a giant magnetoresistive (GMR) read head, and a narrow thin-film inductive write head. A low-noise cobalt alloy magnetic medium and improved electronics were also used, and the distance between the heads and the disk surface was just 10 nm.

The storage density is more than double the previous record, set by IBM in 1997. The company says that desktop hard drives at this density could hold 72 Gbyte data, or 4.5 times the current capacity. Some of the technologies developed in the project will appear in IBM products in 1998, and hard drives with the new density will be available for mobile computers within three years. IBM claims that increased data storage capacity will also result in new disk drive technologies such as tiny disk drives that will plug into flash memory sockets. (Source: *Scientific Computing World*, June 1998)

VR laboratory shows 3-D science

Scientists and engineers will be able to experience their simulations in 3-D virtual reality in the recently opened Virtual Environments Laboratory (VELab) at the High Performance Computing Centre (HLRS) in Stuttgart, Germany.

The VELab comprises a room called the CUBE, consisting of three back-projection walls and a floor

projection, for the stereoscopic display of computer-generated content. Signals come from an SGI Onyx2 with 14 R10000 processors, 4 Gbyte memory and more than 100 Mbyte/s disk access rate. This is connected to the HLRS infrastructure (an NEC SX4 cluster with 36 processors, a Cray T3E with 512 processors and other machines) by means of a 155 Mbit/s ATM line.

The visualizations are performed with the aid of the COVISE software written by HLRS researchers. "COVISE is special because it allows control of remote processes from within a virtual environment", said Dr. Ulrich Lang, head of the HLRS. "It generates the content, allows interaction and links to other systems. It also enables representation of virtual prototypes not only by 3-D shape, but also by properties and behaviour", he added.

The result is that supercomputer simulations can be watched by several people at the same time from within the virtual environment. Those taking part wear stereoscopic glasses, and one of them is actively tracked, so that head and hand positions are registered in order to present an appropriate view. This participant can also move a coloured cutting plane through the view or insert tracer particles into a simulated flow field, for example.

The facility will be used for applications within astrophysics, medicine, fluid flow and city planning.

One astrophysics application involves the simulation of accretion disk formation using smooth particle hydrodynamics, for which the visualization uses a direct volume rendering technique based on the shear-warp algorithm. Another is the simulation of relativistically bent space. So far, explained astrophysicist Dr. Daniel Weiskopf of Tübingen University, Germany, such simulations have focused on special relativistic models. Real-time visualizations based on a relativistic polygon rendering approach have been made possible for the first time, although so far only a single-wall view has been achieved. (Source: *Scientific Computing World*, June 1998)

Simulations study polymer rheology

Finnish and US scientists are using molecular simulation to predict the fluid properties of synthetic molecules that could be used as replacements for petrochemical materials.

Maija Lahtela-Kakkonen of the Center for Scientific Computing in Helsinki, and Tapani Pakanen of the University of Joensuu together with Prof. Richard Rowley at Brigham Young University in the USA are employing non-equilibrium molecular dynamics (NEMD) to obtain information about transport coefficients for branched alkanes.

Previously, simulation techniques had been established only for linear alkanes. In order to cope with branched molecules the researchers have had to explore the effects of inter- and intramolecular potential models on the simulated viscosities in order to find an accurate technique for viscosity simulations.

A number of models were tried; the one that gave best agreement with experiment was the all-atom (AA)

model. However, as some of the molecules have more than 10 carbon atoms, this method is very computationally intensive.

The calculations have been performed on Digital Alpha 400, SGI R10000 and SGI Cray 90 machines. (Source: *Scientific Computing World*, July 1998)

Chips simulate gravity

Computational astrophysicists are using custom-built computer chips to perform gravitational simulations. Designed by researchers at Japan's University of Tokyo, the Gravity Pipe (GRAPE) chips contain circuits that have been configured to perform the simple arithmetic operations required to model Newton's force law. When used in conjunction with a workstation, the GRAPE chips can outperform a supercomputer.

Force law calculations are computationally intensive because they must be repeated many times. Performing the calculation on a dedicated chip increases the execution rate of the simulation by 10 times and allows researchers to concentrate on modelling the more complicated aspects of the problem on a workstation. (Source: *Scientific Computing World*, November 1998)

Nanocomputing with defects

A massively parallel experimental computer built at Hewlett-Packard Laboratories in California, USA, could offer a way of creating practical chemical computers. The Teramac machine has been made from factory-reject processors and contains up to 220,000 hardware defects, any one of which could prove fatal to a conventional computer. It has been designed, however, with a defect-tolerant architecture. Despite the flaws, it operated 100 times faster than a high-end single-processor workstation for some of its configurations.

The Teramac machine is described as a custom configurable computer (CCC); the main feature of its architecture is a high communication bandwidth that enables easy routing around defects. This has significant implications for nanocomputing. Smaller computer circuits can theoretically be built by means of chemical reactions, but the cost is imperfections. The Teramac, claim its creators, could point the way to accommodating these defects. (Source: *Scientific Computing World*, July 1998)

Wavelets under the spotlight

The applicability of wavelets as tools for numerical simulation and scientific computing is under scrutiny by a team of researchers across Europe. New techniques for the numerical simulation of partial differential and integral equations based on the use of multi-scale decomposition and wavelet bases have been proposed as a result of these studies.

The researchers hope the outcome will be a fully developed methodology that will advance the frontiers of numerical simulation and allow the design of efficient algorithms that should combine high accuracy with low computational cost.

The work is based on the idea that the space-frequency localization properties of wavelet bases can be

exploited to provide tools that are applicable to complex real-life problems in scientific computing.

This work will be followed up by an EC Training, Mobility and Research Network called "Wavelets and Multiscale Methods in Numerical Analysis and Simulation". (Source: *Scientific Computing World*, July 1998)

Combination lock to keep hackers out

The world's smallest combination lock could reduce computer crime. Researchers at the USA's Sandia National Laboratories have developed a mechanical device that they claim will keep hackers out of computer systems. The mechanism is so small that it can only be seen with a microscope.

The Recodeable Locking Device consists of a series of notched gears that only move to the unlocked position when the correct code is entered. A potential hacker has only one chance in a million of doing this. If the wrong code is entered the device "locks up" and can only be reset by the owner. Unlike traditional software-based security systems, the mechanical lock is not prone to manipulation by hackers.

The device has six code wheels, each less than 300 μm in diameter. The wheels are propelled by electrostatic comb drives that turn impulses into mechanical motion. The lock is built on a silicon chip using fully integrated circuit fabrication techniques. The entire lock measures about 9.4 mm by 4.7 mm and hundreds of them can be made on a single silicon wafer.

A patent for the lock has been filed, and the device is expected to be marketed in 2000. (Source: *Scientific Computing World*, November 1998)

Sound generator chip with software modem function

Yamaha Corporation has started distributing samples of a sound generator chip YMF738 with built-in software modem functions which enables communications control with software with a special-purpose card. Up till now, the company has been developing and manufacturing sound generator chips, but the demand for chips integrating sound and communications functions is increasing due to the popularity of the Internet system. In March 1998, the company developed the sound generator chip with soft modem functions based on its relationships with PC-Tel Corp. and Intel Corp. of the United States.

YMF738 is designed with the functions of supporting central processing unit (CPU) data processing by enabling smooth operation of the PC-Tel software modem (modem driver) and Intel Audio Modem Riser Card (a type of modem card specification). Generators are based on the specifications of the sound generator chip YMF724 and a memory function has been newly added to accumulate modem data. (Further information from: Yamaha Corporation, Semiconductor Division, 203, Matsunokijima, Toyooka-mura, Iwata-gun, Shizuoka Pref. 438-0192. Tel.: +81-539-62-4918; Fax: +81-539-62-5054. (Source: *JETRO*, December 1998)

First working transistor on spherical surface

BALL Semiconductor Inc. (Allen, Texas) has fabricated a working transistor on the surface of a 1-mm silicon sphere. This is the first time that a transistor has been built on a spherical surface. Using a combination of traditional and unique processes, BALL was able to produce a 5- μm NMOS transistor whose electrical characteristics equalled those of a traditional wafer transistor.

Required processes for fabricating the spherically-placed NMOS transistor include mask data generation and fabrication using the 5- μm design rule, atmospheric Chemical Vapour Deposition (CVD), high-temperature oxidation at 1,250 °C, spherical resist-coating process, spherical lithography, etching and probe-testing of the transistor. Processes created by BALL include the spherical lithography process, which allows the company to align and expose six individual masks on the sphere, the resist-coating process, which requires the sphere to not only drop down an 8-m tube through a "soap bubble" of coating material but to also dry within 1 second, and the atmospheric CVD process. BALL is working to produce an electrically functioning IC on the 1-mm sphere, inductance on the sphere and a pilot manufacturing line. BALL hopes to reduce the cost of semiconductor manufacturing by up to 90 per cent through use of hermetically sealed tubes in place of clean rooms and by reducing processing time to days vs. months. (Reprinted with permission from *Semiconductor International Magazine*, December 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Realization of coherent coupling in semiconductor quantum dot molecule

NTT Basic Research Laboratories and the Institute of Physical and Chemical Research (RIKEN), in collaboration with Delft University of Technology in the Netherlands, have succeeded in producing an artificial quantum dot molecule in semiconductor devices.

This is a man-made molecule, where two atoms share one electron. A coherent coupling (a "super-position" state, or "covalent bond") has been realized in the artificial molecule, making it possible to construct the "qubit" (quantum bit), an essential component of the quantum computer.

The artificial molecule was produced by confining the electron in a small area of several tens of nanometres in a two-dimensional electron gas accumulated at the interface between Gallium Arsenide (GaAs) and Aluminium Gallium Arsenide (AlGaAs). Using the microwave spectroscopy technique, the superposition state (covalent bond) has been successfully confirmed experimentally for the first time at low temperatures of 50 mK.

The production of controllable quantum coherence in single electron devices means that the realization of the quantum computer with solid state devices might not be merely a dream. The success of this research acts as an impetus for future studies. (For further information, contact the Physical Science Research Laboratory, NTT Basic Research Laboratories, Tel.: 0462-40-3449/the

Semiconductors Laboratory, RIKEN, Tel.: 048-462-1111, Ext. 3364 (Source: *STA Today*, December 1998)

Experimental demonstration of quantized electronic conduction

In the "Takayanagi Particle Surface Project" being conducted in the "Exploratory Research for Advanced Technology" (ERATO) programme of the Japan Science and Technology Corporation (JST), JST succeeded for the first time in the world in producing a single atomic chain of four gold atoms standing in line in a chain-shape and measuring current by applying voltage to the chain. It was confirmed in this research that the electronic conduction of an atomic chain has a certain value peculiar to the substance and shows a universal value which does not vary depending on the kind of substance.

In this research, gold was elongated by putting its surface into contact with the gold tip of a scanning

tunnel microscope, an atomic chain of gold having a length of 1 nanometre ($1/10^9$ metre) and a thickness of one atom was produced, and while observing the chain with an ultra-high vacuum high-resolution transmission electron microscope, voltage was applied to the chain to measure the current flowing in the atomic chain. Thus, the condition of electronic conduction during the process in which the rows of atoms were decreasing was measured.

A quantized device instead of a semiconductor is expected in the future, but there remain many research problems for its practical use including the necessity of the confirmation of the storage of charge and flow of current. Present research results are attracting a lot of attention as it may accelerate the studies of the quantized device. (For further information, contact the Office of Takayanagi Particle-Surface Project, JST. Tel.: 042-525-1475). (Source: *STA Today*, December 1998)

D. Market Trends And Company News

Market trends

21st century vision

Examination of current trends can reveal likely developments over the next few years. For instance, it seems plausible to suggest that the growth in the popularity of knowledge management systems will exacerbate the already present problem of "information overload"—employees' time will come to be regarded as the most critical resource for many companies. Employers will have to so manage their time as to ensure that a given proportion is devoted to personally productive tasks.

After about 2003, perhaps, we may see a considerable increase in the number of people who work other than in the conventional office, tapping into the information systems they need from the home or the hotel room or the car. Most, however, are likely to be still employing conventional plug-in sockets: the cost of wireless systems is likely to remain at a level which precludes routine use for non-urgent tasks.

By this time, network computing will have replaced the client-server model as the architecture of choice for large organizations. Information access devices will routinely hold a personal profile of the user, or such profiles will be presented to the device on a smart card, so that contact lists and personal preferences follow the user from device to device. Information will be displayed in a format appropriate to the characteristics of the device being used at any given moment. Although speech output will be increasingly common, screens will remain the most popular means of accessing information. By (perhaps) 2007, access to information will be available at any time, in any place, via highly portable—even wearable—systems. (Source: *Information Strategy*, 3(9) November 1998)

It is getting better, say analysts

Latest semiconductor market figures herald a brighter future from next year. But chip manufacturers must do more to reduce oversupply in the memory market.

Dataquest, Future Horizons and IC Insights have all reported an improved outlook for 1999. Europe could even rebound, but Asia's problems will delay any worldwide bounceback until mid-1999.

Dataquest is most optimistic, stating an overall decline of 6 per cent in 1998 will turn into growth of 12 per cent in 1999.

The IC Insight report believes the bottom of the cycle has been reached and echoes Dataquest with a 10 per cent growth forecast in 1999. Year 2000 will be very good, according to Future Horizons.

IC Insight says the average selling price of ICs has increased. It believes DRAM manufacturers are breaking even, rather than losing money.

Future Horizons, the European analyst, believes the opposite, that all DRAM manufacturers are selling below the cost of production.

A few fab closures have done little to affect oversupply, which will continue, says Dataquest, for another 18 months in foundries and two years for DRAM.

Fortunately, the transition to 0.18 μm processing is delayed due to the increased number of defects. This will help demand catch up with supply. (Source: *Electronics Weekly*, 7 October 1998)

Chip sales in August 1998 rise

Worldwide chip sales showed signs of an upturn in August 1998, according to the Semiconductor Industry Association (SIA).

Global chip sales rose by 1.5 per cent in August, the first month-to-month gain in 1998, but were 16 per cent below the same month in 1997. Total sales increased by \$147 million from July to \$9.81 billion in August. The sales increase came despite a large drop in sales in Japan, down 30 per cent from August 1997 figures. (Source: *Electronics Weekly*, 14 October 1998)

Report highlights potential palladium shortage

Palladium supplies are once again forecast to be insufficient to meet demand.

This is the claim of precious metal specialist Johnson Matthey in its just-published 1998 interim review. "Demand for palladium will climb to 8.2 million ounces, exceeding supplies by more than one million ounces", it said.

Palladium is an essential ingredient in certain types of multi-layer ceramic capacitor (MLCC), although shortages of the metal in the last two years have prompted capacitor makers to find alternatives.

Although capacitor makers are reducing their dependence, other electronics sectors are using more, claims Johnson Matthey. "Lower demand from capacitor producers has been partly offset by the wider use of

palladium in the plating of leadframes and connectors”, said the report. (*Electronics Weekly*, 2 December 1998)

European PC sales boost

European PC sales are growing much faster than the global PC market, offering good news for local chip companies.

US market research firm Dataquest said that in the third quarter of 1998 European shipments reached 5.6 million units, a 23 per cent increase over the third quarter of 1997. The global PC market grew just 14 per cent in the third quarter with 22.6 million units shipped. The key driver for Europe is the consumer market which increased 49 per cent compared with the previous year.

“Consumer demand in Europe is still on the upside of the cyclical growth curve”, said Dataquest analyst Chris Jones.

The French consumer PC market grew by 70 per cent in the third quarter. (Source: *Electronics Weekly*, 11 November 1998)

“Three-year decline is over”—SIA

The three-year decline in global chip markets is over, says the Semiconductor Industry Association (SIA), with predictions for strong growth over the next four years.

The troubled memory chip market is predicted to almost double in revenues from 1998 to 2002 and other surging markets include microprocessors and DSP chips.

According to the SIA high growth rates will not materialize until 2000 with 1999 showing moderate growth in chip markets of 9.1 per cent to \$133 billion. In 2000 growth of 15.2 per cent is predicted followed by 18.2 per cent in 2001. (Source: *Electronics Weekly*, 18 November 1998)

Chip equipment market fails to follow chip demand trend

Chip equipment firms hoping to cash in on an upturn in chip demand will have to wait awhile yet. So claims Theodore O’Neill, semiconductor capital equipment analyst at US brokerage Needham & Co.

Although chip demand is up, the chip equipment market is not following the behaviour of previous chip boom and bust cycles, he said.

It was pointed out that the downturn in chip equipment demand has been unusually severe and that, since demand peaked in September 1997, it has fallen 68 per cent in the last year. This level of chip equipment demand has not been seen since 1993 when chip equipment firms were a quarter of their present size.

“It will take four consecutive quarters of 33 per cent growth in orders just to get us back to where we were in September 1997”, O’Neill added. (Source: *Electronics Weekly*, 25 November 1998)

x86 rivals make gains on Intel

Intel’s x86 processor competitors are gaining market share but are failing to penetrate the corporate market, say industry experts.

According to market research firm International Data Corporation, Intel has lost 10 per cent market share at the

low end of the PC market between the first and third quarter of the year.

While Cyrix is targeting consumer PCs, AMD is competing with Intel across all platforms and in all markets. But it still faces a credibility challenge in corporate markets.

AMD- and Cyrix-based PCs are performing well in compatibility tests with standard software applications, eliminating user fears that buying a non-Intel-based PC could cause problems.

“We have not found much in the way of software compatibility problems with non-Intel microprocessors but you do have to consider what types of operating system you want to run. For example, Cyrix chips have not performed well with Windows NT”, said Bill Catchings, director of ZDTag, a large PC testing organization.

Catchings added that he is seeing frequent reboot problems when running Windows 98 on any PC. This is due to compatibility issues within the software applications rather than the underlying hardware, he said. (Source: *Electronics Weekly*, 25 November 1998)

Demand heralds recovery

Increasing demand for semiconductors across the world is prompting forecasters to predict a return to growth in the chip market next year. This follows this year’s steep double digit decline in revenues.

An upbeat prediction comes from Jean-Philippe Dauvin, chairman of the World Semiconductor Trade Statistics organization (WSTS), who expects the semiconductor market to grow by 6.6 per cent next year, to reach a value of \$130.3 billion. (Source: *Electronics Weekly*, 4 November 1998)

Europe surfs in numbers

A third of households in Europe will be logging on to the Internet within five years, claims Datamonitor in its latest survey.

The figure currently stands at 12.5 million homes, the firm says, but this will more than triple to over 40 million by 2003.

Revenue from the Internet generates \$2.2 billion in Europe. With \$519 million and 2 million subscribers the UK is the second biggest earner behind Germany with 4.5 million Net surfers.

The arrival of free Internet services such as Dixons’ Freeserve and Germany.net have upped public interest while forcing companies to lower their prices.

Revenues therefore will not continue to rise in line with subscriber increases, the report says. (Source: *Electronics Weekly*, 9 December 1998)

Boon in biochips

Microchips are already the foundation of the electronics industry, but in 1998 chip technologies left their electronic roots behind and moved decisively into biology and other fields. This year the same miniaturization tools used to make computer chips were used to shrink and speed up everything from DNA sequencing equipment to diagnostics.

While major microelectronics firms entered the biochip business, teaming up with start-up companies to push commercialization, basic researchers forged new chip technologies. For example, this year researchers created a DNA-processing micromachine that may one day be able to sequence DNA. Already this chip, just a few centimetres on a side, can measure out precise amounts of DNA-containing solution, amplify DNA, chop it into small pieces, separate the fragments, and detect their size—all necessary steps in sequencing. Also this year, researchers at a California biotech firm developed a biochip that can screen a blood sample for cancer cells, bacteria, or other cell types and remove their DNA for analysis. Such tools could bring tests now done in the laboratory into the clinic.

Then there are the DNA chips themselves, in which researchers use arrays of immobilized DNA snippets to search out small genetic variations in genes or to detect RNA messages from the genes turned on in cells. Such chips could one day screen for genetic disease. Their foundations may be in electronics, but microchips have a bright biomedical future. (Source: *Science*, Vol. 282, 18 December 1998)

Bioinformatics set to expand

The USA-based market research company Frost and Sullivan claims bioinformatics will be an important part of the drug discovery process of the future, and that rapid expansion in the bioinformatics field will create a huge demand for gene sequence analysis software. These conclusions appear in the report *Bioinformatics in the Emerging Marketplace*.

"Industry experts agree that virtually all major drug-related breakthroughs will be based on knowledge from genetic discoveries", said one of the authors. "This belief creates a tremendous demand for gene sequence and analysis software, because pharmaceutical and biotechnology firms without any software will be at a severe competitive disadvantage."

To be successful in the field of bioinformatics, drug companies will require employees with both microbiology and computer science expertise. This may result in a serious recruitment problem. (Source: *Scientific Computing World*, November 1998)

Technology 1999—analysis and forecast

As at every other time of breakneck technological change, the most conspicuous feature of the current scene is a cascade of contradictions, confrontations and conflicts. Prominent among them is the question whether the Internet, which not long ago seemed just a quirky tool, might emerge as the future basis of long-distance telephony. But the way that plays out, of course, will depend on the evolution of both telephony and the Internet—each a fast-changing system engendering further contradictions, confrontations and conflicts.

In communications, probably the most portentous development worldwide is the ongoing formulation of a third-generation cellular phone system, but in the United States implementation of the 1996 Telecommunications Act is the name of the game. Here the main issue is whether the regional telephone companies will end up

opening their networks to competitors, as urged by the United States Federal Communications Commission, or if new forms of local competition will render that conflict moot.

Meanwhile, the most amazing revelation about the Internet is its ever-greater robustness, as measured by declines in disturbances and latencies. With the introduction of Internet2, it will become even more robust. Internet2 is a high-speed alternative network for research and academic communities, linked by high-speed gigapop networks being constructed to the very high-performance Backbone Network Service (vBNS). Also there are plans for Oxygen and InterPlaNet. The first is a \$14 billion, global optical-fibre undersea network dedicated to Internet use; the second is the Jet Propulsion Laboratory's scheme for Internet communications with future manned and unmanned space missions.

With ever more complex software requiring ever faster microprocessors, Intel Corp. is facing more competition from companies like Advanced Micro Devices, Cyrix, and even IBM. At the enterprise level, client/server systems may be phased out in favour of computing systems that are Internet-based and more widely distributed, with Java at the root of it all. The digital versatile disk (DVD), developed with consumers in mind, is metamorphosing into an irresistible alternative to magnetic disks for computer data storage.

In Solid State, the coming year will witness the first sampling of 0.18- μ m minimum-feature technologies, as the semiconductor industry has been predicting. In advance of even the industry's Roadmap projections, engineers are extracting still more performance from ICs by using new materials and methods, notably silicon-germanium, copper interconnects, silicon-on-insulator wafers, and insulators with low dielectric constants. As processes involving those materials and methods advance, they will be found more often on the same chip. Joining them soon on communications ICs will be micro-machined filters, capacitors and switches.

The focus of electronic design automation companies in 1999 will be to assist the birth of the system on a chip.

In electric power, the need for new generating sources came into focus, partly as a result of the December 1997 Kyoto agreement on climate change and partly due to weather-induced irregularities in US electricity markets. As usual, gas-turbine technology was the main immediate beneficiary and not nuclear. Indeed, the newly elected socialist-green Government in Germany has confirmed its commitment to phase out nuclear power entirely. A positive development is that photovoltaics is on the verge of becoming big business and quitting its niche status.

In power electronics, the introduction by ABB Industrial Systems Inc. of the integrated gate-commutated thyristor (or IGCT, not to be confused with the IGBT) is a significant advance for motor regulation. Java technology is allowing manufacturers to break the restrictive barriers of proprietary systems and test real-time factory automation over the Internet, involving text, numerical data, and graphics. Industrial robots continue to make

inroads, especially in the United States, and are beginning to penetrate the service industry. Assistive robots, despite their cost, could begin to serve disabled and handicapped individuals.

For better or worse, robots or automata not only can help impaired people, but can also help impair people. With electronics providing the basis for the most sophisticated "stand-off" weapons to date, the US Defense Advanced Research Projects Agency has issued calls for everything from teleoperated attack jets to butterfly-sized reconnaissance aircraft.

Lest the next century become known as one in which wars were fought with 22nd century technology but 20th century medicine, impressive progress also is being registered in *Medical Electronics*. The tens of millions suffering from osteoarthritis could be aided in the early 2000s by an optical coherence tomography technique originally developed to image the transparent tissue of the eye. Several new techniques can help a variety of eye conditions requiring reshaping of the cornea.

How products such as TV sets, computers and large home appliances are handled at the end of their lives will be much affected by legislation taking effect in Japan this year and by regulations being formulated by the European Union. In addition, industry is buckling down to the challenge of reducing the amount of perfluoro-compounds used for plasma etching and cleaning chemical reactor chambers. (Source: *IEEE Spectrum*, January 1999)

Positive growth for flash market

Cahners In-Stat Group expects the flash market to grow at a compound annual growth rate of slightly more than 20 per cent over the next five years.

While aggregate (total dollars divided by total units) ASP and ASP by density is expected to drop significantly again in 1998, it is anticipated that AASP recovery will start mid to late 1999 but will lack the vigour to show an increase for the year. The first year to achieve an increase in AASP since 1995 is not expected to occur until 2000.

The flash market growth, in dollars, was fuelled by an increase of more than 58 per cent in unit shipments, as aggregate and individual ASP took a beating. According to Cahners In-Stat, the flash market is experiencing tremendous pricing pressures. (Extracted with permission from *Semiconductor International Magazine*, November 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Company news

Companies agree on mixed memory packaging

Fujitsu Ltd., NEC Corp. and Toshiba Corp. (Tokyo, Japan) have agreed on specifications for a stacked multi-chip package (MCP) for stacking NOR Flash and SRAM memory chips in a single package. While each company will manufacture and market its own chips, common specifications are expected to promote stacked MCP market penetration and allow companies to act as secondary sources for each other.

The specification is for a 56-ball BGA, with an 8x8 configuration of balls on a 0.8-mm pitch. It will support

various combinations of Flash from 4 to 128 Mb and SRAM from 1 to 128 Mb. It allows switching between 8- and 16-bit output for each chip. Key to the design is pin compatibility between the SRAM and Flash chips to allow stacking with minimal wiring. This stacked design also provides compatibility with future generations of high-density Flash memory.

Seiko Epson Corp. (Nagano, Japan), Hyundai Electronics Industries Co., Ltd. (Inchon, Republic of Korea) and Samsung Electronics Co., Ltd. (Seoul, Republic of Korea) also have endorsed the specification. Fujitsu and Toshiba introduced a BGA-type MCP in April 1997, with the chips mounted side by side. The mobile equipment market is driving demand for both kinds of memory, and the stacked arrangement is expected to reduce space dramatically. (Extracted with permission from *Semiconductor International Magazine*, November 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

IBM ships its first copper chips

With the shipment of its first copper-based microprocessors, IBM Corp. also announced several related initiatives including the availability of the fastest embedded processor on the market, a 400-MHz embedded PowerPC chip. IBM expects the result to be "an explosive 50 per cent growth rate in embedded PowerPC applications", says Ron Tessitore, director of microcontroller development at IBM Microelectronics. The technology is also scheduled for the S/390, RS/6000, and AS/400 server families. IBM also says it will build copper chips for other companies through its standard foundry services. Copper increases performance of the PowerPC 750 chip from 300 MHz to 400 MHz. For more information: www.chips.ibm.com. (Source: *Industry Week*, 21 September 1998)

Toshiba adds drop-in Web access with tuner chips

Toshiba has launched its first Internet tuner chips which deliver drop-in Internet functionality for any electronics product. The Internet tuner ICs are based on a core from Santa Clara start-up iReady Corporation.

Seiko is to use the same iReady core in a range of miniature LCDs (240x160 and 320x240 pixels) which will have Internet tuners built into the display.

The iReady core gives any product the ability to surf the Web, receive e-mail instructions or deliver faxes over the Internet. One benefit of the system is that there are some household appliances which would benefit from being capable of remote operation.

The iReady core is implemented in 120,000 logic gates which cost \$6. This means that Internet capability can be added to a product for a cost of \$10 compared to the \$40+ solutions offered by a microprocessor, operating system and applications software.

iReady has raised \$8.5 million in two rounds of venture capital funding and is now looking for a third round from corporate investors. (Source: *Electronics Weekly*, 14 October 1998)

Intel lists plans for chip rule

Intel has detailed processors in its existing 32-bit Pentium-II line and its high end 64-bit (IA-64) family.

By the end of 2000, a 32-bit chip called Foster will be clocked at 1 GHz, said Fred Pollack, director of Intel's microprocessor products group.

Dynamic execution, large on-chip caches and a bus bandwidth of 3.2 Gbyte/s will enable Foster to compete with Merced, the first IA-64 chip, on existing applications.

Moreover, the Foster chip will use a new seventh generation microarchitecture, showing that Intel intends to continue with 32-bit devices in parallel with the IA-64 devices for some time.

Merced and McKinley, the first IA-64 chips, will strengthen the Achilles' heel of Intel devices—floating point performance. While Intel's recent chips compare well with Risc processors on integer benchmarks, floating point leaves much to be desired.

Floating point and vector performance will be "compelling", said Pollack.

Like today's Pentium line-up, IA-64 chips will move in several directions. Different versions will target varying levels of performance—with the associated cost trade-offs.

Merced itself is still at the hardware description language verification stage. First samples are due next summer.

The McKinley design team is rumoured to be not far behind, and promises twice the performance of Merced. Speculation is rife that Merced will be cancelled. (Source: *Electronics Weekly*, 14 October 1998)

Sun rethinks Java to focus on Asics

Sun Microsystems has finally received first silicon samples of its microJava processor but says it has changed its Java chip strategy to focus on Asic designs.

"We intended to produce standard Java chips but this is increasingly a semi-custom chip market so we are now talking with partners about how to integrate picoJava cores with other products", said Harlan McGann, head of the architectural and technology group in Sun's Microelectronics division. The picoJava core forms the basis of the microJava processor.

McGann said that Sun has received first silicon on its microJava 701 chip from LSI Logic, which is based on the picoJava 2 design. It comprises 4 million transistors in a 67 mm² die area, and runs at 100 MHz with a 100-MHz memory bus and a 33-MHz PCI interface.

"Instead of producing the 701 as a mass market device, it will be used by developers to evaluate Java chip performance and for rapid prototyping. It will be available on a board by the second quarter of next year", said McGann. (Source: *Electronics Weekly*, 14 October 1998)

IBM puts SiGe into mobile chips

IBM's CommQuest Technologies venture has announced the first two silicon-germanium (SiGe)-based mobile phone chips.

The company is claiming that the SiGe power amplifier will achieve better than 60 per cent power efficiency,

compared with 50 per cent for today's GaAs and bipolar-based GSM handset power amplifiers.

The two devices will be a tri-band (900, 1,800, 1,900 MHz) low noise amplifier (LNA) and a tri-band power amplifier with integrated voltage controlled oscillator.

IBM acquired CommQuest earlier this year to get the RF design specialist's CASP (communication applications specific processor) mobile phone architecture, which it is combining with its own semiconductor process technology. (Source: *Electronics Weekly*, 23 September 1998)

Ford puts neural networks into cars

Neural network chip technology is moving from the laboratory to commercial applications with Ford licensing key technologies from NASA's Jet Propulsion Laboratory (JPL).

Ford has signed a licensing agreement to use JPL's neural chip technology in systems that diagnose misfirings in car engines. The goal is to develop a neural network-based chip that prevents engine misfiring, leading to lower levels of polluting emissions.

The alliance between the two organizations marries JPL's hardware expertise with Ford's automotive engineering algorithms. Ford is rushing to develop key technologies that will enable its cars to meet the requirements of the strict US clean air act.

The company also expects car mileage to be improved by using a neural network chip.

Artificial neural network ICs can be used to learn from previous events and recognize patterns that are difficult to detect using conventional techniques. IBM, for example, has been experimenting with neural network technology to develop a computer system that can play the game of backgammon against some of the world's top players and win. (Source: *Electronics Weekly*, 23 September 1998)

Samsung advances to gigabit technology

Samsung Electronics has secured 0.13 μm processing technology in a further step towards having gigabit chips as early as 2002, three to four years ahead of schedule. The technology includes photo and etching processes, a high-function, transistor-making process and a three-layer metal wiring process. A single 4 Gb DRAM chip will contain four billion bits of information, or 32,000 standard newspaper pages on an area the size of a thumbnail.

The new technology is expected to contribute to cost reductions of the lower-capacity DRAMs. With the ultra-micro technology, Samsung will be able to build 30 per cent more circuits than the 0.18 μm processing technology for 1 Gb DRAMs. Already the company has employed the new linewidth technology in its 16 Mb DRAM production, where fully working semiconductors with the 0.13 μm circuitry have been produced successfully. Since current 16 Mb DRAMs use 0.35 μm technology, a potential productivity enhancement of three times more chips per wafer may be achieved with the 0.13 μm technology. (Reprinted with permission from *Semiconductor International Magazine*, September 1998.

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IBM and ST to develop SOCs jointly

IBM (East Fishkill, NY) and STMicroelectronics (St. Genis, France) announced a joint effort to accelerate development of advanced system-on-chip (SOC) products. The two companies have concluded agreements to exchange intellectual property and develop integrated circuits jointly for current and future data storage applications and PC-compatible information appliances.

IBM and ST have agreed to cooperate on the development of ICs for data storage, with a particular focus on hard disk drives. Specifically, ST will gain access to IBM's PowerPC technology, and IBM will gain access to ST's hard drive DSP and CMOS read channel technologies. In addition, using ST's approach of PC-on-a-chip and the common x86 microprocessor core road map, both ST and IBM plan to market a family of "computer-on-a-chip" products that will enable customers to build small, very powerful, multi-function information appliances quickly. (Reprinted with permission from *Semiconductor International Magazine*, September 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

IBM introduces SOI process

IBM (Hopewell Junction, NY) has announced it has developed a "commercially viable" implementation of Silicon-on-Insulator (SOI) for mainstream applications.

IBM plans to incorporate SOI in its chip products in 1999. IBM already produces SOI-based chips in a pilot production line and will introduce the technology on its high-volume manufacturing lines in the first half of 1999. SOI chips can require as little as one third the power of today's microchips if performance levels are held constant. This is especially important for portable devices needing long battery life.

IBM plans to incorporate SOI technology into a wide range of semiconductors, including its merchant-market custom-chip products, standard products (such as the PowerPC microprocessor) and in chips used in its S/390, AS/400 and RS/6000 lines of servers. (Extracted with permission from *Semiconductor International Magazine*, September 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Windows CE drives ARM development

A consortium has been created by ARM to drive the development of Windows CE-based products.

Founding members include Cirrus Logic, Intel, LG Semicon and Texas Instruments. These companies will work together to optimize Windows CE development.

Microsoft is providing all the software required by developers to build products. ARM has tailored its range of devices to work with Windows CE.

Any semiconductor firm that develops a device based on one of these cores is guaranteed to be able to run Windows CE. "What we are trying to do, is by porting it [WinCE] to the ARM architecture it will run on all our

semiconductor vendors' products", said an ARM executive.

This, in effect, creates a string of second sources for ARM processors aimed at products such as PDAs, organizers and car navigation systems.

With Symbian, the Psion spin-off, promoting the EPOC32 operating system on ARM processors, the future success of the architecture has solid foundations. (Source: *Electronics Weekly*, 11 November 1998)

IBM is first with silicon-germanium

The USA's IBM has become the first company to use silicon-germanium manufacturing technology for the high-volume production of computer chips. The new chips are intended for use in wireless communication devices. It is expected that these devices will become smaller, lighter and cheaper because the silicon-germanium chips will be able to carry out multiple functions and will extend battery life. Applications of the new technology may include more powerful and sophisticated portable scientific instruments.

IBM's research into silicon-germanium was originally focused on developing high-speed chips for mainframe computers. However, the patented technology was found to be ideal for wireless communication products, and the new chips are expected to accelerate the integration of cellular telephone, e-mail and Internet access in a single device.

Wireless communication devices require semiconductors that offer a combination of high speed, low noise and low power. This places considerable demands on traditional chip technology. Currently these chips are made from gallium arsenide and are expensive and energy inefficient. The silicon-germanium chips are expected to provide direct replacements for gallium arsenide components at a lower cost. (Source: *Scientific Computer World*, November 1998)

HP unveils new microprocessor

The release of the PA-8500, a new line of high-performance 64-bit Risc microprocessors has been announced by the USA's Hewlett-Packard (HP). The PA-8500 is the first HP chip to be built using a 0.25 μm manufacturing process.

A 440-MHz version of the PA-8500 will be introduced in late 1998, to be incorporated into HP9000 V-Class Enterprise Servers. A 360-MHz version is intended for HP C-Class workstation upgrades. HP predicts that 560-MHz microprocessors will be available in 2000, and faster versions of the chip will follow.

HP promises that the new microprocessors will be compatible with existing PA-Risc microprocessor-based systems. The company claims that this will protect the user's hardware and software investments. (Source: *Scientific Computing World*, July 1998)

Ball Semiconductor presents its vision of the future

Ball Semiconductor (Allen, Texas) has presented its spherical silicon processing technology for creating devices on silicon spheres, which spans the range from

crystallization of polysilicon nuggets to placing solder balls onto finished spheres. From the time the nugget is sent to the crystallizing tool, it is processed in a non-contact fashion until it is ready for the solder balls.

Five enabling technologies were identified for making spherical processing possible: spherical single crystal formation, non-contact processing, spherical lithography, three-dimensional design and clustering. To date, the company has demonstrated a high degree of capability in four of the five areas.

One main advantage of using silicon balls is their robustness in high-temperature processing. Wafer processing has limiting thermal budgets for a number of reasons, one being warpage. If the temperature of a wafer is brought to 1,300° C, it can warp to the point where further processing of 250 nm (0.25 µm) designs would be impossible. Ball has performed oxidation and diffusion at temperatures up to 1,370° C, yielding good uniformity with no noticeable change in the shape of the ball.

One of the main disadvantages of using silicon balls is the inability to implant ions. Many modern design elements, such as shallow junctions and deep wells, can be realized only on wafers using ion implantation. On silicon balls, shallow junctions may be feasible using very high temperature diffusion and very short time intervals. Whether an added usable temperature range can enable diffusion to produce complicated doping profiles is a question that has not yet been answered.

The company has demonstrated promising results for CVD polysilicon deposition and good results for nitride and TEOS depositions. Aluminium deposition results using dimethyl aluminium hydride have been successful also. Wet etching results do not show any surprises, and an atmospheric plasma etching process is under development.

At present, Ball is working with 1 mm diameter balls to develop processes. The company plans to go to smaller sizes, and has no plans to use larger ones. The results demonstrated show potential for the ball concept to capture some of the semiconductor market. Also, without the need for a clean-room or vacuum equipment, ball processing is much cheaper than wafer processing, making it more likely to be tried by a large number of manufacturers. Whether the ball concept merely holds on to a niche, or captures a large market may be answered in the next few years. (Extracted with permission from *Semiconductor International Magazine*, September 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Xilinx claims Internet technology will take mobiles to new heights

Mobile phones which can double up as digital TVs, Web browsers, DVD players, set-top boxes, organizers or PCs are the eventual applications for Xilinx's Internet reconfigurable logic (IRL) technology, according to the company's president and CEO, Wim Roelandts.

"You could turn a mobile phone into a TV, or an organizer into a PC", said Roelandts. "As soon as something is digital it is just a question of algorithms."

For the time being, users of IRL will have to make do with downloading relatively simple functions. Any block of intellectual property in the Xilinx library can be downloaded. IRL allows you to change a whole chip or just one bit on a chip, and it allows one part of a chip to be changed while the other part is still working. "Sticher" cores provide the routing between adjacent cores.

Xilinx sees the technology as being mainly useful where standards and protocols have been changed and a product needs to be updated.

However, Roelandts also sees IRL as providing performance improvements. "We can put in algorithms that are more parallelized that will increase performance," he said. "By using parallel-processed algorithms we can beat the performance of hardwired DSPs and microprocessors." (Source: *Electronics Weekly*, 18 November 1998)

Solar cells power up IMEC plan

IMEC, the International Microelectronics Centre at the University of Leuven in Belgium, is to set up a local joint venture to manufacture solar cells. It may also set up a centre in Flanders to commercialize its solar cell manufacturing process through licensing and joint ventures.

IMEC claims that its solar cell manufacturing process delivers an 8 to 12 per cent efficiency improvement for the same manufacturing cost as current commercial processes.

Another IMEC activity in the process of being commercialized is an exceptionally accurate global positioning system (GPS) receiver chip which has the potential to get down to millimetre accuracies compared to the metre accuracy of current GPS products.

IMEC's GPS chip uses, simultaneously, the US Navstar satellite constellation and the Russian Glonass constellation to get the accurate position fixes.

IMEC is currently discussing how best to commercialize the chip. IMEC is also talking to potential investors in a spin-off company to manufacture and market the chip. (Source: *Electronics Weekly*, 25 November 1998)

Compaq's Alpha set to keep speed tag

Compaq computer revealed its next generation Alpha microprocessor with the aim of retaining the title of the industry's fastest Risc microprocessor.

The Alpha EV7 uses a different approach than Intel's explicitly parallel instruction computing (EPIC) technology that relies on software compilers.

EV7 uses the Alpha 21264 core with various enhancements. It will have a large on-chip 1.5 Mbyte level two cache, plus an integrated Direct Rambus memory controller to cut down on bus data traffic. It offers a very high performance 16 Gbyte/s read/write bandwidth. (Source: *Electronics Weekly*, 21 October 1998)

Microsoft opens smart Windows

Microsoft is targeting its Windows operating system at the ultimate "thin client" platform: smartcards.

Called Smart Cards for Windows, the company's Windows-based development and run-time environment will enable companies to develop applications for smart-cards.

Microsoft is claiming the support of smartcard makers Schlumberger and Gemplus, as well as Merrill Lynch and Cable & Wireless.

Microsoft's smartcard operating system will compete with Java Card and MultiOS which are being supported by Visa and MasterCard. Market research firm Frost & Sullivan believes that Microsoft will not be able to dominate smartcards as it dominates the PC industry. (Source: *Electronics Weekly*, 4 November 1998)

Siemens introduces SelectXpress, an Internet innovation

Network operators and cross-regional Internet Service Providers (ISP) will be able to make their network infrastructure available for common usage in the future for locally active service providers and pure content providers. To supply this facility, SelectXpress, the service selection solution from Siemens AG, will be installed in the virtual point of presence. Service and content providers do not have to build their own infrastructure or Internet accesses but instead can offer their services using the existing technology of other network operators. For the operators of large networks this means that the existing infrastructure is used more efficiently and additional income can be generated. (Source: *ITU News*, October 1998)

Nokia demonstrates the world's first live high-speed data network

Nokia has unveiled the advantages of its high-speed circuit switched data (HSCSD) technology with a live demonstration at its test network in Helsinki. Applications on display include video-on-demand, music-on-demand, information services, large e-mail downloads, network games, rebroadcasting of television programmes, and live videocamera surveillance, all through a GSM network with HSCSD capability.

Nokia's HSCSD solution is the first of its kind to offer the possibility of boosting data speeds from the current 9.6 to 14.4 kbit/s in a single traffic channel. By multiplexing up to four channels into a single time slot, operators will be able to offer transmission rates up to 57.6 kbit/s—six times more than currently available—and, with the help of compression technology, data speeds can be increased even higher. (Source: *ITU News*, October 1998)

Orchid blooms for Motorola

Orchid Biocomputer has entered into a \$15 million deal with Motorola to manufacture and develop micro-fluidic chips that help analyse biomedical substances.

Motorola will provide Orchid with engineering and manufacturing expertise and will help develop commercial applications. Both companies predict a large market for what are called biochips which can help lower the cost of pharmaceutical development and genetic analysis. (Source: *Electronics Weekly*, 9 December 1998)

IBM goes up against RDRAM

IBM has unveiled plans for double data rate (DDR) memory, which will compete against Rambus DRAMs.

Techniques such as DDR, which releases data on both edges of the clock, are aimed at prolonging the life of synchronous DRAM well into the new millennium. This will preserve the existing format of dual-in-line memory modules and, unlike Rambus, does not have royalty costs associated with it.

With much larger memory requirements, servers need the cheapest memory at the highest performance. IBM believes Rambus, with its extra royalty cost, does not have the necessary price/performance benefit.

The company has a five-year plan for DDR memory. It has started to manufacture samples of 64-Mbit and 256-Mbit DRAMs using first generation DDR.

These are clocked at up to 133 MHz, giving a data rate of 266 Mbits per pin. In a module this equates to in excess of 2 Gbyte/s bandwidth between the processor and memory.

In practice, speeds will start at 100 MHz, giving 1.6 Gbyte/s. The first version of Rambus for PCs uses a relatively narrow 16-bit channel, but transfers data through each pin much faster, also achieving 1.6 Gbyte/s. Although slightly more expensive because of royalties, Rambus has other advantages, including simpler board layout and fewer pins on each device.

IBM and other memory manufacturers are already looking at second generation DDR. Clock speeds of 200 MHz are envisaged, giving a bandwidth of 3.2 Gbyte/s. (Source: *Electronics Weekly*, 9 December 1998)

Hyundai develops 256-Kb FeRAMs

Hyundai Electronics Industries has successfully developed 256-Kb ferroelectric random access memory (FeRAM) devices in cooperation with two US venture firms, Symetrix and Celis. The so-called "dream memory chips", the first of its kind in the world, combine DRAM's low-voltage and high-speed data processing rates and flash memory's energy efficiency and non-volatility.

FeRAMs adopt the technology of separate plate driving systems, two-level metal wiring to speed up the data processing rate, a thousand times faster than existing non-volatile memory chips such as flash memories and EEPROMs. Data recording frequencies are potentially one million times higher. These devices take DRAM's standard of one transistor and one capacitor (1T/1C) in one cell instead of the 2T/2C structure, allowing for a smaller size and a reduction in operating voltage from 5-3 V. They are expected to replace flash memories, SRAMs and DRAMs after the year 2000, according to its spokesperson. (Reprinted with permission from *Semiconductor International Magazine*, November 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Sun plans new microprocessor

Sun Microsystems of the USA has revealed plans for a new 1.5-GHz UltraSPARC microprocessor that will be

available commercially within the next four years. The chip will operate almost four times faster than Sun's current 400-MHz microprocessors. The chip is part of a development strategy that aims to pass the 1 GHz frequency threshold with the next generation of microprocessors.

The development of the new microprocessor is part of an ongoing collaboration between Sun and the USA-based semiconductor manufacturer Texas Instruments

(TI). In August 1998, TI announced the development of a 0.07 micron manufacturing technology that allows TI to pack more than 400 million transistors onto a single chip. Sun claims that the 0.07 micron technology will make gigahertz UltraSPARC processors possible.

Sun hopes to launch the 1.0 GHz UltraSPARC IV microprocessor in the year 2000, with the 1.5 GHz UltraSPARC V following in 2002. (Source: *Scientific Computing World*, October 1998)

E. Applications

Telemedicine

After two decades of limited acceptance as a way to provide health care to people in areas where there are few doctors, telemedicine is getting its due, with prisons serving as proving ground for broadening its use, reports the *New York Times*. Starting in 1994 and covering roughly 100,000 inmates in 12 prisons, the University of Texas telemedicine programme is the nation's oldest and largest; the on-line network saves about \$300,000 in prisoner transportation costs alone. Infirmity primary-care doctors or nurses use specialized equipment such as electronic stethoscopes and otoscopes to transmit real-time audio and high-resolution video images to a hospital hundreds of miles away. Both the off-site doctor and patient have two monitors so they can see each other as well as their own images. Based on the efficiency of prison telemedicine programmes, the Commerce Department set up a \$1.2 million telemedicine network to serve Medicaid patients in the rural south-western region of Virginia. The US military uses telemedicine as well, successfully keeping physicians far from front lines. A couple of companies have focused on telemedicine networks as an inexpensive way to serve isolated, home-bound elderly and chronically ill subscribers: Partners Health Care systems, Boston; and Kaiser Permanente, CA. (Source: *Communications of the ACM*, vol. 41, No. 8, August 1998)

Parallel simulations will improve heart surgery

An ongoing computational fluid dynamics (CFD) study of 3-D blood flow may help to determine the optimal geometry for grafting arteries during heart bypass surgery. The simulations are being performed at the USA's National Center for Supercomputer Applications (NCSA) by Colin Caro and Spencer Sherwin of the UK's Imperial College, and George Karniadakis of Brown University in the USA.

By using a 3-D model, the researchers have been able to simulate the complicated flow of blood through helical vessels. From their simulations of the shear stresses on the blood vessel walls, they have concluded that the grafting of prosthetic arteries may be more successful if a 3-D arrangement is used rather than the usual planar geometry.

The simulations were performed using the Nek Tar CFD code developed by Karniadakis, Sherwin and others. The simulation calculates the shear stress on the vessel wall by measuring the spatial rate of change of the fluid velocity. These measurements are made possible by Nek

Tar's high-order spatial accuracy. To represent the complicated arterial structures, Nek Tar makes use of tetrahedral subdomains and automatic mesh generation techniques.

Nek Tar is a parallel code that uses domain decomposition techniques to achieve high parallelism. The simulation was run on a Silicon Graphics Origin 2000 computer at NSCA, using between 8 and 24 processors. (Source: *Scientific Computing World*, June 1998)

Distributed power

Imagine a box the size of a dishwasher that sits outside your house, or maybe in your basement, and provides all the power your house needs. That describes the fuel-cell technology that has been developed for homeowners by Latham, NY-based Plug Power LLC. Scheduled to be commercially available in 2000 through GE Fuel Cell Systems, a joint venture between GE Power Systems and Plug Power, such residential systems are expected to retail for \$3,000 to \$5,000 and generate electricity at just seven to 10 cents per kilowatt hour. Plug Power says its initial units will operate on natural gas, propane, or methanol and can achieve 40 per cent electrical efficiency in simple-cycle operation. When excess heat generated by the fuel cell is captured and reused, overall efficiency can reach 70 per cent to 80 per cent. For more information: www.plugpower.com (Source: *Industry Week*, 2 November 1998)

Power house

A prototype fuel cell that could turn every household into a mini power station has been developed at Keele University in Staffordshire. Chemist Kevin Kendall and his colleagues have incorporated a ceramic battery into a conventional gas-powered water heater. Free electrons produced by the combustion of natural gas and oxygen are used to create a voltage across a thousand tiny tubes of zirconium oxide coated inside and out with metal alloys. This would provide enough electricity to power an average house. A commercial version costing £500 could eliminate domestic electricity bills, Kendall says. (Source: *New Scientist*, 24 October 1998)

C-Cube targets DVD with MPEG-2 codec

DVD quality recording using the PC is the market being targeted by video specialist C-Cube Microsystems.

The video specialist company has produced a single-chip MPEG-2 codec, called DVxplore, which it expects PC vendors to adopt to enable consumers to

record and edit video onto DVD, CD-R or hard disk drives. It will also enable PCs to record video from several sources and act as a digital VCR.

C-Cube hopes that it is onto a winner with its MPEG-2 codec since there is a potentially huge market for DVD-RAM applications. "The key applications for DVD-RAM are in digital content editing and in pre-mastering DVD titles", said Robert Zollo, CEO of Software Architects, a firm that follows the DVD applications market.

The first consumer products are expected in the second quarter of 1999. (Source: *Electronics Weekly*, 11 November 1998)

Inexpensive, compact, high-accuracy chip-size package IC inspection system

Todaka Corp. has developed a non-contact, high-accuracy inspection system BS-200 for checking the appearances of chip-size package (CSP) ICs that applies the outstanding features of the laser measurement and image processing systems.

Amidst the widespread mass production of large, expensive products, this particular inspection system is designed for use in small-scale to medium-scale manufacture and is compact, inexpensive and available at a comparatively low cost.

BS-200 is used to inspect for the existence or non-existence of balls, their positions, diameters and other characteristics, after which a laser beam is used to inspect the coplanarity and stand-off. The operations from the supply of CSP to the discrimination and classification of good and defective products on separate trays are performed automatically.

Further details from: Todaka Corporation, 1-3-21, Aosaki, Oita City, Oita Pref. 870-0278. Tel.: +81-97-521-1379; Fax: +81-97-521-3397 (Source: *JETRO*, November 1998)

Compact multichannel spectrometers

Soma Optics, Ltd. has developed the Fastever series of three compact multichannel spectrometers available in the S-2600, S-2700 and S-2800 models which cover the entire wavelength range from ultraviolet through the visible and near infrared ray domains, using an electronically cooled indium-gallium-arsenide (InGaAs) diode array.

The introduction of an improved version Fastie Ebert mount provides an excellent resolution and an optical system of great brightness. Spherical aberration and astigmatic differences are decreased considerably over the entire spectral domain. These spectrometers, by applying high-speed spectrometry of 100 times per second that enables time resolution analysis, can also be used effectively for the spectroanalysis of plasma light emission and other phenomena which undergo rapid changes.

Communications with the host computer adopts the small computer system interface (SCSI) that permits high-speed data transfer and monitoring of measurement results in real time. The detector is a silicon charge

coupled device (CCD) in the ultraviolet and visible domains, and an electronically cooled InGaAs diode array in the near infrared ray domain.

Applications of these spectrometers include plasma monitoring, quality control of light emitting diodes (LEDs) and lamps, land and marine environmental monitoring, colour measurements of dyes, pigments and paints, and spectral analysis in the sectors of food processing, agriculture and medicine. Further details from: Soma Optics, Ltd. 114-4, Ohkuno, Hinode-machi, Nishitamagun, Tokyo 190-0181. Tel.: +81-42-597-3256; Fax: +81-42-597-3208; e-mail: somaopt@sepia.ocn.ne.jp (Source: *JETRO*, October 1998)

Image retrieval system based on interaction of colour information

The Central Research Institute of Electric Power Industry has established a new coloured image retrieval system based on the interaction of colour information. The image is identified based on the dim colour memories of users or by using partial colour patterns of these images. Analogous images are retrieved from these rather ambiguous images with a retrieval interface using a colour palette. A retrieval software has also been developed for using both these methods.

With the colour-designated retrieval method, a portion of the image is selected and its central or main colour designated, whereupon the computer selects analogous candidate images. These images are selected from the user memory so that the lower right part of the image appears rather reddish. The software can discriminate about a thousand colour hues, but the designated colour retrieval can be continued sequentially simply by clicking the colour with the mouse. In the analogous image retrieval method, the image is decomposed in checkerboard fashion, and the colour pattern of each box compared to determine the degree of analogy. With the newly developed software, the image is divided into 16 sections in the longitudinal direction. Four neighbouring sections are joined to compare the colours of these respective parts.

The conventional type of analogous image retrieval method is generally based on the method of comparing the image overall colour in conformance with the frequency of the colour appearance, but with this method, if the upper half of the image is reddish and the lower half whitish, then with an image in which the red and white colours are clear and well distributed, the images appear analogous. The new methods discriminates the colour characteristics in fine parts or boxes, so discrimination is performed rapidly and accurately to eliminate unnecessary loss of time and labour.

Also, target objects which appear distinctive to the eye, such as a chimney with a reddish or whitish striped pattern, or vertical or lateral images which are different or partially hidden in a separate building, can also be made visible.

The research team evaluated the new retrieval method by using about 2,000 landscape photographs available on the market and fully confirmed that the

retrieval time is shortened by about 40 per cent. Since this technique enables images to be retrieved efficiently even from ambiguous memories, it is anticipated to have a wide range of applications.

The user first designates the place where the colour is remembered. The colours appearing in the designated place are displayed in various hues, so the remembered colour is selected. Images using the designated colour at the designated place are then displayed. Further details from: Central Research Institute of Electric Power Industry, Public Communications Div., 1-6-1, Ohtemachi, Chiyoda-ku, Tokyo 100-8126. Tel.: +81-3-3201-6601; Fax: +81-3-3287- 2863 (Source: *JETRO*, October 1998)

Second SRM for optical fibre metrology available

Scientists in NIST's Optoelectronics Division have developed a second Standard Reference Material to assist the optical fibre communications industry with wavelength division multiplexed optical fibre communication systems.

In a WDM system, many wavelength channels are sent down the same fibre, thereby increasing the bandwidth of the system by the number of channels. If one channel's wavelength were to shift, cross-talk could occur between it and a neighbouring channel. Wavelength references are needed in the 1,500 nanometer region to calibrate the optical instruments used to evaluate system components and measure the channels' wavelengths.

NIST has produced two SRMs with optical fibre coupled cells containing gases, which have accurately measured absorption lines in the 1,500 nanometer region. The first, SRM No. 2517, is based on the fundamental absorptions of light by acetylene. The newest SRM, No. 2519, utilizes an absorption cell containing a small quantity of hydrogen cyanide and is intended for use in calibrating the wavelength scale of wavelength measuring equipment in the spectral region from 1,528 to 1,563 nanometers. To obtain more information on SRMs 2517 and 2519, contact Sarah Gilbert, MS 815.03, NIST, Boulder, CO. Tel.: 80303-3337, (303) 497-3120; sgilbert@boulder.nist.gov (Source: *NIST Update*, 9 November 1998)

Digital dust

Forrester Research estimates that by 2000, 75 per cent of all data will be "born digital"—that is, will never have existed on paper—but that the digital storage medium is so fragile, some information might not last through the decade, reports *Business Week*. The danger extends beyond government and corporate records to new music, early drafts of literature, and academic works, which all face the risk of being lost. In tests by the National Media Lab., St. Paul, MN, under less-than-optimal storage conditions, digital tapes and disks, including CD-ROMs and optical drives, might deteriorate about as fast as newsprint in 5 to 10 years. Another problem is how the unrelenting pace of technology affects the chances that the software needed to get today's data

might not be readily available in 10 years, as anyone who has tried wrestling information from a 5-1/4 floppy disk can attest. (Source: *Communications of the ACM*, vol. 41, No. 6, June 1998)

Eyes not only a window in the soul

Pin numbers will soon be a forgotten memory, if a demonstration at the Nationwide Building Society in Swindon, UK, proves to be a tech harbinger. In order for customers to use a cash machine, the system, which Nationwide describes as the first of its kind in the world, scans users' eyes for identification. Only a direct match allows the transaction to proceed. The system, jointly developed by UK's NCR Financial Solutions Group and Sensor, Inc., can capture more than 250 recognition points. "The iris is safer than fingerprints; which only have 40 recognition points," said a spokesperson. The ID even works with contact lenses, sunglasses and cataracts. (Source: *Communications of the ACM*, vol. 41, No. 6, June 1998)

Floppies: the next generation?

In addition to a backward read-and-write capability with current 3.5-in. floppies, a new version from Fuji Photo Film USA Inc., Elmsford, NY, offers 100 times the storage and a transfer rate 60 times faster. Developed jointly with Sony Electronics Inc., the 200-MB HiFD system uses two special layers on each recording surface. The first layer contains magnetic particles that are protected by a second nonmagnetic film for durability. In addition, the cartridge uses a new shutter that makes it difficult for dust to enter. Visit the Web site at www.fujifilm.com for more information. (Source: *Industry Week*, 7 September 1998)

Supercomputer fights cancer

Supercomputers have played a crucial role in the development of two anticancer agents. The USA-based pharmaceutical company BioNumerik has developed a computational model of the key interactions between the topoisomerase tumour inhibitors and DNA molecules.

Scientists at BioNumerik employed a computationally intensive technique called "mechanism-based drug discovery" to develop the compounds on two Cray J90 supercomputers. The technique integrates medicine, quantum physics, synthetic chemistry and pharmaceutical sciences and allows the researchers to consider the many chemical compounds and chemical reactions that must be analysed during drug development. BioNumerik claims that mechanism-based drug discovery can greatly reduce the time involved in drug development, and can also reduce the risk of failure.

Topoisomerase inhibitors are some of the most potent anticancer drugs known. However, most topoisomerase-based drugs have been made water-soluble for ease of administration. BioNumerik believes that this limits their effectiveness and instead is developing fat-soluble drugs. (Source: *Scientific Computing World*, May 1998)

Merging displays with chips could lead to ultralight laptops

A complete computer or TV set could soon be built on a single sheet of glass, thanks to a new type of liquid crystal display developed by Sharp. Continuous grain silicon (CGS) screens behave like a huge microchip and so can carry processing circuitry as well as that needed for display. Sharp has demonstrated a prototype that uses three small LCDs based on the new technology to create a back-projected TV image.

Most flat panel displays, such as the active matrix screens in laptop computers, work on the thin film transistor (TFT) principle. Amorphous silicon is deposited on glass and etched to create a mosaic of transistors, which switch current through tiny cells of liquid-crystal material to vary their optical characteristics, but because the silicon lacks a crystalline structure, the transistors can only switch slowly. This causes the image to smear when the screen tries to show a fast-moving object.

The problem can be solved by making the screen from a thin slice of silicon formed from a single crystal. But this is far too expensive to be economic, and impossible for screens that are more than a few centimetres across.

CGS displays overcome the problem in a different way. To make them, a glass substrate is cleaned and polished to remove all blemishes larger than 0.1 micrometres. A layer of silicon just 0.04 micrometres thick is then deposited by exposing the glass to hot vapour. The flow of the material is carefully controlled to ensure that the silicon grains take up a regular pattern, with their boundaries neatly aligned. This encourages a smooth flow of electrons through the surface, as in a single crystal.

The silicon layer is then doped to create a mosaic of transistors that behaves like a microchip made from a single crystal of silicon. The display can operate at 600 times the speed of amorphous silicon TFTs.

After three years of secret work with Japan's Semiconductor Energy Laboratory, Sharp showed the fruits of the collaboration: a high-definition rear-projection television set that uses three 6.5-centimetre CGS panels, each one lit by a different-coloured beam, to create a very clear, bright colour image, with no trace of smear on moving images. Displaying 1280 by 1024 pixels, the resolution of the system can be up to twice that necessary for conventional TV pictures.

The next step is to make the panel reflective, by exploiting a high-reflectance aluminium system now being used in the screens which Sharp produces for the latest digital cameras and handheld computers. This could reduce displays' power consumption by 85 per cent by allowing natural light to create a colour image, instead of a back light.

Eventually a solar panel could be integrated with the display, so that a single-sheet PC or TV could work without a battery. (Source: *New Scientist*, 24 October 1998)

Scanning device uses laser beam deflection

A single chip one-dimensional scanning device has been produced by using a combination of micro-electronics, mechanics and optics.

The first intended application for the chip, designed by CEA-LETI in France, is for telemetry and obstacle detection applications.

The device scans a scene via the deflection of a laser beam driven by electrostatic actuation. A system of microlenses is used to achieve the laser beam deflection.

Two cylindrical microlenses, one divergent fixed and two convergent moveable, are assembled one in front of each other on the optical axis.

The electrostatic actuator scans the laser beam in one direction by translating the moveable microlenses in the direction orthogonal to the beam propagation. As the microlenses displace laterally relative to each other the emerging wave plane is collimated, but tilted from the optical axis.

The actuator consists of two electrostatic combs with four fingers each. One comb is fixed and the other is moveable. A potential difference applied between the electrodes causes deflection of the moveable comb by electrostatic forces.

A YAG 0.6 μm microlaser pumped by a laser diode is used as a source. Depending on the application the emission can be visible or infrared.

The silicon surface micromachining technology used in the chips' manufacture allows more than 700 chips to be produced on a 100-mm diameter wafer.

The mechanical structure is first etched in a 30 μm silicon dioxide layer. The silicon substrate is then etched to release the mechanical structures. The driving electrode is achieved by using a lateral evaporation of metal to the sidewalls of the electrodes. The wafer has to be annealed at high temperature because the residual stress in the silica layer causes the beams to bend vertically.

The main difficulty that was encountered during processing was the dicing of the silicon wafer as the laser must propagate on the substrate plane. For this reason the mechanical structures had to be dipped into resist before being diced and then cleaned in successive solvent solutions.

In the next stage of the project the design team intends to optimize the mechanical structure to decrease the currently required drive voltage of 137 V by a factor of three.

Coupled with improving the microlenses features this should open the way for new applications. A two-dimensional version is also under development. (Source: *Electronics Weekly*, 18 November 1998)

Text scanner pen

A smart pen that scans text from the page will be launched with the backing of mobile phone giant Ericsson.

Ericsson Mobile Communications is investing in the Swedish image processing firm C Technologies, which is about to launch its first commercial product, the C Pen.

Pocket-sized, it comprises an Intel StrongARM processor, digital camera and optical character recognition software. The digital video camera takes pictures of the text as the user drags the pen over a page. The C pen can read printed text at speeds of 100 characters/s.

The images are converted into computer-readable text using optical character recognition, and stored as a text file in the pen. With 6Mbyte of flash memory, 3,000 A4 format pages can be stored.

Ericsson plans to market the smart pen under its own brand name. It will use an infra-red data link to connect the device to its handsets, letting scanned text be incorporated in faxes and e-mails, and transmitted over the GSM network.

The smart pen developer also claims that with the processing performance of the 100 Mips StrongARM, text translation can also be incorporated into the device. (Source: *Electronics Weekly*, 4 November 1998)

Ground breaking technology

The University of Missouri is aiming to detect landmines by firing electromagnetic pulse generators into the soil from a helicopter. The system, says the university, will detect reflections from metallic objects as small as 1 cm³ around a 15 m radius from 100 m up. In keeping with current mine detection theory, the system will be multi-sensor. Not only are electromagnetic reflections sensed, but acoustic activity caused by the impact will be analysed as well, then mixed with thermal image data. The work is sponsored by the US Army and is currently still in the laboratory. (Source: *Electronics Weekly*, 2 December 1998)

Mixing methods to detect mines

Minefields do not have to be flat and sandy. Those proposing mine detection techniques frequently fail to grasp the nature of the problem. Mines are found on hill-sides, in ditches, among rocks and between houses. Even if they are on flat land, the area is often overgrown through disuse.

Manual de-mining is horrendously tedious and slow. Everyone who knows anything about technology thinks there must be a better way of doing it. And nobody has found one yet.

The IEE recently brought together experts to find out what the latest thinking is, and to pool ideas for the future.

Metal detectors are well established in mine-finding. "They can detect tiny amounts of metal, the sort of size that is found in 'plastic' landmines", said conference co-organizer David Daniels. "The trouble is that battlefields are littered with bullets, shell cases and shrapnel fragments. Often only one in a thousand bits of metal turns out to be a mine."

As a simple illustration of combined techniques, he introduced ground-probing radar. "This can only detect

metal in large lumps, but it can also detect large lumps of plastic. Sweeping with both cuts the number of false alarms."

To further eliminate harmless scrap, explosive detection may be a valuable technique for a third type of sweep. Two explosive detection techniques were discussed at the conference—electronic smell sensors and quadrapole resonance detectors.

"One sniffing technique uses a quartz crystal coated with a biochemical that reacts with explosive vapour, causing a shift in resonant frequency", said Daniels. "Sensitivity is being pushed up and up, with the aim of matching that of a dog."

Work in Angola and South Africa, he said, had shown that plants several metres away from a mine can absorb explosive molecules and might be exploited in future.

Quadrapole resonance involves hitting explosive with an electromagnetic pulse, then detecting resonating nitrogen atoms. "Different explosives have different resonance characteristics and can be identified", he said. "It works, but only up to 30 cm at the moment."

Other techniques discussed included airborne detection using ultra-wideband synthetic aperture radar. "Plastic anti-tank mines have been detected from several thousand feet", said Daniels. This could be a way to detect likely minefields so that a closer look can be taken from the ground.

The same kind of radar, mounted on a vehicle is a candidate for this closer look.

Cold sky passive radar, using the cosmic background radiation is a further technique being examined. Plastic reflects cosmic microwaves which can then be detected.

The polarizing effect that man-made materials have on light is also being exploited.

What is needed for mine detection, said Daniels, is a toolkit of techniques. A low cost unit that includes several technologies.

The UK's ERA Technologies and Thomson of France are jointly working on such a sensor with partial EU funding. Real minefield trials are planned for this before the end of 1999. (Source: *Electronics Weekly*, 4 November 1998)

Easy touch

Annoyed by the clutter of mice and keyboards on his desk, a researcher at the Sony Computer Science Laboratories in Tokyo has devised a quick and easy way to move files from one computer to another without touching either a mouse or a keyboard. Instead, he uses a pen-like device to "lift" a file icon off one computer screen and transfer it to another. The file itself is then automatically transferred between the two computers over a network.

"There were three different mice on the desk and I kept getting confused as to which mouse went with which screen", says the researcher, Jun Rekimoto. The answer he has come up with, called pick-and-drop technology, is designed for a future generation of computers that will

use the interactive screens now common on palmtops, which allow users to write on them with a pressure-sensitive pen.

The pen-and-screen combination used by Sony is a commercial product made by the Japanese company Wacom. Behind the screen is a low-power radio transmitter linked to a microprocessor. As the pen approaches the screen, a coil inside it interferes with the transmitted signal. By working out where the interference is coming from, the microprocessor works out the position of the pen on the screen. But the pen is also identifiable: buttons on the side of the pen can be pushed to alter the length of the coil and its interference pattern, which changes the ID.

In Sony's system, tapping the pen onto a file icon links the pen's identity code to the file. Then, when the pen is tapped against the screen of another computer on the same network, the network server notes the pen's identity code, looks to see which file icon it last touched, and transfers that file to the new computer. The icon immediately appears on the screen of the second computer. Files can either be copied or cut and pasted in this way.

The system should be especially useful for people such as stock market traders and television editors, who regularly use two or more computers. But Rekimoto says pick-and-drop could prove its worth in any office where people need to exchange files, and for people preparing lectures and presentations. A speaker could connect his or her laptop computer to a large interactive display screen, known as a digital whiteboard, and transfer text, video clips and other data from it to the whiteboard with the touch of a pen.

Sony's prototype has been developed on Mitsubishi palmtop computers, which are equipped with Wacom's interactive LCD screens.

As part of the development process, Sony wants to increase the number of different pen identification codes—there are just three at present—to make the system practical for a large number of users on the same network. (Source: *New Scientist*, 21 November 1998)

Smart glass

A technology that lets people control how much light their windows allow into a room is now at hand, reports the *Wall Street Journal*. The technology, being examined and tested by Research Frontiers, Woodbury, NY, is dubbed "particle devices", or SPDs, and is made up of droplets embedded in a plastic film attached to ordinary window glass. A 100-square-foot window using SPD technology should use the same amount of electricity as a 60-watt light bulb, and claims to block 99 per cent of ultraviolet rays. SPDs could be used in car sunroofs, ski goggles, and sunglasses. (Source: *Communications of the ACM*, vol. 41, No. 11, November 1998)

Sponging in data

The latest in scanning: a new Hewlett-Packard, handheld device is as easy to use as a kitchen sponge. Using the scanned document's texture as a road map, the

Capshare 910 Information Appliance's optical sensors track its location. Just wipe its flat edge a few times across the page, and like a jigsaw puzzle, the device's microprocessor reconstructs the text and images into a coherent whole. Complete digital pages can be sent via infrared port or serial cable to a laptop, smart phone, PDA, or printer. The device can hold up to 50 pages of text and images. (Source: *Communications of the ACM*, vol. 41, No. 12, December 1998)

Blue is the colour

Nichia Chemical Industries, world leader in short wavelength semiconductor light sources, is starting to ship samples of blue laser diodes. These will find applications in the next generation of data storage devices where shorter wavelengths mean more data per unit area. The diode operates at 400 nm, purple, with an output power of 5 mW. This is enough power to read data from a CD. Nichia has constantly been streets ahead of its competition, announcing 10,000-hour blue laser diode operation in 1997, when the life of most competing devices was measured in minutes. The diode is an InGaN device, part number NLHV500. (Source: *Electronics Weekly*, 20 January 1999)

Printers

Four main segments of the market for printers are (1) production printing, high-volume output cut sheet and continuous forms; (2) departmental printing (30-90 page-per-minute); (3) smaller workgroup printing; and (4) home or individual printing market sector. Production printing is mainly monochrome, but high-speed inkjet printers (1,000 ft docs/min.) are beginning to appear. Dot matrix is still popular, especially for the production of impact-dependent forms, such as carbon copies. Colour laser printers are a particularly exciting new trend in the low-cost end of the market. They work by having four sets of toner with different colours, all of which are put on the laser before the document is finally fused.

Multifunctional machines are now being developed at all levels of the market—combining scanners, copiers and printers. For example, Primax bolts a flatbed scanner onto a low-end printer to turn it into a copying device. At the high-end of the market, HP for example are producing devices which are effectively powerful print engines with built-in copying properties; and by having one scanner at the top end, and one at the bottom end, it is able to scan double-sided documents in a single pass. Electronics For Imaging (EFI) produces servers that plug inside printers and copiers, and drive their engines, using what they call Fiery Raster Image Processing (RIP) technology—thereby reducing ownership costs through using a colour copier as a printer. At costs of 8-25 pence per page, although not press quality, it looks good to the human eye.

The low end of the market is the most significant in the scanner arena, owing to the interest of individuals with Web-based requirements. Canon and Sharp are offering multifunctional devices comprising a box containing fax, feed-through scanner, copying and printing—

for PC connectivity. However, if in such a device one of the components goes wrong, all of them are out of service until the matter is put right. The ultimate aim is the provision of an inkjet dot that is invisible to the naked eye. Epson claims to be able to do this using electricity that passes through a crystal to release onto the page, rather than using heat—and claims to be able to get down to a three-picolitre inkdot. It is concluded that until screen resolutions beat those available on paper, hard copy is still going to be easier on the eye, and the paperless office will never be a reality. (Source: *Information Week*, 27 January 1999)

Banking on the Internet

Although dubious about the benefits, bankers are prepared to invest in the Internet. According to an international study conducted by Ernst & Young, 96 per cent of the world's 100 largest banks do not expect any increase in business from the Internet, yet by the year 2001 "banks will spend proportionately the same amount of money on Internet technology as they spend on their high street branches".

The same survey revealed that over half the enquiries made over the Internet remain unprocessed for 24 hours or more.

Paul Talbot, who runs the Management Consultancy side of Ernst & Young, commented that the banks regard the Internet as just another technology. (Source: *Technology Ireland*, January 1999)

Solar power

Teflon-encapsulated photovoltaic cells are expected to make solar power more popular with house-holders. A company in Germany, bmc Solar Industrie GmbH, has produced tile-like photovoltaic panels that can be incorporated with traditional roofing materials, such as slates or shingles.

Although the technology was ready for the market, the company initially found it difficult to secure the backing needed to build a demonstration project. However, certification from the European Joint Research Centre convinced industry that the solar cells work, and with the support of local authorities in North Rhine Westphalia about 50 houses will be built with photovoltaic roof tiles by the end of this year. bmc Solar Industrie is now gearing up for mass production and the price of tiles is expected to fall sharply.

bmc Solar Industrie GmbH can be contacted at Tel.: +49 219 66075; Fax: +49 219 63391. (Source: *Technology Ireland*, January 1999)

ID systems

Those all-too-vulnerable old passwords could be on the way out in 1999 as the computer industry introduces a clutch of cheap technologies that confirm the identity of a computer user by checking their fingerprint, iris pattern, voice or facial features.

Behind the new technology is a new industry standard, the Human Authentication Application

Programming Interface, which allows any "biometric" ID system to be connected to a personal computer.

Compaq is launching a fingerprint reader that costs just under \$100. The device works like a miniature scanner and plugs into the printer port of a PC; and NEC of Japan says it is developing intelligent software that distinguishes between individual fingers, so that the user can open one file by touching the sensor with one finger and log onto the Internet by touching with another.

Net Nanny, a Vancouver company, does not rely on a fingerprint reader. Instead, its software analyses the user's typing rhythm when entering a password. If the rhythm is not recognized, the user is refused access despite entering the right password.

Korean consumer electronics company Lucky Goldstar and IriScan of New Jersey both plan to launch eye-recognition systems soon. The user will look into a digital camera that captures an image of the iris. The software records 266 variables that describe the iris and stores them as a 512-byte file. The PC will work only after it sees a matching pattern. The companies say the probability of two different irises kicking the computer into life is 1 in 10^{78} .

Meanwhile, Saflink of Tampa, FL, has been working with the Belgian company Lernout & Hauspie on a security system which uses the latter's speech recognition technology to check a voice against a stored recording. Its Saftylatch software will use an ordinary microphone and sound card, and will cost under \$100. The system can also be used with a laptop so data are secure if a traveller's PC is stolen.

Visionics of New Jersey and the Polaroid Corporation are claiming 99.99 per cent accuracy with their jointly developed faceit device, which checks a user's entire face. A digital camera takes a photograph and the PC extracts a face print which logs "all facial features". The PC will work only when the user's face fits.

But even the tightest security device cannot protect data if a user logs on and then leaves a PC unattended. So RF Ideas of Illinois has developed a user-proximity sensor to solve the problem. A radio transmitter plugs into the computer and transmits weak query signals as soon as the keyboard or mouse has been idle for a couple of minutes. The user wears a pendant with a radio transponder which answers the query from the PC. If it gets a response, the computer remains active—but as soon as there is no return code, the PC blocks access. (Source: *New Scientist*, 9 January 1999)

High-performance solar cell self-illuminating traffic beacon

Kyocera Corp. has developed a new type of high-performance solar cell self-illuminating traffic beacon, ACCLESS Series, designed to prevent nighttime traffic accidents. The number of the new high-brilliance light emitting diode (LED) is double that of conventional types and distributed uniformly over the entire LED plate, by which the new self-illuminating traffic beacon features a maximum brightness up to 1.6 times greater than that of

conventional types of solar cell self-illuminating traffic beacons. By improving the circuit system, the light illumination time is prolonged to a maximum period of 2.6 times, so that the visibilities and guidance properties of these beacons are considerably improved.

BROCCA SULZER effect is utilized for the first time, and the conventional ON time is divided into two parts, by which the beacon light now appears closer to a flicker light than a continuous light, which improves the beacon light visibility.

In the day, the battery is charged with solar cells, and at night the solar cell output is sensed by a sensor circuit and switched on automatically, whereupon the flicker circuit is actuated and the light emitting device starts to flicker. At early dawn, the sensor circuit switches the circuit off automatically and terminates the flickering operation. A connector is introduced that improves the beacon start-up wiring and the solar cell connection tasks so that the beacon system installation is eased substantially with the use of fitting gadgets.

Further details from Kyocera Corporation, Public Relations Department, 6, Takeda-Tobadono-cho, Fushimi-ku, Kyoto 612-8501. Tel.: +81-75-604-3514; Fax: +81-75-604-3516 (Source: *JETRO*, January 1999)

Siemens develops the first offline text scanner

Students line up to use the photocopier, journalists reach for their text markers, and archivists grab their scissors. Things have now got a little easier—with Siemens' Pocket Reader, the world's first offline text scanner. The device makes it possible to record printed texts and edit them later on a PC using conventional word processing software. The pen-shaped scanner can record all the typefaces used in the German, English, French, Italian and Spanish languages. Pocket Reader recognizes the scanned characters, combines them to form words, and checks their plausibility and correctness in an electronic dictionary. (Source: *Deutschland*, January 1999)

F. Software

Research: making a case

Case-based reasoning (CBR) technology is rapidly gaining ground in the commercial sphere, fuelled by the rise in Internet and Intranet applications. Academic research on the next generation of the technology continues apace as well. Pdraig Cunningham of Trinity College Dublin and Barry Smyth, a recent Trinity graduate but now at NUI Dublin, are collaborating on a project that tackles the issue of performance in Web-based CBR applications.

The researchers are examining how to distribute the processing load associated with a Web-based CBR application, to ensure that the user organization's Web server does not become overburdened with traffic. "At some point, the relevant cases can be moved from the server side to the client side in order to eliminate the effect of the network latency and also to reduce the load on the server," Pdraig Cunningham explained.

The user's system will be able to execute the processing task within a Java applet downloaded from the Web server to the user's browser. Key to this project is the recently ratified language for formatting information on the Web, extended mark-up language (XML), and Microsoft and Netscape are now incorporating support for this into their respective browsers.

XML is more flexible and powerful than hypertext mark-up language (HTML), the original means by which information was published on the Web. Cunningham's group has now developed a tool called case-based markup language (CBML) for representing and manipulating cases in XML format. The research is funded by the Advanced Software Technologies Initiative, which is part of the Irish software program in advanced research (PAT).

Barry Smyth is also collaborating on a second ASTI project, called Impact, with a University College Dublin colleague, Gregory O'Hare. The aim here is to embed CBR technology within "intelligent" hand-held devices. Such a device could be used, for example, by a maintenance technician working along the fuselage of an aircraft. The device would act as an on-line help system that offered information relevant to the section of the plane the technician was working on at any particular time.

This project also entails the use of wireless communications technology and navigational aids such as global positioning satellites and electronic compass technology. One immediate application the partners hope

to develop, according to Smyth, is a hand-held tourist guide for Dublin.

Smyth is also collaborating with IT publishers Scope Communication, in a project funded by Enterprise Ireland's applied research programme. This initiative, called Casper, is looking at ways of personalizing Web content for individual users. The thrust of the research is to deploy CBR technology to develop a match between a user's profile, based on his or her previous browsing behaviour, and both current and new information. So a user looking for employment opportunities would be offered information relevant to their previous experience or interests. (Source: *Technology Ireland*, February 1999)

A new computer program promises to cover your tracks

You can never be too paranoid on the Internet. That seems to be the philosophy behind a program called Freedom which promises to preserve the anonymity of Net users as they browse the Web, send e-mail and post messages to newsgroups.

"We anticipate it will be used by people like political dissidents, or someone with an illness they do not want their employers to know about," says Dov Smith, a director of Zero Knowledge Systems, the Montreal company that created Freedom.

The program handles the problem by encrypting data, such as requests for Web pages, before the information leaves the computer. The program then shuttles it between a series of Web servers, each of which encrypts it again, hopelessly scrambling the electronic trail.

The program starts by selecting at least three separate servers from the cooperative Freedom network. Then, before the computer sends out a data packet, it encrypts it three times—in effect wrapping the data in three secure "envelopes", each of which can only be unwrapped by a specific server.

The packet goes to the first server, which unwraps the outermost envelope, revealing only the address of the next server in line. The first server then sends the packet to the second, which unwraps the second envelope, reads the address for the next server in line, and sends it along. The final server does the same to the last envelope before sending the packet to the Web site. Information coming back from the site is treated the same way but in reverse.

What this complicated procedure means is that no single server in the system knows both where the packets are going and where they are coming from. The program provides similar anonymity for users posting to newsgroups or sending e-mail.

Some of the ideas behind this software have already been used on the Net, says Sameer Parekh, president of C2NetSoftware and an authority on Net privacy issues, but no other package has brought them together. (Source: *New Scientist*, 20 February 1999)

New service checks time software's Y2K compatibility

NIST's Time and Frequency Division has established a service to assist users in testing how well their time-setting software will handle dates after 1 January 2000. The year 2000 problem, or Y2K, refers to the failure of a computer program or system because the "00" year designation is mistaken for "1900".

The service sends the exact time to any computer that requests it, but transmits dates that are exactly two years in the future. For example, the message transmitted at 14:37:26 Coordinate Time Universal (known as UTC) on 1 November 1998, had a time of 14:37:26 UTC on 1 November 2000.

The service supports all common digital formats. The time of day will be correct and will be directly traceable to the NIST atomic clock. The service will run until the end of 1999. Users with time-setting software on their computers that receive digital time messages over the Internet can access this test facility by changing the address in the software to connect to "y2k-test.timefreq.bldrdoc.gov" (IP address 132.163.135.136). Users of NIST's Automated Computer Time Service modem dial-up service can test their systems by dialing (303) 554-7760.

Windows 3.x/95/98 software modified to allow selecting the NIST Y2K test time-server is available free of charge on the World Wide Web at <http://www.boulder.nist.gov/timefreq/service/nts.htm>

This facility is for testing only, and users should be careful about connecting operational systems to these servers. NIST will not be responsible for damage to systems that cannot properly handle dates in the year 2000 and beyond.

The client and server software were developed as part of a joint project between NIST and the University of Colorado at Boulder through JILA, a joint institute operated by the two organizations. (Source: *NIST Update*, 9 November 1998)

Information retrieval

By understanding meaning and context, a natural language search engine promises to make information retrieval as simple as an ordinary conversation. The design intent is to avoid retrieving the vast amounts of irrelevant data that are typical of searches using Boolean technology, says Kathleen Dahlgren, president, chief technology officer, and co-founder, InQuizit

Technologies, Santa Monica, CA. Called InQuizit, the software uses meanings and concepts, however phrased, to search and retrieve only the meaningful information requested. Using any information source that has been "InQuizitized" (analysed and indexed by InQuizit), users simply type in a plain English query, and the system delivers it—no more, no less, the company asserts. The system does not retrieve information when query words appear in the text in the wrong context. For example, it is designed to understand the difference between "Who has set the table?" And "Who has the set of tables?" (Source: *Industry Week*, 7 September 1998)

Design tool meets demands of large FPGAs

Altera has announced its fourth generation software for turning hardware designs into FPGA programming data. Dubbed Quartus, the software replaces Max Plus II, in service now for nearly six years.

When Max Plus II was launched, the largest device produced by Altera was 12,000 gates—it is now 250,000 gates. While the software has coped well, newer, more complex FPGAs are making the task harder.

Added to this is the demand for workgroup design, where many designers work on a project, often several on the same chip. Software needs to be able to handle this, along with the ability to compile designs using multiple processors.

So Altera has created Quartus, its fourth generation design tool. Written from the ground up, Quartus uses a central database—the common object model from Microsoft. This includes synthesis and simulation tools from outside suppliers.

Multiple engineers can work on a design and this extends to access via the Web.

Other concerns arising from today's large FPGAs have also been addressed.

After the design is compiled for the first time, any changes (of which there are always a few) can use the incremental compile feature. This only updates the part of the design affected by the changes, obviously saving time.

When compiling, Quartus can spawn multiple processes and can therefore compile across a network or multiple processors. This includes heterogeneous systems, such as those combining SPARC and Pentium-based workstations. So using eight processors roughly halves compile time compared with a single processor.

Quartus has been written to take advantage of the latest FPGAs, called APEX. The software works out whether parts of the design will work best in product term blocks or look up tables.

Verification, which is becoming the major problem in large designs, has been an important focus. Quartus has its own simulation tool, or others can be linked in using scripting files.

To help verify the device at board level, Altera has a function called Signal Tap. This uses some space on the chip and allows the user access to internal data through a cable linked to a PC. (Source: *Electronics Weekly*, 28 October 1998)

Making a billing

Using the Internet could become more expensive if service providers adopt new software that allows separate billing for e-mails, downloading graphics and streaming audio or video.

Xacct of Santa Clara, CA, says its software allows Internet Service Providers (ISPs) to collect details on what their customers are doing with their connections. Right now, providers generally charge a flat monthly rate for all users.

It is very difficult to collect information on Net use, even if you are the ISP controlling all of the computers because different computers in the system do not report everything they are doing to a central place.

Xacct's software monitors all the computers and records exactly what they are doing—for instance, if they are handling a video stream—and which customer they are sending it to. Xacct says a company might decide to charge \$10 an hour for a high-quality video feed, but only \$1 an hour for a low-quality video feed, and only a flat rate for basic e-mail.

By monitoring Net traffic types, the software is also a useful security tool. Charles Arsenault of Canadian telephone company Teleglobe says it is using the program to monitor approaches to its firewalls—servers that provide a buffer between business systems and the outside world. (Source: *New Scientist*, 3 October 1998)

Cellular automata help environmental cause

An interactive parallel software environment based on cellular automata (CA) has been developed by scientists at Italy's ISI-CNR for developing high-performance applications in science and engineering. CAMEL (Cellular Automata envionMent for SystEMs ModelLing) is designed for use both as a tool to model dynamic complex phenomena and as a computational model for parallel processing.

Cellular automata are said to be effective at solving scientific problems because they can capture the essential features of systems in which global behaviour arises from the collective effect of numerous simple, locally acting components.

So far, scientist have used the system to develop applications in geology, image processing, genetic algorithms and, most recently, in the ESPRIT-funded CABOTO project to model and simulate the bioremediation of contaminated soils. In this project a novel approach involving macroscopic CAs was taken, whose "state space" is the Cartesian product of different subspaces.

CAMEL includes the CARPET (CelluLAR Programming Environment) programming language for modelling complex phenomena, together with a user interface and visualization capabilities. CARPET enables cellular automata models to be defined within CAMEL. (Source: *Scientific Computing World*, December 1997)

Cyber snap

Searching the Web for an image is difficult because you have to find text that describes it. Now researchers at

the Massachusetts Institute of Technology have developed a program that can match images in seconds. Eric Grimson of the MIT artificial intelligence laboratory says his aim was to be able to show his system sample images and ask it to "find me things like this".

Military researchers have spent enormous sums developing pattern recognition technology that will recognize faces or the outlines of enemy aircraft. But these programs are poor at picking up broad classes of objects. There are also programs that correlate the colour of pixels but Grimson says that they produce some "really strange" matches.

Grimson uses a more flexible approach which represents images as patterns of colour, like those that a short-sighted person might see without glasses. For example, snow-capped mountains appear as a field of blue above a jagged white field, which in turn is above an area of brown or green.

He trains the system by showing it sample images. Like other artificial intelligence software, the more examples it is given, the more the system learns and the better it performs. The software, which runs on a personal computer, can sort 10,000 images in less than a minute. "The system makes mistakes, but some are fun," says Grimson. For example, a search for images of snowy mountains may yield 18 pictures of mountains and one of banks of clouds—which like snowy mountains have a blue field above a white one.

Grimson has built a prototype to search trademark files for the US Patent and Trademark Office. Trademarks may vary in design and the task is important for companies seeking new trademarks and protecting existing ones. But the search is currently carried out by hand. The MIT group also developed the technology for searching the Web. (Source: *New Scientist*, 25 April 1998)

Finders keepers

It is not hard to find information on the Internet. But finding relevant information is a little trickier. So surfers will be pleased to hear that Mother knows best—the "mother of all search engines", that is. The page at <http://www.mamma.com/submits> your request to six of the bigger search engines at the same time, formatting the query into the correct syntax for each site. The list of responses is usually more tightly focused and shorter than you would get from just one search engine. (Source: *New Scientist*, 9 May 1998)

Adding a dimension to facial recognition

Cambridge Neurodynamics has developed what it believes is the first three-dimensional facial recognition system.

Using a 3-D representation of a face provides a wealth of additional information compared with systems using 2-D video images. This added data is vital when tackling the more taxing problem of face recognition, identifying a person from scratch using a database of known individuals.

To create a 3-D model, multiple images of a person's face—typically ten—are captured on video.

While the snapshots are taken, the person is illuminated with a vertical line of light. This results in the face being scanned, with multiple contours of the face being captured across the images. It is from this data that a 3-D representation is created.

Using a PC, the position and rotation of the 3-D modelled face is then aligned with those stored in the database, to ensure that like is compared with like. Before the database is trawled, however, the model is operated on by an artificial neural network. This is used to improve the system's recognition performance by factoring out variations in a person's face while captured on video camera—for example, if the person was laughing or grimacing.

According to George Harpur, senior systems consultant at Cambridge Nerodynamics, the system achieves a near 90 per cent correct recognition against a database of 50 individuals. This may not seem impressive considering that humans can do this perfectly without even conscious effort, but Harpur points out that getting a computer to do this is exceptionally difficult, "especially when it cannot be expressed as a set of rules".

Cambridge Neurodynamics is also working on a modelling technique that creates a 3-D face image using a single snapshot and a patterned light source. This promises cost savings by letting a simpler, cheaper camera be used. (Source: *Electronics Weekly*, 4 November 1998)

Universal computer language dissent

A drive towards a single language that will run on any type of computer was dealt a blow when 14 companies split with Sun Microsystems over the future of its Java programming language. The companies, led by Hewlett-Packard and Microsoft, said they would develop their own version of the Java language independent of Sun, heralding the development of two or more similar—but incompatible—forms of Java.

Java, which is now widely used to create small programs called applets that add new features to Web pages, promises to allow programmers to write a program only once, rather than having to write separate versions for Windows, Macintosh, Unix and other operating systems such as Linux. This is possible because for each type of computer, there is a program called a Java virtual machine that translates Java into a form the computer's microprocessor can understand.

The idea was championed by Sun, which has been fighting to maintain a single standard. Although the rules of the Java programming language are public, allowing anyone to write programs, programmers have to license the Java name from Sun, which holds the trademark.

The latest split is the result of a dispute over a relatively small subset of the Java language, used for embedded systems. These are programs buried deep within the control systems of, for instance, a printer or an

assembly line robot. They have to perform consistently and react to rapidly changing input data.

Programmers developing embedded systems need software tools that ensure the devices do not crash or suffer long delays

The split is probably the beginning of the end for a unified Java language. Java may even fragment further, possibly under different names if Sun wins the right to control the Java name. (Source: *New Scientist*, 14 November 1998)

Upstart operating system

The open-source software movement has developed a free computer operating system that is poised to compete with Microsoft's Windows.

Linux (www.linux.org), a simpler-to-use variant of the old standby UNIX already is the operating system of choice for Internet servers, the computers that route Internet traffic and host sites on the World Wide Web, and its use is growing rapidly for small-sized servers on local area networks. It also serves as the operating system on a cut-rate supercomputer at Los Alamos National Laboratory, called Avalon. And now, thanks to a massive effort by programmers around the world, all but a handful working for free, Linux is poised to make significant inroads in the workstation and desktop personal computer world, which is largely the domain of Microsoft and, to a lesser degree, of UNIX.

Linux, by all accounts, is stable, powerful, and fast—and it is free. Linux is the fruit of a kind of on-line commune, an intellectual descendant of the counterculture of the 1960s, and although free software is nothing new—UNIX itself was initially distributed free by its developer, Bell Labs—Linux represents one of the most visible successes of what is called the open-source software (OSS) movement, an approach to software development first championed in 1983 by computer scientist Richard Stallman at the Massachusetts Institute of Technology. Proponents of this model, which now include the Web giant Netscape, believe that all software should not only be free, but should also be accompanied by its native code, the instructions written by programmers.

The Avalon supercomputer has been running for many months without crashing, reliability that is almost unheard of in the supercomputer world. Some common applications for personal computers and workstations also run faster under Linux. According to an internal Microsoft memo, leaked to the public via the Internet by an internal source and confirmed as authentic by Microsoft, Netscape's Navigator Web browser rendered graphics and text "at least 30-40 per cent faster" when it ran in Linux that it did in Microsoft's own operating system, Windows NT. Finally, Linux's small size and speed mean that it runs very well on less expensive computers, including those with Intel's older 80486 processor and its clones. "For low-budget operations, you can take used 486s, install Linux, and you have a really

cheap but powerful Internet server," explains Todd Lewis, a Linux volunteer.

Linux's source code has been open since it was first created in 1991 as a simpler-to-use version of UNIX by Linus Torvalds, then a 21-year-old undergraduate at the University of Helsinki. He posted the approximately 10,000 lines of code on the Internet, and in short order other programmers began sending him fixes and improvements, which Torvalds incorporated into the system. As news of Linux spread through the programming community, more programmers joined the effort, and in March 1994, with 100,000 users, version 1.0 was released along with supporting software. This was followed in June 1996 by version 2.0.

By then, the Linux kernel—the core operating system—had grown to 400,000 lines of code, all of it written by volunteers and incorporated into the kernel by Torvalds. Under the terms of the "CopyLeft" licence developed by Stallman's Free Software Foundation, a virtual organization that is promoting the concept of open-source software, anyone can use the code and modify it, but they must then send the change to the community for review. Several thousand volunteers now contribute, but the buck still stops with Torvalds, who works for a small Silicon Valley chip designer called Transmeta Corp. in Santa Clara, CA.

The development effort has spread to the commercial world. Today, at least four companies, including RedHat Software in Research Triangle Park, NC, and Caldera Systems in Orem, UT, develop and sell Linux-compatible ancillary software such as graphical user interfaces and suites of common business applications, which the companies package with Linux. They, too, send proposed Linux modifications to the appropriate individual and adhere to the same CopyLeft licence as everyone else. According to industry newsletters, the operating system now runs on an estimated 10 million computers, mostly workstations and Internet servers, displacing other UNIX systems and Microsoft's Windows NT.

Linux is also making inroads in the research community. Recently, Michael Warren's group at Los Alamos used Linux as the operating system for Avalon, a collection of 140 Digital Equipment Corp. Alpha desktop computers wired in parallel. The result is a genuine supercomputer, capable of 47.7 billion calculations per second, at a total cost of \$300,000—parts, labour and software included. Several research groups at Los Alamos have used Avalon to solve problems in areas as diverse as astrophysics and molecular dynamics (cnls.lanl.gov/avalon)

Linux will soon make its most direct challenge to commercial software in the form of a set of programs called GNOME, a so-called front end that would turn Linux into the equivalent of the Windows 98 operating system for PCs, complete with supporting functions such as a file management system, text editor, mail protocol interpreter, and disk formatter. GNOME cannot run software configured for Windows 98, but with filters it

can work with files prepared in various Microsoft applications, such as Word and Excel.

Linux is not the only success of the open software movement. Many add-on programs, so-called utilities such as the file compression program Zip, and file readers such as Ghostview were born of this movement. Apache, an Internet server program that runs under Linux and was developed by about 20 programmers from around the world, is now found on more than half the computers that host Web sites, according to the November 1998 Netcraft Web Server Survey (www.netcraft.com/Survey). BIND, developed by hackers at the University of California, Berkeley, in the 1980s, is used by virtually every Internet router system to convert Web aliases into true numeric addresses, and the open-source program Sendmail routes about 80 per cent of all e-mail sent today.

Netscape embraced the open-source software credo when it released the source code for the latest version of its Communicator software. Within hours after its release, a group of Australian hackers wrote a small piece of cryptographic code that greatly increased the security of Communicator, which can be downloaded free from Netscape's Web site. (Source: *Science*, Vol. 282, 11 December 1998)

Protecting your e-mail

Those concerned about who—other than the intended recipients—might read their e-mail messages can employ encryption. There are two mechanisms by which this can be achieved: Pretty Good Privacy (PGP) and Secure MIME (S/MIME). Both employ public key encryption.

Three variants of PGP are available: the commercial package Open PGP and the free version, PGPFreeWare, both from Network Associates; as well as the international version of OpenPGP. S/MIME was originally developed by RSA, but it is now being offered as an open standard. It is likely to find favour with large companies, while individual users will probably choose PGP.

Plug-ins for both PGP and S/MIME are available for use with the e-mail program, Eudora. The former adds a new option on the main menu, and a preferences option on the sub-menu allows the user to specify default actions when sending and receiving mail. Two icons on the toolbar enable messages to be encrypted, and signed, respectively. Microsoft Outlook and Outlook Express use S/MIME. Advanced options include selecting from multiple certificates and algorithms, and decoding of incoming messages is handled automatically.

Encryption software is also available for most other e-mail clients. Even if an older program not supporting encryption is being used, documents can still be encrypted manually before they are sent as attachments to e-mail messages. (Source: *Internet Magazine*, November 1998)

Examining XML: new concepts and possibilities in Web authoring

The World Wide Web Consortium (W3C) released the specification for XML (eXtensible Markup Language) 1.0 as a recommendation in February 1998. Both XML

and HTML have their origins in SGML (Standard Generalized Markup Language), but XML differs from HTML in that it can be extended to suit a wide variety of purposes. Given this, it has been claimed to form the basis for a whole new generation of Web authoring options.

In fact XML was created with the Web environment in mind. Essentially, it is a metalanguage which defines a series of rules concerning the development of unique tags for encoding documents. Users can therefore specify their own tags which define the content, syntax and semantics of the document. As a result, authors can add metadata to the document to an extent not previously supported.

XML, however, is unlikely to replace HTML; the two are complementary, rather than competing. HTML addresses structure and presentation, and handles text material very well. XML is best suited to handling data semantics and meaning, as well as presentation features not supported by the text-orientated HTML.

In addition, HTML is much simpler to code and use than XML, making it more appropriate for casual Web authors. A further major obstacle to using XML immediately is that at present Microsoft's Internet Explorer 4.0 appears to be the only commercial browser which includes even partial support for XML. IE 5.0 and Mozilla (formerly Netscape Navigator 5.0) both promise they will offer more comprehensive support for XML. Some tools for creating and reading XML documents do exist, however. Information about these can be found in The Web Developer's Library Software Guide at <http://www.wdvl.com/software/xml> (Source: *Computers in Libraries*, November/December 1998)

Software approach to the basics

Some of the floating-point operations traditionally implemented within processor hardware could be replaced by software implementations if the methods of Marius Cornea at Intel Corp. in the US are adopted. Cornea has developed a methodology for proving that certain new, fast algorithms for performing floating-point divide, remainder and square root produce a correct result as measured by IEEE standards. Algorithms that meet the expected levels of performance could, ultimately, be implemented as a software construct at no cost to performance.

For an algorithm to be employed in this way, said Cornea, it would first need to generate the correct IEEE results for all possible input values and computation modes allowed by the IEEE standard for binary floating-point arithmetic. Counting the number of clock cycles per operation would then reveal whether the algorithm meets performance expectations. "For divide, the algorithms would most likely be inlined by compilers, as a fixed sequence of assembly language instructions", he explained. "For square root, they would probably be packaged as library functions. Firmware might also be used to store them."

The result of such software implementations would be a reduction of processor size. (Source: *Scientific Computing World*, June 1998)

New Internet protocol for geographic data

Users of geographic information systems (GIS) may soon be able to communicate their results more easily using the Internet. The Canada-based company Global Geomatics has announced the first commercial products based on a new, open Internet protocol. The protocol is called Open Geospatial Datastore Interface (OGDI) and was developed by Global Geomatics and the Canadian Department of National Defence.

The OGDI protocol supports digital geographic vector and raster data formats. These include desktop GIS, CAD drawings, scanned images and maps, satellite imagery, Vector Product Format and terrain elevation data. Global Geomatics offers a Java and C-based Application Programmers Interface (SPI) that allows any program to benefit from OGDI. Software for the publication of geographic data on the Web is also available.

The company claims that software based on OGDI will solve many of the problems associated with integrating digital geographic data into information systems, and will encourage the creation of large digital geographic libraries. (Source: *Scientific Computing World*, November 1998)

Fast protein database available on the Web

A Web-accessible database at the US's San Diego Supercomputing Center (SDSC) is claimed to be revolutionizing the way that protein structures are compared and studied. The database is installed on a 256-processor Cray T3E supercomputer at the University of California, San Diego. It is available to the public and contains more than 8,000 protein structures. The system can be used to study proteins already in the database, or to submit new protein structures for comparison.

The database was developed by SDSC researchers Ilya Shindyalov and Phil Bourne. Employing the Cray T3E reduced the time required to create the database to several weeks, compared with one and a half years on a less powerful computer, say the researchers. The T3E has also greatly reduced the time required to search for similarities among the 8000 protein structures. Using 24,000 processor-hours, the T3E is able to compare each protein with every other one in a few weeks. Other computers might take up to 50 years to carry out the same task.

The analysis method, developed by SDSC scientists, examines and compares local geometries in the protein structures. The comparison of proteins by the SDSC method has brought together some unlikely pairs. For example, one snake toxin shows strong similarities to a harmless bacterial enzyme used for nitrogen transportation. The database can be found at <http://cl.sdsc.edu/ce.html>. (Source: *Scientific Computing World*, October 1998)

Common file formats for sharing text

Document file formats fall into two broad classes: proprietary formats and standardized formats.

Most word processors have their own proprietary file formats, but fortunately all the big name products on the market today are able to import and export files to other common formats. Thus, if you are using Microsoft Word under Win 95 and you double click on a WordPerfect 5.1 for DOS file, you will be told "Word is converting filename.doc". The advantage of these kinds of conversions is that they preserve most of the low-level formatting, such as bold and italics, and can even preserve some of the advanced functions.

However, when transferring documents, what do you do when the destination program does not have a conversion utility or when you cannot be sure what word processor the recipient is using? If the file has little or no formatting, use a text-only format (more about this later). The various text formats mostly use .txt as the file extension and these files can be read by almost any computer and any program.

If you need to preserve basic formatting, an excellent choice is Microsoft's Rich Text Format (*.rtf). RTF is a widely used standard, supported by all the recent big name word processors. With the spread of Web browsers, a viable alternative to RTF is hypertext mark-up (*.htm), which also preserves all the basic formatting.

If neither RTF nor HTM are suitable, try using a proprietary format that is widely used. WordPerfect 5.1, for example, was almost a standard at one time. Most, if not all, of the word processors released in the last five years will be able to convert WP5.1 files. An early version of MS Word is another possibility.

When formatting is not critical, or when all else fails, save your document as a text file. Here is a quick overview of the various text formats. The following are the text file options presented by Word's Save As command.

Text Only—Saves text without its formatting. Soft returns at the end of each line remain soft. Tab characters are retained, but paragraph indenting is lost. Select this format only if the destination program cannot read any of the other available file formats.

Text Only with Line Breaks and MS-DOS Text with Line Breaks—Saves text without formatting. Soft returns at the end of each line are converted to hard returns. Tabs are retained and indenting is lost.

Microsoft's advice is, "Use this format when you want to maintain line breaks, for example, when transferring documents to an electronic mail system".

MS-DOS Text—Converts files the same way as Text Only. Uses the extended ASCII character set, which is the standard for MS-DOS-based programs. Use this format to share documents between Windows and non-Windows-based programs.

Text with Layout and MS-DOS Text with Layout—Preserves line breaks. Inserts spaces in a converted document to approximate indents, tables, line spacing, paragraph spacing, and tab stops. Converts section breaks and page breaks to paragraph marks. Soft returns e-mail soft.

Using Microsoft Word 97, if you use Word to reopen a Text with Layout document, indented paragraphs are recognized as such and the correct paragraph formatting applied. However, if you use the Windows Notepad or Lotus Word Pro to reopen the file, the paragraph is indented by the insertion of multiple spaces.

Unicode—Unicode is an encoding standard which can represent the text of the many alphabets spoken in the world. It is a 2-byte (16-bit) code, so it can handle far more than the 256 characters allowed by conventional code pages.

Unicode is a superset of 8-bit ANSI, which is itself a superset of plain 7-bit ASCII. Currently, the Unicode standard contains 34,168 distinct coded characters derived from 24 supported language scripts. These characters cover the principal written languages of the world. (Source: CIA, October 1998)

Information and contacts for service exporters in developing and transition economies

<http://www.intracen.org/serviceexport>

What is it?

A "one-stop" resource to help service companies develop and expand their ability to export services.

The Homepage provides information on all service categories and sub-sectors as defined under the General Agreement on Trade in Services (GATS), concluded as part of the Uruguay Round. It offers help on bidding and tracking internationally-funded projects and contains a list of important Internet links relating to services markets and marketing.

The One-stop Shop features information, links and contacts that allows visitors to share information, identify export opportunities, locate strategic partners, develop international linkages, learn from international success stories, exchange ideas, discuss challenges and provide advice and solutions.

Who is it for?

Service enterprises, professional associations and governments.

Access to the One-stop Shop is available to everyone. Listing on the enterprise database is limited to developing countries and economies in transition. Business opportunities sought and offered by enterprises in industrialized countries are displayed on the on-line bulletin board.

For more information: Peter Slessor, Trade in Services. Tel.: +41 22 730 0517; Fax: +41 22 730 0578; e-mail: slessor@intracen.org (Source: *International Trade Forum*, January 1999)

Putting the Internet into perspective

What are some of the key issues involved in using the Internet to have a positive impact on business processes in Africa?

Infrastructure—The huge latent demand for telephone lines in Africa is evidence of poor infrastructure. How can the Web then be a viable business tool for

African business? The emergence of satellite and cellular technology is making it possible for countries to leapfrog the normal technology progression curve and make an immediate entry onto the international playing field. Plug your PC into your mobile phone and you have the ability (through an Internet service provider) to access the Internet. This is one way in which African companies are going to be able to bypass infrastructural inadequacies.

The immediate benefits of Internet access are obvious: a greater proportion of connected people will be able to increase the volume and frequency of their communication and the transfer of information. This can only lead to improved levels of competitiveness.

Cost of hardware—Even if an average consumer could get access to an ISP, the cost of hardware would be a pitfall. Finding creative ways around this issue for the general consumer might mean the roll-out of community-based initiatives with learning centres built into traditional meeting places. Multi-user terminals with pay-as-you-go access could be sponsored by corporate or government social development budgets.

When it comes to business, the issue is reduced to a cost-benefit decision. This makes the up-front strategy for using the Web as a business tool that much more critical.

Vast geography—The expense associated with cross-border travel to meet and collect information or learning is considerably reduced with the introduction of Web-based communication. E-mail is the biggest use for the Internet and for Africa this represents a way to overcome the dispersed nature of business activity. Connecting geographically dispersed business via the Web is an accelerated way to present global business partners or competitors with a unified African face.

Multinationals—Much of the existing business activity, and undoubtedly future business activity, is and will be driven by the multinationals. They require that their African business interests be cohesively networked. The Internet is the perfect way to facilitate this.

Moreover, multinational pressure on local manufacturers, distributors, sales agents and retailers will see accelerated development in Internet-based communication for all those involved in the buyer-supplier chain. If you want to be competitive as a business outside of a multinational or be an attractive partner to a multinational, it is imperative that Web technology form an immediate part of your business planning.

Training and education—E-mail should not be the limit of your Web strategy. Distance learning is a huge growth aspect of the Web world and has enormous implications for Africa. Given the infrastructure and cost implications of setting up a physical world training operation, especially for a multi-country network of

operations, the Internet makes perfect sense. It is the ideal medium for delivery of training material, as it reduces costs and spans geography. Moreover, its innate properties can add huge value to training material because it is:

- Interactive;
- Real-time;
- Measurable;
- Modular;
- Unobtrusive.

Take, as an example, primary health-care initiatives in Africa. Each new clinic will require initial and ongoing training of nursing staff. The Internet could be used to deliver centrally-updated course material, backed by live interaction with trainers.

The Internet provides the ability to leapfrog the traditional development curve to place one immediately on the global playing field.

Why register your domain name?

Internet domains form a small but vital part of the on-line mix. Why is it critical? Because it is the first place people will look for you on the Internet.

The default is to try and guess the name. So, if your target is an American company you will try the form `www.company-name.com`. If that does not work, only then will you use a search engine. By that stage you may have lost a potential visit, or a potential client, to boredom or impatience, says Alison Wright, marketing manager of The Internet Solution, a South African Internet service provider.

According to Wright, there are two issues involved in deciding how urgently to consider registering your company or brand name as a domain. Firstly, there is the possibility that domain sharks could register the domains corresponding to your trademarks before you do, and then ask you to pay them to return them. You are particularly at risk if your trademark is a generic word. If your firm is the Nairobi-based "Golden Bus Company", the `www.golden.co.za` address does not necessarily denote your brand and does not necessarily revert to you in the case of a lawsuit.

The other issue to consider is that there might be another company with a similar brand, which might get there first. If, for example, a company called Golden Nurseries were to register the domain, they would have as much legal and moral right to it as the Golden Bus Company.

(Source: *CIA*, December 1998/January 1999)

tolerant, and packets of data arrive at different times. The traffic is mainly one way (downloaded).

Once the information is received, the customer normally reads the page and keeps the communications link alive. UMTS will maintain a virtual link, by means of a signalling (as opposed to the data) channel, so that once the data has been downloaded, the customer pays nothing more until the next information request. In addition, UMTS will potentially offer an asymmetrical two-way link allowing large data-dumps to the customer while retaining only a small link in the opposite direction. During the time the user is reading the downloaded page, network resources can be reallocated to other users.

Service concept

The third-generation mobile system is customer focused: its aim is to provide seamless services regardless of terminal type, network, or access method. As part of the service ethos, the virtual home environment (VHE) is another new customer option. VHE will let customers retain and personalize their services anywhere—and use them at any time in both wireless and wired environments. Third-generation systems also will allow users to determine the quality of the voice or video call, and pay accordingly.

Users will have specific services—voice mail, fax, and perhaps some video services—which they will resort to regularly. They may also set up an easy way to access the services, possibly using a Web browser and short codes to telephone friends. If the customer roams to a different country and hence to a different network operator, UMTS will ensure that the specific services are not only available, but that his or her preferences are retained. The preferences may include how goods purchased over the Internet are paid for and how services react when the bandwidth is decreased.

The UMTS system offers a layered approach to coverage. In small, localized areas (picocells) like offices or homes or filling stations, for example, the available radio access bandwidth is relatively high, up to 2 Mb/s. The picocell will be covered by a larger microcell, which offers a lower bandwidth of 384 kb/s and may cover a few square kilometres.

The picocell and microcell, will be covered by a larger macrocell offering even lower bandwidth services (144 kb/s) over a large area such as a city. A global system of satellites will cover remote areas. While much attention is being given to cellular operators, UMTS also applies to wireline operators. The latter will offer the same capabilities and provide higher bandwidths, including broadband services.

Thus, substantial progress has been made in defining wireless standards for third-generation systems. But there is a lot of debate about how UMTS will be implemented in network architecture since the core specifications have not yet been defined. The future network must support different access mediums—from wireless local loop to cellular to corporate wireless local-area network (LAN). This means adapting data transfer rates from 9.6 kb/s

(the current GSM data rate) to 5 Gb/s for full broadband data.

Since cellular network operators have a considerable investment in GSM, it is unlikely they will dump old technologies and invest in new ones in a single step.

UMTS will be phased in just as GSM was, and GSM's ongoing evolution will ease the transition to UMTS. New network architecture will be introduced within a year to expand GSM services. These services, called GPRS (general packet radio system), provide packet data or connectionless services that add functionality and flexibility to existing GSM services.

In addition to network changes, the GSM radio interface is being modified to offer new coding schemes that increase the standard GSM data rate of 9.6 kb/s up to 69.2 kb/s on a single time slot. Called EDGE (enhanced data rates for GSM evolution), this development is now being discussed in the GSM standards forum, and would involve using different radio-coding schemes so that more bits may be transmitted within the same bandwidth.

Both GPRS and EDGE introduce variable data rates and asymmetrical services by combining technologies and different coding schemes to uplink and downlink traffic. These new architectures and services will help soften the edges between current GSM systems and UMTS.

The combination of different access methods is intended to provide both flexibility and network efficiency. The UMTS terminal will adopt the access method that best suits its environment; this will give optimum performance.

Smart phones

- While mobile phone usage has been growing at a fast pace globally, mobile data usage in the public arena is low. Several reasons account for this sluggish acceptance.
- Low data rate: GSM offer only a 9.6-kb/s transfer rate;
- Complexity: users not only need a personal computer, a cell phone, and potentially a data card, but also the ability to configure, run, and ensure that the other end of the system is also set up properly;
- Expense: in many countries, cellular service is still costly;
- Unfriendly data support: people complain that they need a science degree to configure and run the services.

It is interesting to compare current mobile data usage with forecasts suggesting a massive swing toward mobile data. This will not happen immediately. Many factors will combine to encourage this trend. While the higher data rates offered by advanced GSM and the UMTS network should increase usage, other areas such as terminal evolution and dual-mode handsets will push the process along.

GSM/satellite will soon appear with systems being put into Earth orbit by Iridium, Globalstar and ICO. These devices will soften the edges between technologies and networks, support global roaming, and make digital voice and data communications available everywhere.

With improvements in electronic integration, credit card-sized cell phones that can slot into a standard PC are appearing. It takes little imagination to foresee multimode handsets incorporating the many radio access methods used across the globe and so providing true worldwide coverage. The concept of the world phone is dawning.

Smart phones are also emerging. They add PC/organizer functionality to a cell phone/wireless terminal, beyond what has already been seen. Initial products combining organizers and cell phones such as the Nokia 9000 are being upgraded to products like the Alcatel OneTouch COM smart phone with touchscreen technology to provide user-friendly interfaces. These terminals have a touchscreen on the front of the phone that changes the display from cell phone to organizer at the touch of a "virtual button". Users can send and receive e-mail and the device can be used either longitudinally or laterally.

Beyond the five-year horizon, other developments such as the softphone are expected. A softphone is a handset that operates on different technologies and uses the most appropriate frequency for its location. The idea is for the phone to configure itself for any access network, such as GSM 1900 or GSM 900, and for any voice system, such as GSM or satellite, by downloading the appropriate technologies as software. This means the terminal would configure itself to operate with local network technology, no matter where the user is. (Extracted from *IEEE Spectrum*, October 1998)

Germany

Transforming the energy sector

Germany's new federal government has decided to gradually phase out nuclear power. At the same time, support is to be given to renewable energy sources and energy saving measures. The federal government believes that a reorientation of energy policy is necessary due to the world's limited reserves of fossil fuels and the dangers to the global climate associated with their use as well as the risks of nuclear power and the unsolved problems of nuclear waste disposal. Until now, renewable energy sources—sun, biomass, wind and water—have made only a small contribution to fulfilling Germany's energy needs. Yet their share is growing year by year.

The number of power plants generating electricity from renewable energy sources increased from 5,600 in 1990 to more than 18,000 in 1997. The greatest growth has been in photovoltaic plants, which use solar radiation to generate electricity: they experienced a 30-fold increase, rising from 228 in 1990 to a total of just under 7,000. There has been a tenfold increase in the number of wind installations, with the total rising from 497 at the beginning of the decade to almost 4,900 in 1997. The number of power plants generating electricity from biomass has increased by 47 per cent. There were also 20 per cent more hydroelectric facilities in 1997 (5,463) than in 1990 (4,387). They supplied 3.4 per cent of the electricity generated in 1997. In all, renewable

energy sources supply 5 per cent of Germany's electricity needs.

In the restructuring of the energy sector, the experts are relying on improved efficiency and energy saving, itself a substantial "energy source".

In the long term, believe supporters of the new energy policy, Germany could meet all its energy needs from renewable energy sources. A sustainable energy supply could be built on an intelligent mix of energy sources based on solar cells, wind farms (also over the surface of the sea), hydroelectric power, biomass-based district heating power systems, the generation of electricity from organic waste, hydrogen-based systems, and possibly the importation of electricity generated in southern countries with the aid of solar thermal technology. (Source: *Deutschland*, 1998)

India

E-mail in India

As part of the liberalization drive in India, electronic mail is the first value-added service to become operational in the services sector that the Government has thrown open for private participation. The service is currently being offered by only a couple of commercial firms, but their numbers will increase soon as more firms are obtaining licences to operate. Presently, there are around 45,000 people using e-mail in India.

The major factors that impede the growth of e-mail in the country include: an inadequate telecom network, lack of IT awareness among users, non-permission to interconnect VSAT and e-mail services, and lack of cooperation among service providers. Currently, a subscriber of one e-mail service is not able to communicate with another one hooked on to a different service provider locally, due to the failure in complying to the same ID format.

In reality, the e-mail service in India is around five years old, with competition increasing. Soon, subscribers will clamour for connectivity to the users of other networks, and demand a larger reach for lesser charges. Catching up innovations in e-mail delivery will become a necessity. Introduction of e-mail culture in an organization improves motivation and boosts the morale of the staff, leading to greater participation in an organizations' quest to achieve excellence. (Source: *Online and CD-ROM Review*, 22(5) October 1998).

Remote services boom

Remote services may be a market in which India can beat the world. It has a vast population, low wages and a good grasp of English. At present, some 25,000 Indians are employed in remote services, reckons the National Association of Software and Service Companies (NASSCOM). McKinsey, a consultancy, thinks that the number will rise to 3 million people within the next 10 years.

Software showed the way. India has been writing and debugging code for the world for over a decade, and it is

now busy fighting the millennium-bug menace. Software exports are worth \$2.7 billion a year. Remote services—using software rather than writing it—could some day make that seem a small change.

The work ranges from typing in telephone-directory entries to conducting basic research, and everything in between. It is mostly stuff that is too routine for expensive western workers, who could be serving customers directly; but not so repetitive that machines can do it.

Western companies with big back offices are setting up operations in India, or hiring Indian-based firms to do the work for them. British Airway's two-year-old World Network Services, based in Mumbai, handles an array of back-office jobs for its parent and other airlines, including dealing with errors that pop up in automatic reservation systems and keeping track of frequent-flier miles. Selectronic, a two-year-old firm in Delhi, plucks doctors' dictation from a toll-free number, transcribes the recordings and sends the results back as text to an American Health Maintenance Organization (HMO).

Although they serve so many different industries, such firms have a lot in common. Their growth rates are startling: BA's operation has grown to 750 in two years and it is hiring 800 more workers for a new office in Pune. GE grew from 50 to 700 employees during 1998 and is adding workers at a rate of 100 a month.

Cultural fusion is another common feature. Since these companies are outposts of American or British firms and adhere to their standards, they must master not only unfamiliar terms but also the mind-set behind them. At Selectronic, a six-month training course in American medical terminology is supplemented with group viewings of Chicago Hope and Emergency Rooms, accompanied by take-away pizza.

What makes it all worthwhile is India's cheap, high-quality labour. Although half the population is illiterate, India's universities produce roughly 2 million degree-holders every year, most of whom have some facility in English. Many of those employed in the remote-services business would be deemed overqualified in the West.

Unlike the software business, India's other world-class industry, remote services do not employ only the highly educated. Selectronic recruits from its lower-middle-class Delhi neighbourhood. Its employees may speak English less fluently than GE's, but Selectronic compensates with rigorous training and a checking process that vets every one of the 1.3 million lines of transcription the company produces monthly.

Back-office work makes up the bulk of the business, but remote services range beyond that. Bechtel, an American company, has a team of engineers in Gurgaon working on construction projects worldwide. Pfizer and Quintiles, two American health-care firms, find India's crowded hospitals ideal venues for conducting cheap trials of new drugs (strictly to international ethical standards, they insist). Decision Support International distributes financial data, telephone books and college catalogues to tiny, independent data factories across Delhi and Madras, where they are fed into computers and rearranged

into new products for sale by its mostly American customers.

McKinsey reckons this business will be worth \$50 billion by 2010. What could stop this happening? The price of telecommunications, several times American and European levels. Unless rates come down, India will lose out on call centres, a business that is expected to grow fast. Another worry is stifling bureaucracy and regulation. Automation also looks a threat, but may prove an opportunity. The more information that is collected by machines, the more errors creep in that need human intervention. BA found that customers were offended by machine-generated letters. Now it customizes them in India.

The Government knows it is on to a good thing. Last July it said it would exempt remote services' export earning from corporate tax, putting the business on the same footing as software. The industry's best hope is a big effort by the Government to free it from the regulations that killed manufacturing exports at birth. (Source: *The Economist*, 16 January 1999)

Israel

High-tech incubation

Although Israel has been developing technology for years, primarily for military use, the past decade has seen high-tech become the country's primary export. In great part this is due to the influx of highly-skilled immigrants from the former Soviet Union and from the improved political climate in the mid-90s following the signing of peace accords. To employ the hundreds of thousands of immigrant scientists and engineers, the Government set up the technological incubators programme.

One thousand start-ups are currently in incubators or have recently left to operate alone. Another 2,000 or so fledgling companies were established without government support, often with the help of foreign investors.

The incubator project currently has a 51 per cent success rate: just over half of the companies survive after leaving the nest. Another mark of the initiative's success is the fact that foreign investment in ex-incubator companies has reached \$200 million and now exceeds government investment, one of the project's primary aims.

Foreign investment in Israeli high-tech comes in several forms. There are venture capital funds, which bring together private and corporate investors lured by Israeli technical skills and by government grants and tax breaks. Acquisitions and mergers between start-ups and larger multinational concerns are also becoming more common.

Another more hands-on form of foreign investment is proving popular, especially in electronics, the largest high-tech industry sector covering telecommunications, components, defence and medical technology.

The electronics industry employs 45,000 people in a country of only six million. Electronics sales rose by

12 per cent from 1997 to over \$8 billion in 1998. Some examples of start-up success include two-year-old Verisity, a player in the electronic product verification market, and Mango Computers.

However, despite the fact that Israel has more scientists and engineers per head of population than the US, not all is smooth sailing for start-ups.

First, there is rarely a local or regional market for the technology, which is a disadvantage from the outset. Then there is the manpower shortage: science and engineering just does not pull in young Israelis like business studies and law.

While there is nothing to be done about the first, the situation is changing on the second point, thanks to a government programme called Education 2000. (Source: *Electronics Weekly*, 24 February 1999)

Malaysia

New Malaysian Fab Venture Announced

A start of a new semiconductor contract manufacturing venture, 1st Silicon (Kuching, Malaysia) was recently announced by Datuk J. C. Fong, chairman of the company's board of directors. The new company is funded and supported by the Malaysian State of Sarawak and individual investors.

The facility will be built in the Sama Jaya Free Trade Zone of Kuching, which is sufficient for two wafer fabs. It is estimated that the company will reach a production capacity of 20,000 wafers per month in the year 2000. Plans are also in place to establish an office in Northern California in late 1998 to handle liaison activities between US customers and headquarters in Kuching. In addition, future design engineering, marketing and sales personnel will be located in the United States. (Extracted with permission from *Semiconductor International Magazine*, September 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Spain

HPCN programme for Spanish industry

A new programme has been set up in Spain to promote the application of high-performance computing and networking (HPCN). Coordinated by the European Centre for Parallelism of Barcelona (CEPBA), the CEPBA-TTN technology transfer node is encouraging the use of HPCN technology by commerce and industry, particularly by small and medium enterprises (SMEs).

Ten industrial sectors have been targeted by the programme including aerospace, automotive, optics and the environment. To educate industry on the benefits of parallel computing, five demonstration programmes have been created. Topics covered include parallel design tools for ophthalmic lenses, parallel numerical simulations for fatigue analysis and parallel software for aerodynamic and acoustical design.

CEPBA-TTN is also coordinating the creation of HPCN industrial applications. The Parallelization of

Wave Simulation (PARAWAS) will parallelize numerical simulations that model the effect of coastline development. The Advanced Communications Applied to Aerospace Development (ACATAD) is applying Internet communications and computer-supported collaborative work (CSCW) practices to the Spanish aerospace industry with the goal of linking together large and small aerospace companies, universities and research institutes. (Source: *Scientific Computing World*, May 1998)

Tanzania

Computers donated

The United Nations Population Fund (UNFPA) has donated 100 computers, worth US\$ 350,000 to the Tanzanian Government for a population census to be held this year. UNFPA resident representative Teferi Seyoum said 20 PCs would be installed immediately for training and processing of the census data. (Source: *CIA*, February 1999)

United Kingdom

Home Internet access costs more in UK

The UK tops Europe as the most expensive place for home Internet access, according to analysts Datamonitor.

Despite having the second highest number of subscribers at over two million, the average subscription cost per month for the UK was \$25.44 in 1998. Germany, which at over 4.5 million has the largest number of subscribers, was second highest with a monthly cost of \$24.14. Sweden's near one million subscribers had the lowest fees at just \$5.29.

Yet despite the high costs, Datamonitor expects the UK home on-line market to be boosted with the advent of free Internet access services.

Dixons' Freeserve has already succeeded in gaining 900,000 subscribers, almost half the UK market. Such competition will spur service providers to reduce access costs, as has already happened in the more mature European markets. (Source: *Electronics Weekly*, 27 January 1999)

Government starts initiative on solar power research

Energy Minister John Battle has announced government sponsorship for solar energy projects.

The initiatives are:

- A field trial of photovoltaic (PV) installations in 100 homes with the aim of creating a design manual for house builders;
- Development projects for PV systems and components where the DTI will put up between 25 and 50 per cent of total costs from a £1 million budget;
- To showcase large-scale building applications, with the hope of funding five to six a year.

The total budget is several million pounds, said a DTI spokesman. (Source: *Electronics Weekly*, 24 February 1999)

JEMI UK opens Scottish technology transfer centre

The Joint Equipment and Materials Suppliers Initiative (JEMI UK) has moved to the Edinburgh University campus in Scotland. JEMI is a non-profit association of 40 large and small companies. It supplies the British wafer fab industry with equipment and materials. It has sister organizations in France (JEMI France) and in Germany (VDMA Productronic). These three associations and firms in The Netherlands are members of Semiconductor Equipment and Materials European Association (SEMEA), a pan-European association for equipment and materials.

Dr. Neil Downie, Chief Executive of JEMI UK, said that Scotland is the most important area for semiconductor production and is often referred to as "Silicon Glen", because like the Silicon Valley, it has a high concentration of this industry. Thus it makes sense for JEMI to have its headquarters in Scotland. The move also allows JEMI to be closer to the University of Edinburgh, a leader in silicon technology with several spin-off semiconductor-related companies to its credit, and poised to start the construction of a new R&D clean room facility.

The United Kingdom is the largest semiconductor producer of all European countries. It is the location of the European headquarters of many suppliers to the industry, and all of the major equipment makers maintain a strong presence. There are large world-class semiconductor suppliers manufacturing in the United Kingdom, including BOC Edwards for gases and vacuum pumps, Applied Materials for ion implanters and Trikon for machines for the innovative ForceFill pressure-based via filling process. Smaller firms such as VG Scientific, Oxford Plasma Technology and Oxford Instruments, STS and Lumonics also build world-class equipment in the United Kingdom. Services also are well represented with world-class operations at the Ministry of Defence laboratories at Malvern, the Edinburgh University Micro-fabrication Unit and the Central Microstructure Facility of the Rutherford Appleton Laboratory in Oxfordshire.

JEMI maintains close links with the Government and encourages its members to take advantages of UK financial support. There are generous schemes available in areas of high unemployment or heavy industry closure for setting up new company operations, along with well-supported R & D schemes. (Reprinted with permission from *Semiconductor International Magazine*, September 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

Seiko-Epson sets up UK R&D site in Cambridge

Seiko-Epson has set up a UK research and development facility in Cambridge, a move which will boost development of Cambridge Display Technology's (CDT's) light emitting polymer (LEP) displays.

"Seiko Epson has been collaborating with Cambridge University's Cavendish Laboratories for over three years and this is an extension of that collaboration," said Satoshi Nebashi, manager of the new laboratory. "We will

be performing basic research on thin-film transistors and organic optical electronics."

Organic optical electronics includes Seiko-Epson's work with CDT on LEPs. These were invented at the Cavendish Laboratory and Seiko-Epson's LEP work is the most advanced among CDT's technology partners. (Source: *Electronics Weekly*, 11 November 1998)

Imaging research centre

Described as a UK first, the Centre for Industrial and Medical Imaging (CIMI) was officially opened at the University of Nottingham in November 1997. Funded by the European Union, the goal of the Centre is to provide a platform for the practical implementation of new computer imaging technology. This will be done both through imaging research and development as well as through the transfer of technology to industry, commerce and medicine. The scope of the Centre will be broad, covering technologies that range from pattern recognition to virtual reality visualization.

CIMI currently consists of two divisions and a Reality Centre. The role of the Reality Centre is to develop simulation and reality modelling applications for high-performance computers. The Image Analysis division is concerned with practical image analysis solutions across many disciplines. The Computer Imaging Research division is described as the foundation of the Centre's activities. Researchers in this division are developing advanced imaging technologies in a number of fields including geography, medicine, science and engineering. (Source: *Scientific Computing World*, December 1997)

Foresight LINK gets drive

The Government is providing £5 million to fund new research into vehicle technologies for energy efficiency and emission control.

The Foresight Vehicle LINK programme supports projects between industry and academia to develop new vehicle technologies.

The emphasis for the latest funding stage is to improve energy efficiency, reduce emissions and enhance occupant safety. The vehicles can range from a car to a lorry, and can include public transport.

One project already started involves the investigation of virtual controls. This is based on the idea that a driver's gestures will be seen by a camera and interpreted accordingly.

Another project is looking at the concept of supplying electronics that is guaranteed not to fail during the life of the car, requiring reliable software and hardware.

With the Foresight programme, it is industry which proposes project ideas. Those that are selected then receive funding for up to half of the project's total cost. To date, industry has supplied some two thirds of the project costs.

The initial call for Vehicle LINK projects was oversubscribed by a factor of eight. There are currently 150 organizations involved in the programme. (Source: *Electronics Weekly*, 7 October 1998)

IP centre opened in Scotland

An intellectual property (IP) trading centre in Livingston, Scotland has been formally opened by Scottish Enterprise.

Called the virtual component exchange (VCX), the centre is the third and final part of Scotland's Alba Centre. It follows Cadence's system-on-a-chip design house and the University Masters degree courses in system level integration.

The VCX will address the business issues raised by the trading of IP. As such it sits alongside the virtual socket interface alliance which is looking at the physical issues of how IP blocks are integrated into chips.

Scotland's legal system makes it the ideal place to site a trading centre.

Several high profile companies have joined Scottish Enterprise as founder members of the VCX. They include ARM, Cadence, ISS, Mentor Graphics, Motorola, Phoenix, Siemens and Toshiba.

Further links will be forged with IP developers and existing "IP banks" such as Design & Reuse and NeuW. (Source: *Electronics Weekly*, 28 October 1998)

United States of America

Multi-million dollar university-based research programme under way

The US semiconductor industry and the federal government have formed a new microelectronics Focus Center Research Programme targeting the most challenging technological problems the industry will face in the future. The Focus Center Research Programme is negotiating with university consortia led by the University of California at Berkeley and the Georgia Institute of Technology over multi-million-dollar research and development contracts that will study new methodologies in designing, testing and connecting microchip components.

Upon the successful review of the first two centres, the industry plans to establish four additional focus centres nationwide, which will lead the research efforts of a multi-university network. Funds for the focus centres and participating universities will provide salaries for students and faculty, along with equipment and upgraded facilities.

The programme is the most ambitious research project the US semiconductor industry has undertaken since 1987 when it formed SEMATECH, a consortium of US chip manufacturers created to establish US leadership in manufacturing and process technology.

Funding for the future research awards will come from member companies of SIA; SEMI/SEMATECH, a consortium of US semiconductor suppliers and the Department of Defense, represented by the Defense Advanced Research Project Agency (DARPA).

"By helping to ensure the progress of the \$70-billion per year US microchip industry, the Focus Center Research Programme makes an important investment in the future of the US economy", said George Scalise, SIA president.

"The increasing cost and complexity of research and development in integrated circuit design and manufacturing has grown beyond the capabilities of any single company to address," said Larry W. Sumney, president and CEO of the Semiconductor Research Corp. (SRC), based in Research Triangle Park, NC.

A new subsidiary of SRC, the Microelectronics Advanced Research Corp. (MARCO) will manage the Focus Center Research Programme on behalf of industry programme participants. Researchers at the focus centres will generate ideas for technology solutions. Then the Government and member companies of SRC, SEMATECH, SEMI/SEMATECH and SIA will play a critical and complementary role in bringing appropriate ideas to successful commercialization. (Reprinted with permission from *Semiconductor International Magazine*, September 1998. Copyright 1998 by Cahners Publishing Co., Des Plaines, IL, USA)

NOAA selects IBM for new NWS supercomputer

The National Weather Service has awarded a contract to lease a new supercomputer from International Business Machines (IBM) that will significantly improve its weather, flood, and climate forecasts for the country. A NOAA spokesperson said the four-year, \$35.6 million contract, awarded to IBM of Somers, New York, is contingent on the availability of funding.

The new high-performance Class VIII computing system will allow the NWS's National Centers for Environmental Prediction in Camp Springs, Maryland, to operate more sophisticated models of the atmosphere and oceans to improve weather, flood, and climate forecasts for the country. A Class VIII computer is a system representative of the eighth generation of high-performance computers, where each generation represents approximately a 5- to 10-fold increase in sustained computational power over the previous generation.

The new system will use a highly parallel computer architecture to immediately provide a significant increase in computational capacity as compared to the current system, a Cray C-90 supercomputer from Silicon Graphics Inc. The new supercomputer, which will be housed at the Suitland Federal Center in Suitland, MD, will be integrated into routine operations beginning in the spring of 1999. The transition of operations to the new system will be completed in late 1999. (Source: *Sea Technology*, November 1998)

Funding for WTO's info tech project in developing countries

The United States Department of State has made a grant of US\$ 90,000 in support of the World Trade Organization (WTO) information technology initiative for least-developed and developing countries. This initiative aims, through the use of information technologies, to support the integration of some 50 least-developed and developing countries into the multilateral trading system.

The United States grant will help provide Internet connections, computer equipment (personal computers,

printers, modems, etc.) for the operation of WTO Trade Reference Centers in these countries. The centres enable trade ministries to keep in touch with WTO activities via the WTO Internet site (www.wto.org) and the Trade and Development Centre (www.itd.org), jointly operated by the WTO and the World Bank. Through these and other trade-related Internet sites, ministries can gather informa-

tion from electronic trade databases which will enable governments to better utilize the multilateral trading system.

The US contribution comes in addition to grants already provided for the same project by Norway, Hong Kong (China) and the Netherlands. (Source: *WTO Focus*, October 1998)

H. Standardization And Legislation

Standardization

New group turns the first page on e-book standards

The Open Electronic Book Standards Committee (OEBSC) recently launched its effort to develop voluntary standards for the emerging electronic book industry. The Committee, which includes book publishers and electronics executives, met during Electronic Book '98, a workshop co-sponsored by the National Institute of Standards and Technology (NIST) and the Video Electronics Standards Association.

E-books are hybrid products that combine features found in books and computers. Manufacturers hope to take advantage of advances in fields such as video display technology and high-capacity storage media (such as digital video display or semiconductor memory) to produce the next generation of easy-to-use, portable, battery-powered e-books.

Members of OEBSC would like to develop standards that would support the growth of the industry within a year.

A major goal of OEBSC is to develop voluntary standards for electronic content. Another goal is to ensure "interoperability" among the different electronic books coming on the market. This interoperability would allow consumers to buy a machine from one manufacturer and purchase the actual text of a book from multiple sources.

For more information, contact Victor McCrary, NIST, 100 Bureau Drive, Stop 8951, Gaithersburg, MD 20899-8951. Tel.: 975-4321. (Source: *NIST Update*, 9 November 1998)

Electronic bookworm

Major computer, software and book publishers have launched an initiative to set standards for the first electronic books.

Known as eBook, the hand-held terminal could become a mass market electronics product fuelling demand for chips and displays.

"The Open eBook standard is designed so that early purchasers of eBook titles will be able to read their 'books' on all devices supporting the standard", said

Microsoft vice-president Dick Brass, in charge of Microsoft's eBook projects.

Japanese electronics giant Sharp teamed up with US firm NuvoMedia to develop Rocket eBooks. These will be 600 g handheld computer devices with a high-resolution Sharp LCD screen. Rocket eBooks will hold 4,000 pages of text. (Source: *Electronics Weekly*, 14 October 1998)

Electronics firms put wheels on drive for automotive standard

US electronics firms have come out in support of an initiative by leading car makers to define a standard for automotive data and communications.

The electronics firms are creating a separate consortium to support the Automotive Multimedia Interface Consortium (AMIC) created by car manufacturers Chrysler, Daimler-Benz, Ford, General Motors, Renault and Toyota.

AMIC's goal is to support the ITS data bus hardware specification with an interface standard that allows electronics products to work in cars.

The AMIC supporters claim that, by having a set of standards, drivers will be able to install a range of products such as car navigation systems, car computers and telecommunications equipment.

The telematics market is expected to affect 1.2 million vehicles by 2003 according to market research firm Strategy Group.

Called the Telematics Suppliers Consortium (TSC), the group of supporting electronics companies comprises Hewlett-Packard, Motorola and Navigation Technologies with further members to be announced at a later date. (Source: *Electronics Weekly*, 28 October 1998)

Disagreement looms over next digital TV standard

Set-top box manufacturer Pace Micro Technology is predicting the end for the European DAVIC cable modem standard, with a US-developed system taking a lead.

The UK's largest cable company, Cable & Wireless Communications has ordered 100,000 set-top boxes which will use the multimedia cable network system (MCNS) rather than DAVIC, the European digital video

broadcast (DVB) standard. Other European cable companies are following suit, according to Pace.

Pace claims that silicon conforming to DAVIC is not yet in large-scale production. Even when it is released, no one is sure whether the devices will actually work together. (Source: *Electronics World*, October 1998)

56 K modem standard continues to break new ground

At the recently held meeting of ITU Study Group 16, the multimedia group of the Telecommunications Standardization Sector of the International Telecommunication Union, approval of the new V.90 (56 K) modem standard was completed with the unanimous agreement of the Study Group. At the same meeting, the approval process was initiated for a new all-digital version of the same technology which is to be known as V.91.

ITU, a specialized agency of the United Nations, coordinates global communications standards. Study Group 16 of the ITU Telecommunication Standardization Sector (ITU-T), where the work on modem standards is carried out, is responsible for the development of standards for multimedia systems.

The new V.90 Recommendation, is already finding wide deployment for Internet and on-line service access. V.90 modems are designed for use on normal telephone lines where the connections are analog at the customers' premises and digital at the service providers' premises. Unlike other modem standards, V.90 modems take advantage of the characteristics of the digital-to-analog converters present in the telephone network to achieve hitherto unobtainable high rates of transmission. Download speeds of up to 56,000 bits per second (bit/s) are possible, depending on telephone line conditions, with upload speeds of up to 33,600 bit/s.

Manufacturers formerly producing modems based on proprietary schemes have already largely migrated to the new standard. It is estimated that over 20 million V.90 modems have been supplied since the standard was "determined" for approval in February 1998. According to industry analysts, the V.90 Recommendation is expected to boost modem sales significantly. Point-Topic, a market researcher, estimates that the revenue from 56 kbit/s modems will rise to \$4.3 billion in the year 2000 from \$600 million in 1997.

Work began on the development of V.90 (previously referred to as V.pcm) in ITU-T in March 1997 and, following agreement on all substantive technical issues, the first stage of approval took place in February 1998. With final approval now granted the new Recommendation has been completed in record time.

The V.91, all-digital extension to V.90, allows modem signals to be transmitted through all-digital telephone connections which are configured for speech rather than data signals. Such connections, which terminate digitally at both the customer's and service provider's premises, have hitherto only been able to achieve data rates of 33,600 bit/s; however the use of V.91 modems will allow data to be transmitted on these lines at close to 64,000 bit/s. The standard is expected to be particularly

useful on ISDN connections where a data bearer channel is not available or cannot be guaranteed. (Source: *ITU News Release*, 27 October 1998)

New standards for multi-megabit/s network access adopted

The International Telecommunication Union has closed a vital link in the high-capacity information highway by reaching agreement on a set of new technical system specifications for multi-megabit/s network access, and initiating the formal approval process.

The new specifications, designated as the G.990 series of Recommendations, specify several techniques to provide megabit/s network access on existing telephone subscriber lines simultaneously with the regular voice communication. Main applications are high-speed Internet access, video and other on-line data communications such as electronic commerce, home office and distance learning.

"These new specifications for multi-megabit network access link well into the already existing ITU-T fibre- and coaxial cable-based standards on gigabit/s transport systems for the core network, enabling network providers to offer on demand high-capacity digital services over the last mile—another major step towards building the information society", said Peter Wery, Chairman of ITU-T Study Group 15.

The new access systems are industry's response to the yearning of subscribers for quicker network access without long waiting times and at high bit rates. Commercially very important, industry analysts foresee a market potential of several billion dollars worldwide.

The new access network specifications provide for:

- Symmetrical bi-directional access at bit rates of up to 2 Mbit/s (New Recommendation G.991.1).
- Asymmetrical bi-directional access bit rates of up to 640 kbit/s in the upstream (subscriber to network) and up to 6 Mbit/s in the downstream (network to subscriber) direction, depending on the subscriber line length (Draft new Recommendation G.992.1).
- Splitterless, asymmetrical bi-directional access (Draft new Recommendation G.992.2, previously known as G.lite). This is a simpler, splitterless asymmetrical system which can be installed by the user. Depending on the subscriber line length, the system provides upstream access up to 512 kbit/s and enables the subscriber to download data and video at speeds of up to 1.5 Mbit/s. The standard eliminates the need for a piece of equipment called "splitter" at the consumer's premises. New G.992.2 compliant modems will simply plug into the back of the PC as current modems do. Industry analysts expect that the adoption of the standard will speed up the roll-out of high-speed Internet access to consumers over existing telephone lines. It is also expected that this type of megabit/s system will become a "best seller" in the network access arena, with transmission speed of Internet data 25 times faster than today's 56 k analog modems and close to speeds achieved on cable

modems. (Source: *ITU New Release*, 29 October 1998)

Multimedia over the Internet gets a boost

Record-breaking progress in the standardization of multimedia communications over the Internet has been made in recent months by ITU Study Group 16. The work of ITU in Internet Protocol-based standards has been recognized by the Plenipotentiary Conference of ITU, which took place in Minneapolis in November 1998. The Conference integrated in the Strategic Plan, as one of the priorities of the Telecommunication Standardization Sector, the production of recommendations covering IP-related aspects as well as interoperability and convergence of IP-based networks, including the Internet, with existing network infrastructures.

Ten new Recommendations extending the use of the H.323 standard on IP-based networks have been approved in the last few months. The Group has also approved two new Recommendations for audio-visual communications over ATM networks.

The record number of approvals reflects the intensive industry interest and activity in multimedia communications over packet networks and the important role ITU-T Recommendations are playing in facilitating growth in these rapidly evolving new markets.

The H.323 family of Recommendations has been widely adopted by the industry as the standards for multimedia communications over the Internet. Recommendations for voice, video and facsimile transmission are included in the H.323 family as well as standards for conferencing, network gateways, voice services and security. The ten new Recommendations extend the H.323 family to include facsimile transmission and multimedia broadcasting over the Internet and the provision of services such as Call Hold, Call Park/Pickup, Call Waiting and Message Waiting. The new standards also provide for communications between different administrative domains, efficient call signalling over the Internet, call and device management and low-complexity single-application terminals.

The new facsimile transmission standard (Annex D of H.323) provides users with an opportunity for inexpensive long-distance facsimile transmission (calls over the Internet are not charged individually) and, together with other Recommendations in the H.323 family, the new standard creates a framework for the integration of facsimile, voice, video and data services by Internet service providers. The multimedia broadcasting standard (H.332) is expected to find widespread application for distance learning, corporate training and talk shows over the Internet.

The two new multimedia over ATM standards (H.310v2 and H.247), together with the existing Recommendation (H.321v2), provide a new framework for audio-visual communication in ATM network environments. The use of ATM networks enables higher quality videophone and multi-party videoconferencing with enhanced picture and audio quality. Recommendation H.310v2 provides a means of interworking ATM-based

systems with existing ISDN-based equipment. One important anticipated application of the new recommendations will be the ability of home workers to participate via ISDN in videotelephony and multi-party video-conference sessions with their colleagues connected to ATM-based corporate intranets.

The new Recommendations for facsimile transmission and for broadcasting over the Internet and the new multimedia over ATM Recommendations have completed the final stage of approval. The other eight new Standards (Annex G of H.225.0, Annex E of H.323, Annex F of H.323, H.341 and H450.4/5/6/7) have passed the first stage of approval and were scheduled to complete the approval process at the Study Group 16 meeting in May 1999. (Source: *ITU News Release*, 1 December 1998)

ITU starts work on important new standard for Internet voice gateways to interface with conventional telephone systems

At a meeting held from 17 to 20 November 1998 in Turin, experts from a number of companies and organizations involved in multimedia communications over the Internet started work on an important new Internet standard. The meeting was part of the work programme of Study Group 16, the multimedia group of the Telecommunications Standardization Sector of the International Telecommunication Union. The new standard, which is being referred to as H.gcp during its development phase, will be an important addition to the H.323 family of Recommendations which have already been widely adopted by the industry as the standards for multimedia communications over the Internet.

The new standard will permit control of gateway devices that pass voice, video, facsimile and data traffic between conventional telephony networks and packet-based data networks such as the Internet. Connections through such gateway devices allow callers from a normal telephone to make long-distance voice calls over the Internet.

The H.323 family of standards already provides an extensive framework for the provision of new services; the new Recommendation will permit low-cost Internet gateway devices for the first time to be interfaced in a standard way with the signalling systems found in conventional telephony networks.

Use of packet-based networks in this way is generating intense interest from telecommunication carriers and service providers who see the opportunity to offer new services based on the integration of facsimile, voice, video and data. Industry analysts estimate that international telephone traffic over Internet gateways will grow from a mere 1 per cent of all traffic in 1997 to 25 per cent by 2003 with a market value of US\$ 7 billion.

Work on the new standard started recently at a meeting of Study Group 16 and the plan is to have the new standard ready for the first phase of approval at the next meeting of the Study Group in May 1999. Study Group 16 has recently gained a reputation for rapid progress on standards in an industry noted for its short

timescales. Significant progress on the new Recommendation took place at the Turin meeting with proposals from several major telecommunications and IT companies.

Initiatives towards a standard in this area have already been taken by a number of leading manufacturers and service providers. Establishment of the H.gcp programme in the ITU-T reflects wide industry support for the work to be progressed in officially recognized standards bodies where a broad spectrum of operators, manufacturers and scientific organizations can participate.

The short timescales for the project and the high level of activity reflect the hunger for standards in the Internet industry. "Service providers and equipment vendors need this new standard urgently", said Federico Tosco, vice-chairman of Study Group 16. (Source: *ITU News Release*, 4 December 1998)

Messaging companies agree Web standard

Eleven US wireless messaging companies have agreed on a communications standard for delivering Internet-based information services.

According to the companies, the agreement will enable the broadcasting of Web site content to tens of millions of wireless communications users. The standards are based on Motorola's FLEX wireless technology.

"These new standards will allow wireless messaging companies to provide highly personalized services, which are inherently more valuable to the end user than generic information services", said industry analyst Iain Gillott at International Data Corporation.

The 11 companies, who page over 30 million customers, are Air Touch Paging, Ameritech Cellular and Paging, Arch Communications Group, Metrocall, MobileComm, Network Services, PageMart Wireless, PageNet, Preferred Networks, SkyTel and Teletouch Communications. (Source: *Electronics Weekly*, 25 November 1998)

Standards group pencils in 2001 for third-generation mobile launch

Five global standards organizations from Europe, Asia and the US have joined up to bring third-generation mobile phones to market by 2001.

"The launch of this third-generation partnership project shows the commitment of industry from the whole globe to develop the next generation mobile system based on GSM", said Karl Heinz Rosenbrock, ETSI's director general, in launching the third-generation partnership project (3GPP).

The five organizations—ETSI from Europe, TI from the US, ARIB and TTC of Japan, and TTA from Korea—represent a majority of the global mobile phone market.

By working together, they hope to ensure their submission to the International Telecommunication Union (ITU) for third generation phones to become the global standard.

Also expected to join 3GPP are China's Ministry of Information Industry and its Research Institute of Telecommunications and Transmission.

The partnership will develop technical specifications based on existing standards such as GSM and future standards such as Europe's UTRA, already proposed to ITU.

The aim is to provide worldwide coverage for third generation mobile phone users. (Source: *Electronics Weekly*, 9 December 1998)

Eight firms link up for home standard

Eight companies involved with the home audio-video interoperability (HAVi) standard have established a licensing programme.

The programme will enable interested companies to begin developing hardware and software that conforms to the standard.

This will include such products as TVs, digital VCRs, set-top boxes and hi-fi equipment.

Devices will be linked by an IEEE1394—or Firewire—bus, allowing for "hot" plug and play. Compliant software in each device will automatically sense when extra hardware has been added to the bus.

Content, such as MPEG video and audio streams, can be sent to the relevant devices without the user having to be concerned about myriad, different connecting leads.

Java has been selected as the programming language for HAVi. This leaves it open to each device manufacturer to choose their own hardware platform and design.

The first products that conform to HAVi specification are due to go on sale at the end of 1999.

The eight firms developing HAVi are Grundig, Hitachi, Panasonic, Philips, Sharp, Sony, Thomson Multimedia and Toshiba. (Source: *Electronics Weekly*, 16 December 1998)

Standards war could wreck CDMA hopes

A virtual holy war over standards proposals for third-generation mobile phones could wreck any chance of a worldwide network, says global standards authority the International Telecommunication Union (ITU).

ITU has taken the extreme step of threatening to throw out current proposals for standards if the dispute over intellectual rights is not resolved.

Unless the various warring factions agree to settle their differences by 31 December 1998, the code division multiple access (CDMA) technology could be ditched. ITU said it would select a competing standard based on time division techniques.

The dispute follows Qualcomm and Ericsson not giving permission for their intellectual property to be freely available or licensed to all. (Source: *Electronics Weekly*, 16 December 1998)

Legislation

Surfing to the music store

Two music copyright bodies have begun a pilot scheme to determine how record companies can use the Internet for selling music on line. Funded by the European Union, Britain's Mechanical Copyright Protection Society and Performing Rights Society have created a Web site

containing copyrighted music to test the reactions of surfers. At <http://www.musictrial.com>, tracks can be downloaded and copied for free.

The two bodies, jointly known as the Music Alliance, have chosen the free audio streaming package Liquid Audio for downloading and playback. The company which developed the software, Liquid Audio of Redwood City, CA, claims that it incorporates secure authorization and payment algorithms.

Gary Numan's classic dirge, *Cars*, is the first track available on the Web site. The record companies will monitor feedback from visitors to the site, says Mark Isherwood of the Music Alliance. (Source: *New Scientist*, 19 September 1998)

Copyright code

Union, a committee of 700 European Industrial property lawyers, wants the European Commission to clarify the law on patenting computer software. The present law confusingly says that programs "as such" are not patentable. No one knows what this means. Inventors often describe their software as "systems" to get round the law.

One patent examiner admitted: "It is like a camel, difficult to define, but you know it when you see it". Union fears it could take ten years to get all 15 States to change their laws, so it wants the European Patent Office to rule that a computer program cannot be patented because it is already protected by copyright. (Source: *New Scientist*, 8 May 1998)

E-commerce law

Singapore passed an electronic commerce law as part of an effort to establish the country as an international hub for growing cyber trade. "We need to create an environment of trust, predictability and certainty in the Singapore System, with good arbitration and good jurisdiction, for e-commerce to flourish", says a member of the Singapore parliament. The law explains the rules for agreeing how contracts are formed electronically and the use of electronic signatures and records. It also sets up an infrastructure under which companies that issue digital certificates verifying an Internet user's identity are licensed as trusted third parties to generate and verify digital signatures. (Source: *Communications of the ACM*, vol. 41, No. 8, August 1998)

I. Recent Publications

Just how perfect is a perfect fit?

Very perfect. It has to be. Anything less is going to create inefficiencies, and inefficiencies are going to create new costs, often soaring costs. Your engineers demand tough standards to get the best fit, and they want to make sure pieces fit snugly before they even start designing them. For your products, wear and tear must be rock bottom, and technical obstructions near zero. So that they will be needing those International Organization for Standardization (ISO) Standards here and now.

They will find them all grouped in the ISO Standards Handbook *Limits, Fits and Surface Properties*. This second, totally revised edition has all the key standards from the different technical committees involved. And contains tolerances.

Why tolerances? Realistically, of course, not even the flattest sheet of metal can be totally flat, and variants, however minimal, despite all technical rigour, are natural and inherent. Most workpieces, indeed, do not need to be an exact size. It is sufficient to manufacture a given piece so that its size is within two permissible limits. The measurement of such tolerances—the variation in acceptable size of the manufactured part—and the measurement of fitting properties, is a science that is vital in multiple spheres. When a specific fit condition is required between mating parts or workpieces, an allowance—either positive or negative—has to be ascribed to the basic size in order to achieve the required clearance. The enormous importance of the science of limits and fits in engineering is testified by the fact that educational courses in mechanical and manufacturing engineering regularly include the topic in their syllabuses. And to further confirm their key role, simply check out on the Internet the number of manufacturers in fields from automobiles to aircraft that refer to ISO standards on limits and fits.

The ISO Standards Handbook *Limits, Fits and Surface Properties* includes 41 International Standards, and is going to be the reference book needed on the factory floor and in the design office; engineers, designers, technologists and students of engineering will all have at their fingertips the standards information they need. The standards in this Handbook are subdivided into sections which cover: terminology; general limits and fits; limits and fits for screw threads; limits and fits for gears and involute splines; and properties of surfaces.

Additionally, the contents of this ISO Standards Handbook are also available on CD-ROM. Users will be given the advantages of electronic search capabilities,

easy access to the contents through hypertext links, the possibility to display multiple pages and to enlarge portions of standards as they wish (with the zoom). While the paper version is retained for those who prefer using the Handbook in this form, the CD-ROM retails at the same price, so that those who enjoy using the tools of information technology may prefer to invest in the CD-ROM today and discover the advantages for themselves.

In most products, thousands of pieces go into making it work, and all must fit together. Help your engineers make sure that all works in harmony. Give them this Handbook.

ISO Standards Handbook *Limits, Fits and Surface Properties*, 2nd edition, 1999 (the first edition of 1988 was entitled *Applied Metrology—Limits, Fits and Surface Properties*), one volume, 838 pages, SwFr 196. This price does not include postage and may be modified without prior notice. ISBN 92-67-10288-5. Available in English only from ISO members and ISO Central Secretariat.

CD ROM: ISO Standards Collection: *Limits, Fits and Surface Properties*. SwF 196. This price does not include postage and may be modified without prior notice. ISBN: 92-67-10293-1. Available in English only from ISO members and ISO Central Secretariat. ISO International Organization for Standardization, ISO Central Secretariat, P.O. Box 56, CH-1211 Geneva 20. Tel.: +41 22 749 01 11; Fax: +41 22 733 34 30; e-mail: sales@iso.ch, Internet: www.iso.ch

Understanding distributed multimedia technologies and applications

Distributed multimedia is currently one of the fastest growing technology areas due to the explosive growth in the use of the Internet and the rapid development of digital communications technology. It is having, or will have, an impact across all industry and commerce including:

- Entertainment
- Broadcast television
- Military systems
- Medicine
- Banking
- Manufacturing and process control
- Transport systems
- Business communications
- Marketing promotion
- Retailing

Multimedia means the simultaneous use of two or more forms of media, such as sound with text or images

with music. The essential benefits in multimedia systems derive from the ability to convey multimedia information in real-time between users a few metres or many thousands of kilometres apart. It is a particularly challenging technology area as it involves many disciplines including video and audio coding, real-time software, communications networks, mobile communications, rapid access databases and terminals.

This report demystifies the various technologies used in distributed multimedia, it shows what can be achieved with the technology and will make readers aware of the opportunities available from integrated information distribution systems.

Price: £185.00. Publication Sales, ERA Technology Ltd., Cleeve Road, Leatherhead, Surrey KT22 7SA, UK. Tel.: +44 (0) 1372 367014; Fax: +44 (0) 1372 377927; e-mail: pub.sales@era.co.uk. See us on the Internet: <http://www.era.co.uk/techserv/pubs/pubspage.htm>

Comprehensive revision of the INSPEC Thesaurus and Classification for 1999

The INSPEC Thesaurus has undergone a comprehensive revision to incorporate developments in terminology and now contains nearly 8,300 preferred terms of which 563 are new.

Each INSPEC record is indexed using controlled terms chosen from the Thesaurus to provide a powerful search aid. As well as listing the controlled terms and lead-ins or cross-reference terms, the Thesaurus gives further help by showing the relationships between terms, the dates on which they were added and the terms in use before these dates. Available from November 1998, the Thesaurus has the ISBN 0 85296 966 X and costs £60.

The 1999 INSPEC Classification scheme has undergone a major revision which takes account of the latest developments in many areas of science and technology. It gives the period of use of each classification entry and, where appropriate, indicates codes that should be used when searching the database for references prior to that date. An index to the scheme containing over 5,000 entries forms an integral part of the publication. Available from November 1998, the Classification has the ISBN 0 85296 967 8 and costs £30.

Produced by the Institution of Electrical Engineers (IEE), INSPEC is the world's largest English-language bibliographic database in the fields of physics, electrical engineering and electronics, computers and control engineering and information technology. The IEE is the largest professional engineering society in Europe with over 130,000 members.

For more information, contact: The Marketing Department, The Institution of Electrical Engineers, Michael Faraday House, Stevenage, Herts. SG1 2AY, UK. Tel.: +44 (0) 1438 313311; Fax: +44 (0) 1438 742840; e-mail: inspec@iee.org.uk; Web-site: www.iee.org.uk/publish/

New book confronts issues challenging semiconductor industry

A wide range of issues important to the US semiconductor industry—and a strategy to correct what some experts see as a potentially dangerous trend of declining long-term basic research and development—are reported in a volume of scientific and engineering papers now available.

The book, *Characterization and Metrology for ULSI Technology*, is published by the American Institute of Physics and was edited by six scientists led by Dave Seiler, chief of the Semiconductor Electronics Division, National Institute of Standards and Technology (NIST), Electronics and Electrical Engineering Laboratory.

The papers specifically address issues concerning how to measure and understand the materials and technologies involving "ultra large scale integration", or the production of larger and larger circuits that contain more and more densely packed electronic components. Among the issues discussed in the papers is the concept of meeting future R&D needs by forming partnerships among industry, universities and government agencies. The strategy of forming consortia is referred to as a "cross-functional approach" to the problem.

To order *Characterization and Metrology for ULSI Technology*, contact Springer-Verlag New York Inc. at (800) 777-4643. NIST's Seiler may be contacted at (301) 975-2054. (Source: *NIST Update*, 9 November 1998)

Integrating reliability with the design stage of electronic products

The complexity of many modern electronics products, constructed from hundreds or even thousands of parts, increases the in-built possibility of failure unless best practice is used in all stages of design, manufacturing and product testing. This report:

- Provides useful comment on the physical factors affecting component reliability;
- Removes the myth that reliability is a totally mathematical concept;
- Provides an awareness of the more general implications of reliability;
- Explores the relationship between costs and benefits.

A methodology is established for conducting a reliability analysis using modern PC-based software. A case study demonstrates a typical reliability analysis on an existing production electronic unit which includes a wide range of components from microprocessors and control logic through low- and medium-power components to high-power output devices. The results of the practical study highlight the benefits of implementing these programmes not only during new product design but also at the design update stages of existing products. A guide to the implementation of a reliability analysis strategy provided in the form of a chart which can be tailored to each product requirement.

A reliability programme is worthwhile for most manufactured electronic products. It is a cost-effective way of maintaining consumer confidence and market share, whilst achieving a long-term reduction of manufacturing and user costs.

Price: £195.00. Publication Sales, ERA Technology Ltd, Cleeve Road, Leatherhead, Surrey KT22 7SA, UK. Tel.: +44 (0) 1372 367014 (Direct); Fax: +44 (0) 1372 377927; e-mail: pub.sales@era.co.uk. See us on the Internet: <http://www.era.co.uk/techserv/pubs/pubspage.htm>